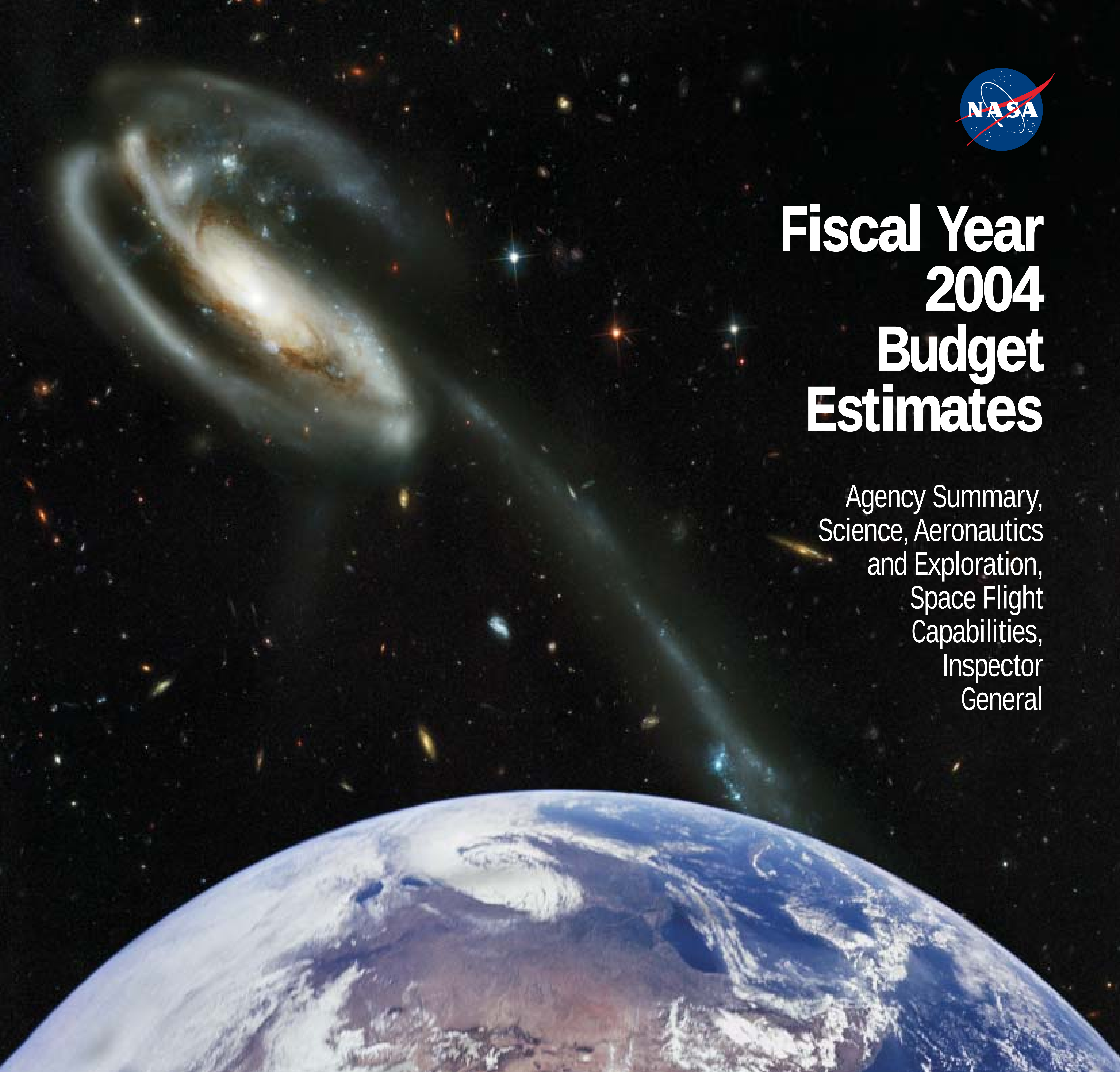

# Fiscal Year 2004 Budget Estimates

Agency Summary,
Science, Aeronautics
and Exploration,
Space Flight
Capabilities,
Inspector
General

## NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
## PRESIDENT'S FY 2004 BUDGET REQUEST

| (budget authority, $ in millions) | Business as Usual | FULL COST | | | | | | Chapter Number |
|---|---|---|---|---|---|---|---|---|
| By Appropriation Account / By Enterprise / By Theme | Pres. Bud. FY 2003 | Est. Pres. Bud. FY 2003 | **FY 2004** | FY 2005 | FY 2006 | FY 2007 | FY 2008 | |
| **Science, Aeronautics & Exploration** | **7,015** | **7,101** | **7,661** | **8,269** | **8,746** | **9,201** | **9,527** | SAE SUM 1 |
| **Space Science** | **3,414** | **3,468** | **4,007** | **4,601** | **4,952** | **5,279** | **5,573** | SAE 1 |
| Solar System Exploration | 976 | 1,046 | 1,359 | 1,648 | 1,843 | 1,952 | 2,054 | SAE 2 |
| Mars Exploration | 496 | 551 | 570 | 607 | 550 | 662 | 685 | SAE 3 |
| Astronomical Search for Origins | 698 | 799 | 877 | 968 | 1,020 | 1,022 | 1,061 | SAE 4 |
| Structure & Evolution of the Univ. | 331 | 398 | 432 | 418 | 428 | 475 | 557 | SAE 5 |
| Sun-Earth Connections | 544 | 674 | 770 | 959 | 1,111 | 1,169 | 1,216 | SAE 6 |
| Institutional | 370 | -- | -- | -- | -- | -- | -- | |
| **Earth Science** | **1,628** | **1,610** | **1,552** | **1,525** | **1,598** | **1,700** | **1,725** | SAE 7 |
| Earth System Science | 1,249 | 1,529 | 1,477 | 1,440 | 1,511 | 1,606 | 1,629 | SAE 8 |
| Earth Science Applications | 62 | 81 | 75 | 85 | 87 | 94 | 96 | SAE 9 |
| Institutional | 318 | -- | -- | -- | -- | -- | -- | |
| **Biological & Physical Research** | **842** | **913** | **973** | **1,042** | **1,087** | **1,118** | **1,143** | SAE 10 |
| Biological Sciences Research | 245 | 304 | 359 | 399 | 453 | 456 | 481 | SAE 11 |
| Physical Sciences Research | 247 | 351 | 353 | 392 | 380 | 409 | 401 | SAE 12 |
| Commercial Research & Support | 170 | 254 | 261 | 251 | 254 | 253 | 262 | SAE 13 |
| Institutional + AM + SAGE | 181 | 3 | -- | -- | -- | -- | -- | |
| **Aeronautics *** | **986** | **949** | **959** | **932** | **939** | **934** | **916** | SAE 14 |
| Aeronautics Technology | 541 | 949 | 959 | 932 | 939 | 934 | 916 | SAE 15 |
| Institutional | 445 | -- | -- | -- | -- | -- | -- | |
| **Education** | **144** | **160** | **170** | **169** | **169** | **170** | **170** | SAE 16 |
| Education | 144 | 160 | 170 | 169 | 169 | 170 | 170 | SAE 17 |
| **Space Flight Capabilities** | **7,960** | **7,875** | **7,782** | **7,746** | **7,881** | **8,066** | **8,247** | SFC SUM 1 |
| **Space Flight** | **6,131** | **6,107** | **6,110** | **6,027** | **6,053** | **6,198** | **6,401** | SFC 1 |
| Space Station | 1,492 | 1,851 | 1,707 | 1,587 | 1,586 | 1,606 | 1,603 | SFC 2 |
| Space Shuttle | 3,208 | 3,786 | 3,968 | 4,020 | 4,065 | 4,186 | 4,369 | SFC 3 |
| Space Flight Support | 239 | 471 | 434 | 419 | 402 | 407 | 429 | SFC 4 |
| Institutional | 1,192 | -- | -- | -- | -- | -- | -- | |
| **Crosscutting Technologies *** | **1,829** | **1,768** | **1,673** | **1,720** | **1,828** | **1,868** | **1,846** | SFC 5 |
| Space Launch Initiative | 879 | 1,150 | 1,065 | 1,124 | 1,221 | 1,257 | 1,224 | SFC 6 |
| Mission & Sci. Measurement Tech. | 275 | 434 | 438 | 435 | 439 | 439 | 444 | SFC 7 |
| Innovative Tech Trans. Partnerships | 147 | 183 | 169 | 161 | 168 | 172 | 179 | SFC 8 |
| Institutional | 528 | -- | -- | -- | -- | -- | -- | |
| **Inspector General** | **25** | **25** | **26** | **28** | **29** | **30** | **31** | IG |
| **TOTAL** | **15,000** | **15,000** | **15,469** | **16,043** | **16,656** | **17,297** | **17,806** | |
| year to year increase | | | 3.1% | 3.7% | 3.8% | 3.8% | 2.9% | |

* Aerospace Technology Enterprise includes both Aeronautics and Crosscutting Technologies

NOTE: May not add due to rounding

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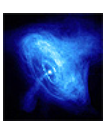
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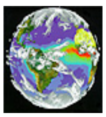
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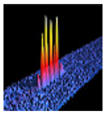

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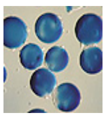

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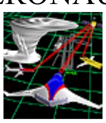

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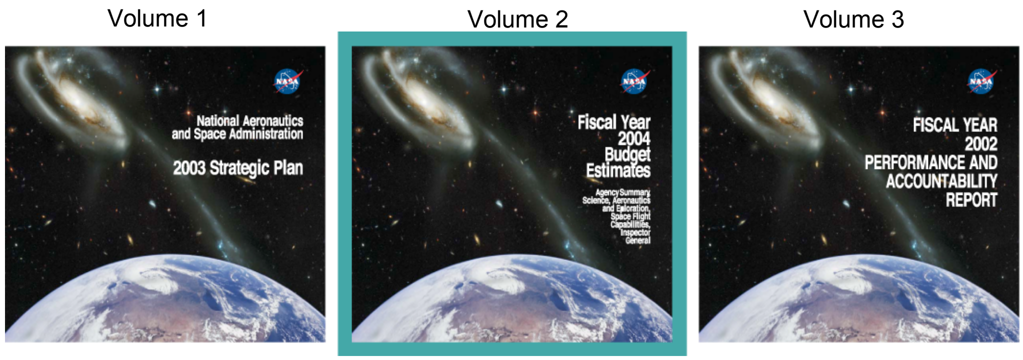
# AGENCY SUMMARY



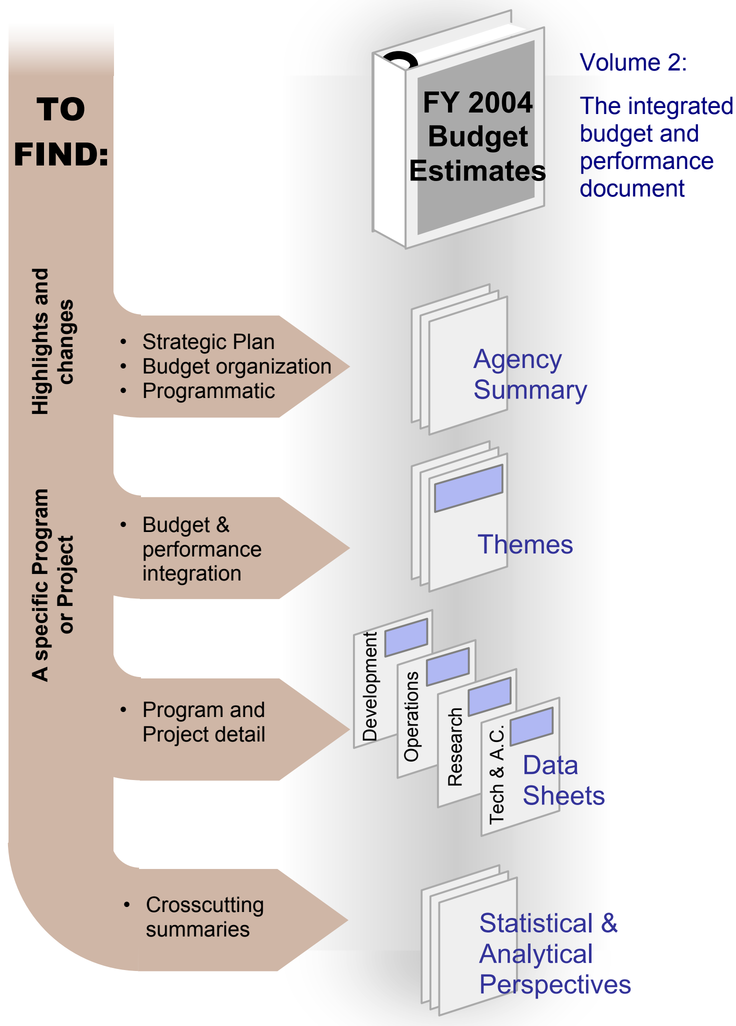

This document is part of the three-volume NASA Fiscal Year 2004 Congressional Budget Submission.

This integrated budget and performance document represents a new approach to presenting the National Aeronautics and Space Administration (NASA) budget request, and a major step forward in budget and performance integration. It looks different from NASA's budget requests of the past, and we have made many changes that improve the clarity and consistency of the text. It is one of three volumes – along with the *2003 Strategic Plan* and the *Fiscal Year 2002 Performance and Accountability Report.*

The Agency Summary that follows provides highlights of:

- Strategic Plan changes,
- Programmatic changes, and
- Budget organization changes.

The table to the right may aid you in navigating through this integrated budget and performance document.



# HIGHLIGHTS OF THE NEW STRATEGY

| Strategy Highlights | Summary |
|---|---|
| The New Vision and Mission | NASA's Vision and Mission reflect our hopes and challenges for the future. |
| Transforming NASA | To be successful, NASA must transform itself while guided by a set of core values. |
| Agency Goals | Agency Goals outline what NASA will achieve in coming decades and provide the context for planning and program development. |
| Implementing Strategies | NASA will base all activities on a foundation of sound planning and management practices. |
| As Only NASA Can | NASA will pursue activities unique to our mission in aeronautics and space. |
| Strategic Structure and Performance Planning | NASA's planning process starts with our long term Vision and Mission, and flows to more focused near term plans and documents. |

Each highlight is briefly discussed below and then discussed in depth in the NASA 2003 Strategic Plan.

## New Vision and Mission


NASA's new Vision and Mission focus the Agency's programs on the pursuit of answers to compelling questions. Using our unique knowledge and expertise, we build the tools that enable revolutionary robotic and human missions. Through scientific research and strategic investments in transformational technologies, we open new pathways toward missions that were impossible only a few years ago.

NASA's Vision and Mission reflect our hopes and challenges for the future.

Through them, we emphasize our unique roles and focus the Agency on the things it does best. As the Nation's leading organization for research and development in aeronautics and space, we are explorers and pioneers who use our unique tools, capabilities, and perspective for the benefit of the Nation and the world.

Our ability to fully achieve our Mission is constrained by the need for new technologies that can overcome our current limitations. We must provide ample power for our spacecraft as well as reliable and affordable transportation into space and throughout the solar system. We must deploy innovative sensors to probe Earth, other planets, and other solar systems. We must be able to communicate large volumes of data across vast distances, so that we can get the most from our robotic explorers. And we must learn to mitigate the physiological and psychological limitations of humans to withstand the harsh environment of space.

To address these challenges, we are making strategic investments in our FY04 budget request in transformational technologies. Some of these investments include Project Prometheus for breakthrough propulsion techniques that will enable spacecraft to travel faster and farther and will allow them to carry larger scientific payloads and make new types of measurements, and new power systems that will transform the way we conduct research in space. Also, revolutionary optical communications technologies, using laser light instead of radio waves, will dramatically increase our ability to transmit information across the solar system. Research into the human factors of space travel through the human research initiative will enable us to understand the effects of the space environment on how we live and work in space and will ensure that future explorers can carry out their missions safely and effectively.

## Transforming NASA

NASA's strategy for the future represents a new paradigm, in which strategic building blocks progressively create steppingstones to exploration and discovery. To be successful, NASA must transform itself while being guided by a set of core values.

### *NASA's Core Values*

*Safety.*
*NASA's Mission success starts with safety. A commitment to safety permeates everything we do. We are committed to protecting the safety and health of the general public, pilots and astronauts, the NASA workforce, and our high-value assets on and off the ground.*

*People.*
*Our greatest strength is our workforce, a team of highly qualified individuals that is representative, at all levels, of America's diversity. We foster a culture of trust, respect, teamwork, communication, creativity, equal opportunity, and empowerment.*

*Excellence.*
*We are committed to excellence. We continuously improve our processes, products, and services to better serve our customers.*

*Integrity.*
*We are honest and ethical in all that we do. We deliver on our commitments, and we are accountable for our performance.*

These values are not only central to responsible public service, they are also essential to the achievement of our Vision and Mission. With these values as our solid foundation, we will pursue these five significant transformations.

**1) All investments will contribute to a single set of Agency goals and will be directly traceable to our Vision and Mission.**

The NASA of today is unified around a common purpose, expressed by our Vision and Mission. A single set of NASA-wide goals defines how we will achieve our Mission. These goals are not unique to any one organization within NASA; they span the entire Agency to provide a context for planning programs and monitoring performance. Every NASA program and project must be relevant to one or more of the goals, and thus to the Vision and Mission. Specific performance measures will be identified for each program to assess how well that program contributes to the goals. Underperforming programs will be redirected or canceled.

**2) Human space flight capabilities will be expanded to enable research and discovery.**

In the early days of NASA, the demonstration of human space flight was a national priority, motivated by the need to prove American technological preeminence. This demonstration led to some of the most spectacular achievements in human history, and during the past 20 years, NASA has systematically developed the capability to live and work in space. With a successful Space Shuttle program and an International Space Station that is nearing completion, we now have the tools that enable the utilization of the unique environment of space for research and development. Human space flight will always be an integral and critical element of our strategy for space exploration. NASA will continue to expand its human presence in space—not as an end in itself, but as a means to further the goals of exploration, research, and discovery.

**3) Technology developments will be crosscutting.**

With the new focus on a unified NASA Vision, Mission, and goals, we must carefully select our technology investments to provide the greatest benefit across the Agency and to the public. We will emphasize technologies with broad applications, such as propulsion, power, computation, communications, and information technologies. These and other crosscutting technologies represent opportunities to leverage our limited resources to advance the overall NASA Mission. Project-specific technologies will continue to be identified and funded with resources from the project to which they apply.

**4) Education and inspiration will be an integral part of all our programs.**

Over the years, NASA's exploration and innovation have inspired and motivated countless individuals from all walks of life. The information age has made our task easier in some ways, but more difficult in others. Today, there is so much competition for the minds and imaginations of young people that it can be difficult to engage them in the science and engineering that will lead them to technical careers. NASA's education and public outreach programs must be modern, successful, exciting, and relevant to students, teachers, and parents. In the past, education and outreach were not always built into NASA programs at their inception, and their effectiveness varied as a result. Today, educational and motivational activities are being incorporated into every NASA program from the earliest stages. A new NASA Enterprise has been created to serve as the Agency's focal point for education planning and implementation, and the performance of our education programs will be tracked like that of any other NASA activity. The result will be a much more effective use of the vast educational potential of NASA's ongoing exploration and research. Over time, this may help to turn the tide of declining interest and performance in science and mathematics among America's youth and may motivate more of them to pursue careers as scientists, engineers, and explorers.

**5) We will operate as One NASA in pursuit of our Vision and Mission.**

NASA is a large Agency, consisting of thousands of public servant and contractor employees, Field Centers across the United States, and facilities in foreign countries. With our new focus on a unified long-range Vision and Mission, it is imperative that all elements of the Agency work together as a single team. By developing common procedures, capabilities, tools, and organizations, we will ensure that the overall functioning of the Agency is as smooth and efficient as possible. We will also present a single electronic presence to the Nation, so that all NASA products and information are readily available without confusion or delay. By unifying the Agency, we will reinforce the shared commitment of all NASA employees to our common goals.

## Agency Goals

Our Vision and Mission represent NASA's fundamental contributions to the Nation and the world, and they provide us with a clear, unified, and long-term direction for all of our activities. To achieve the new Vision and Mission, we have established Agency goals that outline what NASA will achieve in the coming decades. They also will provide the context for planning and program development. Seven strategic goals are established to carry out NASA's Mission. In addition, three enabling goals are established in areas critical to the achievement of those strategic goals. The goals listed below are described in detail in the strategic plan.

*Goal 1: Understand Earth's system and apply Earth-system science to improve the prediction of climate, weather, and natural hazards.*

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

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

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

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

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

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

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

*Goal 9: Extend the duration and boundaries of human space flight to create new opportunities for exploration and discovery.*

*Goal 10: Enable revolutionary capabilities through new technology.*

The goals will be achieved by NASA's Enterprises and supporting organizations through a series of objectives. The programs and tasks that implement the objectives are funded through 18 themes, which represent the Agency structure for budget planning, management, and performance reporting. Every activity that is funded within a theme must contribute to the achievement of one or more goals through its associated objectives. These contributions are documented by the long-term and annual performance measures which constitute NASA's Performance Plan that is integrated throughout this document and summarized in the Special Issues section. This structure ensures that NASA is directly accountable for its performance, and that the results of every NASA program are visible to the taxpayers and traceable to the Agency's Vision and Mission.

The matrix shown on the following pages lists the goals and shows their relationships to the budget themes and Enterprises that implement them. It also provides a roadmap for the objectives, and supporting contributions that are described in detail in the relevant Theme write-up.

## Implementing Strategies

To fulfill our challenging Mission and realize the full potential of the benefits we can provide to the Nation, we will base all NASA activities on a foundation of sound planning and management practices. These Implementing Strategies are not necessarily unique to NASA; they are similar in intent to management strategies of all well-run organizations. But, they are critical to NASA's achievement of its strategic and enabling goals.

All of NASA is committed to these Implementing Strategies. Through them, we will ensure that we maintain the excellence and innovation that the Nation expects, along with an unwavering commitment to safety and fiscal responsibility.

The Implementing Strategies below are described in more detail in the Strategic Plan. Objectives for each are included in the Performance Plan Summary in the Special Issues section.

- Achieve management and institutional excellence comparable to NASA's technical excellence;
- demonstrate NASA leadership in the use of information technologies;
- enhance NASA's core engineering, management, and scientific capabilities and processes to ensure safety and mission success, increase performance, and reduce cost;
- ensure that all NASA work environments, on Earth and in space, are safe, healthy, environmentally sound, and secure; and
- manage risk and cost to ensure success and provide the greatest value to the American public.

## As Only NASA Can

We will pursue activities unique to our Mission in air and space. If NASA does not do them, they will not get done. If others are doing them, we should question why NASA is involved. NASA is the Nation's leading organization for research and development in aeronautics and space. We have developed expertise, tools, and facilities that collectively represent a unique national asset. It is our mandate to undertake challenging projects of national importance that fit our unique capabilities. We must apply those capabilities to conquer persistent limitations to exploration. By focusing on these requirements, we are able to apply extensive, but finite, capabilities to the challenges that truly demand this expertise. Our successes often spawn new projects that can then be accomplished by private industry, universities, or other Government agencies, and NASA-developed tools and techniques will be transferred to these organizations to help them succeed. In this way, we continuously enhance the collective capability of the Nation, and we ensure that the explorers and innovators of NASA are ready to take on the next challenge. By continuing to pioneer and discover, we will expand our horizons and inspire the Nation's youth
. . . *as only NASA can.*

All elements of NASA work together to achieve Agency goals. The goals are listed below, and the Themes are listed by Enterprise at right. Elements of the matrix indicate each Theme's primary ( ■ ) and supporting ( ○ ) contributions. These contributions are the objectives and annual performance goals addressed in the Theme discussions in this document.

## Goals

**MISSION I — Understand and protect our home planet**

1. Understand Earth's system and apply Earth system-science to improve the prediction of climate, weather, and natural hazards.
2. Enable a safer, more secure, efficient, and environmentally friendly air transportation system.
3. Create a more secure world and improve the quality of life by investing in technologies and collaborating with other agencies, industry, and academia.

**MISSION II — Explore the universe and search for life**

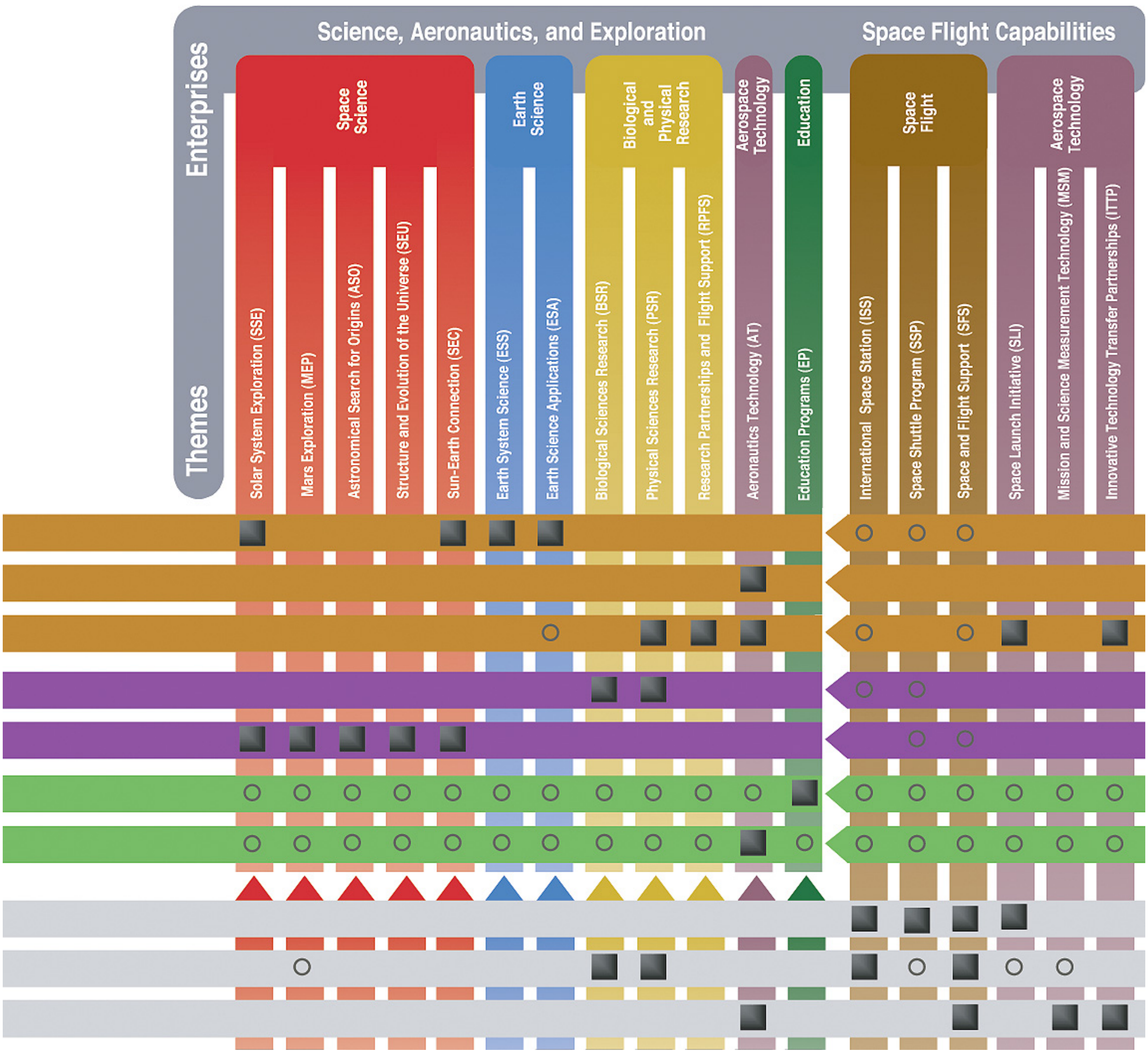
4. Explore the fundamental principles of physics, chemistry, and biology through research in the unique natural laboratory of space.
5. Explore the solar system and the universe beyond, understand the origin and evolution of life, and search for evidence of life elsewhere.

**MISSION III — Inspire the next generation of explorers**

6. Inspire and motivate students to pursue careers in science, technology, engineering, and mathematics.
7. Engage the public in shaping and sharing the experience of exploration and discovery.

**Enabling Goals**

8. Ensure the provision of space access and improve it by increasing safety, reliability, and affordability.
9. Extend the duration and boundaries of human space flight to create new opportunities for exploration and discovery.
10. Enable revolutionary capabilities through new technology.


Enterprises
Themes
Science, Aeronautics, and Exploration
Space Flight Capabilities
Space Science
Earth Science
Biological and Physical Research
Aerospace Technology
Education
Space Flight
Aerospace Technology
Solar System Exploration (SSE)
Mars Exploration (MEP)
Astronomical Search for Origins (ASO)
Structure and Evolution of the Universe (SEU)
Sun-Earth Connection (SEC)
Earth System Science (ESS)
Earth Science Applications (ESA)
Biological Sciences Research (BSR)
Physical Sciences Research (PSR)
Research Partnerships and Flight Support (RPFS)
Aeronautics Technology (AT)
Education Programs (EP)
International Space Station (ISS)
Space Shuttle Program (SSP)
Space and Flight Support (SFS)
Space Launch Initiative (SLI)
Mission and Science Measurement Technology (MSM)
Innovative Technology Transfer Partnerships (ITTP)

## Strategic Structure and Performance Planning

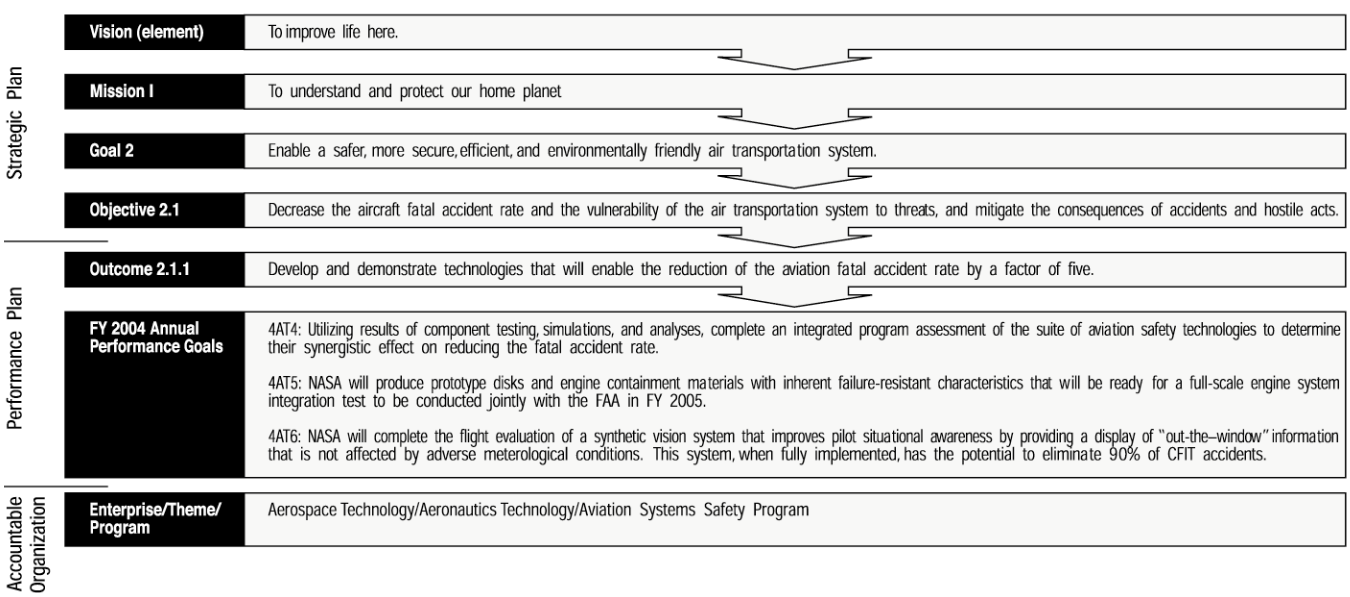
NASA's planning process starts with long-term Vision and Mission and flows to more focused near-term plans and documents.

The NASA Vision, Mission, goals, and objectives are documented in the strategic plan. The proposed outcomes and FY 2004 annual performance goals are distributed throughout this Integrated Budget and Performance Document. NASA will improve the quality of these measures, and our objectives as necessary, making them more quantifiable and verifiable, and will release an updated FY 2004 performance plan prior to September 15, 2003. NASA also plans to release an updated FY 2003 performance plan that is consistent with this new strategic plan and the new strategic framework for budget and performance integration.

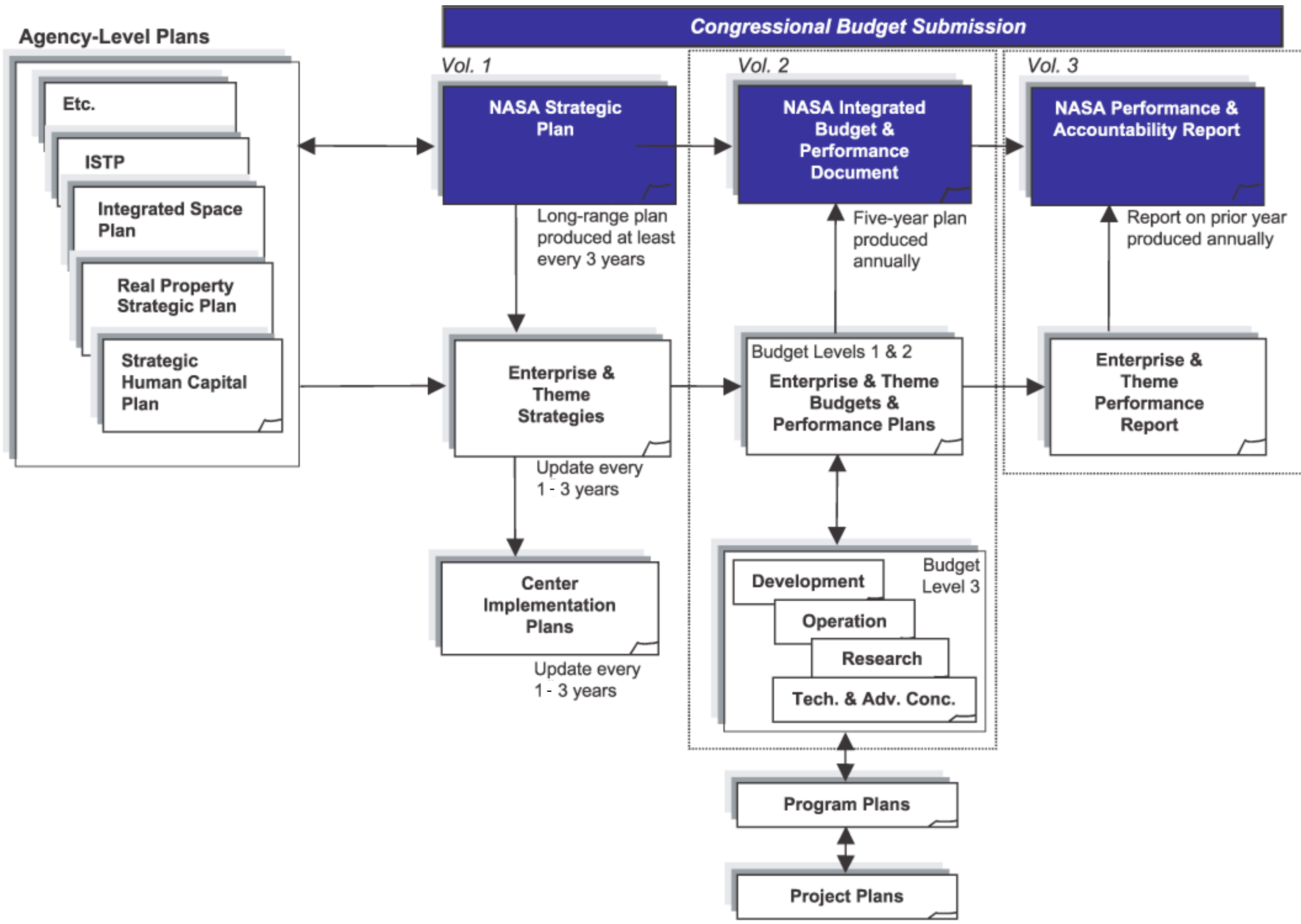
In order to make performance planning an integral part of how the Agency is managed, NASA will incorporate the performance planning process into our annual budget formulation or program operating plan (POP) development process. The POP for preparing the FY 2005 budget request will be the first formal development cycle tasked with defining the outcomes and annual performance goals for each theme.

NASA will also be revising Enterprise and theme implementation plans to provide more detail as to how the goals and objectives in this plan will be achieved. NASA Centers will also be revising their implementation plans to illustrate how they will support the Enterprises and themes in meeting NASA's Mission and Vision.

The following figures show the strategic structure. The first figure demonstrates the flow from the Agency Vision and Mission down through the performance plan in this document. The second figure shows the relationship between this document and the other documents in the Congressional Budget submission. The other documents are the *2003 Strategic Plan* and the *FY 2002 Performance and Accountability Report*.




This example demonstrates the flow from the top level of the strategic plan through the detailed performance measures.




This diagram provides a summary of and linkage between NASA's key strategic, budget, and performance documents.

# HIGHLIGHTS OF PROGRAMMATIC CHANGES

| New Initiatives in President's FY 2004 Budget Request | | | |
|---|---|---|---|
| **($ in millions)** | **2004** | **2004-08 Total** | **Pages** |
| **To Understand and Protect Our Home Planet:** | | | |
| Climate Change Research Acceleration | 26 | 72 | SAE 8-2 |
| Aviation Security | 21 | 196 | SAE 15-11 |
| National Airspace System Transition Augmentation | 27 | 100 | SAE 15-15 |
| Quiet Aircraft Technology Acceleration | 15 | 100 | SAE 15-19 |
| **To Explore the Universe and Search for Life:** | | | |
| Project Prometheus | 93 | 2,070 | SAE 2-19 |
| Optical Communications | 31 | 233 | SAE 2-19 |
| Beyond Einstein Initiative | 59 | 765 | SAE 5-2, 19 |
| Human Research Initiative | 39 | 347 | SAE 11-15,19<br>SAE 12-13, 15 |
| **To Inspire the Next Generation of Explorers:** | | | |
| Education Initiative | 26 | 130 | SAE 17-7, 9 |
| Total for Initiatives | 337 | 4,013 | |

NASA's FY 2004 request is $15.469 billion, a $469 million or 3.1 percent increase over the FY 2003 President's Budget. NASA's request includes $337 million ($4.0 billion over five-years) for new initiatives.

Initiatives represent strategic investments in breakthrough nuclear propulsion and power systems to be demonstrated on an ambitious mission to Jupiter's moons; revolutionary communications technologies using laser light instead of radio waves to dramatically increase our ability to transmit information across the solar system; constellations of networked spacecraft that will probe the edge of black holes and the mystery of dark energy that is expanding the universe; research into the human factors of space travel to enable safe human exploration beyond Earth; climate change research targeted at high priority policy issues; new aeronautics technologies to enable safer, quieter, and more efficient air travel; and education investments to expand the number of students pursuing science and engineering careers. These initiatives are summarized in the table above.

This budget maintains changes made in the FY 2003 Budget Amendment sent to Congress in November 2002 including additional resources to the International Space Station to successfully achieve U.S. core complete and support its newly prioritized research program; adding a fifth annual Space Shuttle launch; and supporting the Integrated Space Transportation Plan that calls for development of an Orbital Space Plane, technologies for future launch systems, and a service life extension program to keep Shuttle flying longer.

This budget is restructured to reflect Strategic Plan with two new accounts entitled *Science, Aeronautics, & Exploration* (SA&E) to reflect our science and research driven agenda, and *Space Flight Capabilities* that contain activities that enable the SA&E activities to succeed.

Program budgets have been revamped to reflect full cost, meaning institutional activities such as personnel and facilities are now included in the benefiting program's budget, hence, reflecting the true cost of the program and enabling managers to make better economic decisions.

# Space Science Enterprise

The Space Science Enterprise seeks to answer fundamental questions about life in the Universe, including how it arose, its mechanisms, where in the solar system it may have originated or exist today, and whether there are similar planetary environments around other stars where the signature of life can be found. The Enterprise also seeks to understand how the universe began and evolved, how stars and galaxies formed, and how matter and energy are entwined on the grandest scale. The Space Science Enterprise is comprised of five themes described below.

## Solar System Exploration

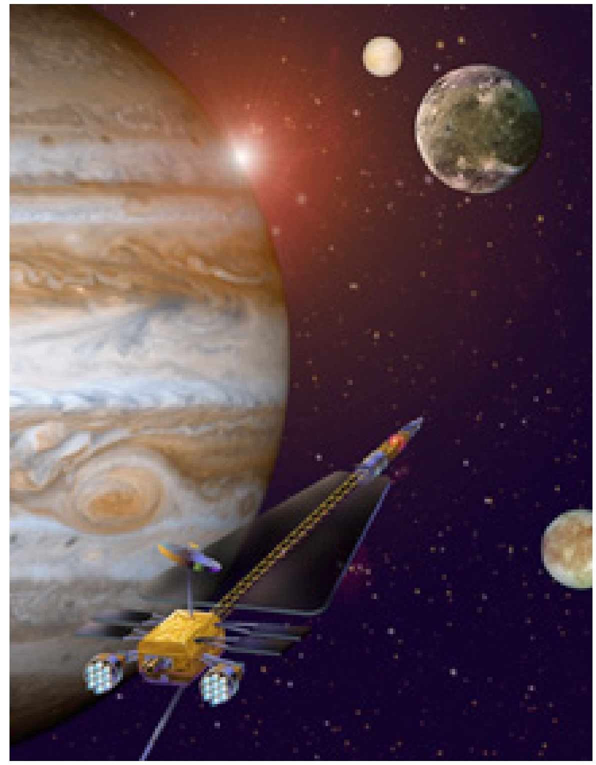
This theme seeks to understand how our own solar system formed and evolved, and about possible life beyond Earth. The planets of our solar system and the ancient icy bodies far from the Sun are Rosetta stones that can tell unique stories about the evolution of our solar system. As we learn more about the origins of living systems on Earth and our solar system's planets and moons, we may learn that life has also arisen on some of them. Highlights for FY 2004 include:

**Overall budget**
FY 2004 request is $1,359 million, a $312 million or 30 percent increase over FY 2003 President's Request (full cost):

- $177 million for three missions in development; MESSENGER mission to explore Mercury, DAWN mission to orbit around two asteroids, and Deep Impact mission to probe below the surface of a comet.

- $130 million for New Frontiers program to explore the outer planets in the solar system, including funding for the New Horizons mission to Pluto and the Kuiper Belt.

- $68 million for Astrobiology research to improve the ability to find and identify life on other planets.



NASA's new Project Prometheus will transform our abilities to explore the outer planets as illustrated by this image of the Jovian mission.

**New Initiative – Project Prometheus**
Request includes $279 million for this new initiative ($3 billion over five years). This consists of $186 million ($1 billion over five-years) from the Nuclear Systems Initiative introduced in FY 2003 and adds $93 million ($2 billion over five-years) for a first flight mission, Jupiter Icy Moon Orbiter, to be flown within a decade.

- Nuclear technology will enable unprecedented science data return through high power science instruments and advanced communications technology.

- Jupiter Icy Moon Orbiter will search for evidence of global subsurface oceans on Jupiter's three icy Galilean moons: Europa, Ganymede, and Callisto. These oceans may harbor organic material.

- Mission will set the stage for the next phase of exploring Jupiter and will open the rest of the outer solar system to detailed exploration.

**New Initiative – Optical Communications**
Request includes $31 million for this new initiative ($233 million over five years):

- Offers potential for many orders of magnitude improvement in communication data rate. Example: using conventional radio frequency communications, the Mars Reconnaissance Orbiter will take 21 months to map 20 percent of the surface of Mars; if used optical communications then would allow the *entire* surface to be mapped in 4 months.

- Critical technology exists, but must be demonstrated. Plan first demonstration at Mars in 2009 using telecom satellite around Mars that relays data to high-altitude Earth balloons. The balloon receiver technology will be demonstrated by the middle of this decade.

- Promises dramatic reduction in cost per byte of data returned and could, ultimately, replace the Deep Space Network.

**Major Events in 2004**
- Deep Impact will launch in January 2004, to fire a projectile at comet Temple-1 to investigate the composition of the comet's interior.

- MESSENGER will launch in March 2004, to conduct a detailed investigation of Mercury, the least explored terrestrial planet.

- Stardust will encounter comet Wild-2 in January 2004 and collect dust samples that will be returned to Earth in 2006.

- Cassini arrives at Saturn in July 2004 following a seven-year journey.

- Genesis returns to Earth in September 2004 with its samples of the solar wind following its two-year "sunbath".

## Mars Exploration

This theme explores the mysteries of the history and present conditions on Mars. Dry and cold today, the Martian surface shows the traces of a wet and warmer past. Frozen water at its poles and hints of relatively recent liquid water flows make Mars the most likely place to seek evidence of ancient or present extraterrestrial life. Contrasts between the current and past geology, atmospheres, and magnetic fields of Mars and Earth promise insights into why these neighboring planets differ so much today. Advances in our understanding of Mars would be useful for future human exploration. Highlights for FY 2004 include:

**Overall budget**
FY 2004 request is $570 million, a $20 million or 3.6 percent increase over FY 2003 President's Request (full cost):

- $184 million for development of 2005 Mars Reconnaissance Orbiter, an orbiter that will map Martian surface features as small as a basketball (20-30 cm).

- $29 million for 2007 Scout Mission, a unique opportunity for scientists and industry to compete and provide innovative ideas for Mars exploration.

- $118 million for 2009 Mars Smart Rover/Lander, a rover that will traverse tens of kilometers over Mars and last over a year, digging and drilling for unique samples to study in its onboard laboratory.

- $9 million ($336 million over five-years) added for a new mission, a telecommunications satellite around Mars in 2009, to enhance science data return and demonstrate the first interplanetary optical communications link.

**Major Events in 2004**
- Mars Exploration Rovers arrive at Mars in January 2004 and will begin science operations. The Rovers are designed to last for 90 days of surface operations and should travel about 600 meters during that time.

- Mars Reconnaissance Orbiter will begin integration and test in preparation for launch in 2005.

## Astronomical Search for Origins

This theme strives to answer two questions: Where did we come from? Are we alone? The theme seeks to observe the birth of the earliest galaxies and the formation of stars, find planetary systems in our region of the galaxy, including those capable of harboring life, and learn whether life exists beyond our solar system. We need to understand the building blocks of life, the conditions necessary for life to persist, and the signatures it writes on the sky. By exploring the diversity of other worlds and searching for those that may harbor life, we hope to understand the origins of our own world. Highlights for FY 2004 include:

**Overall budget**
FY 2004 request is $877 million, a $78 million or 10 percent increase over FY 2003 President's Request (full cost):

- $239 million for Hubble Space Telescope operations as well as funding for a Shuttle servicing mission in 2005 and a Shuttle retrieval mission in 2010 as the Hubble ends its operations.

- $255 million for development of James Webb Space Telescope planned for launch about 2010 and promising to build on the legacy of Hubble Space Telescope.

- $80 million for development of Space Interferometry Mission planned for launch in 2009 to detect planets around other stars.

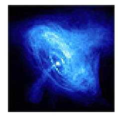
### Major Events in 2004

- Final preparations for Hubble Space Telescope Servicing Mission-4, which will launch in early 2005. Two new instruments will be installed on this mission: Wide Field Camera-3 and the Cosmic Origins Spectrograph.

- Final preparation for SOFIA airborne observatory first flight in April 2005.

- Initial science operations of Space Infrared Telescope Facility (SIRTF), the final mission of NASA's Great Observatory Program.

## Structure and Evolution of the Universe



This theme seeks to understand the nature and phenomena of the Universe. It seeks to understand the fundamental laws of space, time, and energy and to trace the cycles that have created the conditions for our own existence. This is accomplished in part by observing signals from the Big Bang, mapping the extreme distortions of space-time about black holes, investigating galaxies, and understanding the most energetic events in the universe. We also must try to understand the mysterious dark energy that pervades the universe and determines its ultimate destiny. Highlights for FY 2004 include:

### Overall budget

FY 2004 request is $432 million, a $33 million or 8.3 percent increase over FY 2003 President's Request (full cost):

- $116 million for development of Gamma-ray Large Area Space Telescope (GLAST), a mission to study high-energy objects like black holes.

### New Initiative – Beyond Einstein

Request includes $59 million for this new initiative ($765 million over five years):

- Offers potential to answer three questions left unanswered by Albert Einstein's theories: What powered the Big Bang? What happens to space, time, and matter at the edge of a black hole? What is the mysterious dark energy expanding the universe?

- Laser Interferometer Space Antenna (LISA) will use three spacecraft "formation flying" 5 million kilometers apart in a triangle to observe the distortion of space due to gravity waves.

- Constellation-X will use a team of powerful X-ray telescopes working in unison to observe black holes, investigate "recycled" stellar material, and search for the "missing matter" in the universe; it will be 100 times more powerful than any single X-ray telescope that has come before it.

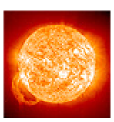
- Einstein Probes, a program that will begin later this decade, consists of fully and openly competed missions (in the manner of the Discovery, Explorers, and New Frontiers programs) to conduct investigations that benefit Structure and Evolution of the Universe science objectives.

### Major Events in 2004

- SWIFT gamma-ray burst explorer begins science operations following launch in late 2003.

- GLAST will conduct its Critical Design Review.

## Sun-Earth Connections



This theme investigates our Sun and how its structure and behavior affect Earth. The Sun's energy is responsible for the Earth's present ecosystem, but the Sun is a variable star. Its small variability profoundly affects the Earth. Changes in its long-term brightness cause ice ages, and its 11-year cycle of activity causes aurorae and other disturbances on the Earth. Solar flares affect the upper atmosphere and can damage satellites and disable the power distribution grid on the ground. The Sun is also our nearest star and is an ideal laboratory for basic physics and learning about other stars. Highlights for FY 2004 include:

### Overall budget

FY 2004 request is $770 million, a $95 million or 14 percent increase over FY 2003 President's Request (full cost):

- $166 million for development of STEREO and Solar Dynamics Observatory.

- $212 million for future flight missions.

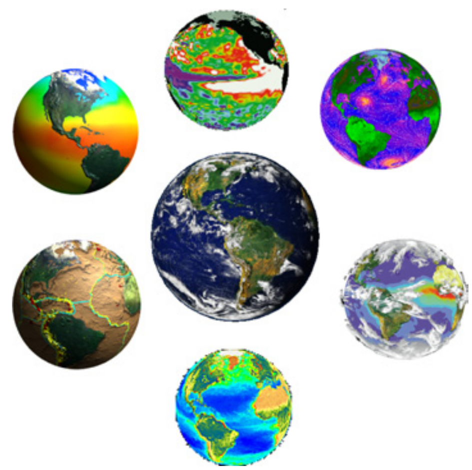
### Major Events in 2004

- STEREO completes integration and test in preparation for launch in 2005. STEREO will use two identically equipped spacecraft to provide revolutionary 3-D imaging of coronal mass ejections.

- Solar Dynamics Observatory enters implementation of development in January 2004. It is a cornerstone mission in the Living With a Star program. It will study the Sun's magnet field and the dynamic processes that influence space weather.

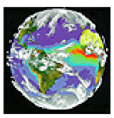
# Earth Science Enterprise

NASA's Vision to improve life here starts with the Earth Science Enterprise's study of planet Earth from space. The Enterprise seeks to understand and protect our home planet by advancing Earth system science and applying the results to improve prediction of climate, weather, and natural hazards. The Enterprise is comprised of two themes described below.



NASA uses remote sensing satellites to view different environmental processes on the Earth, from severe weather to changes in ozone levels to volcanic eruptions.

## Earth System Science



Within this theme, we are deploying and operating the first comprehensive constellation of Earth-observing research satellites designed to reveal interactions among Earth's continents, atmosphere, oceans, ice, and life. These interactions produce the conditions that sustain life on Earth. Data and information from our satellites enable researchers to understand the causes and consequences of global change and inform the decisions made by governments, businesses, and citizens to improve our quality of life. Highlights for FY 2004 include:

### Overall budget

FY 2004 request is $1,477 million, a $52 million or 3.4 percent decrease from FY 2003 President's Request (full cost):

- The decrease in the budget from FY 2003 to FY 2004 is driven primarily by major development programs that are past their peak development spending and are preparing for launches in 2004 including AURA, Cloudsat, and Calipso.

- $96 million for the NPOESS Preparatory Project (NPP) under development in partnership with National Oceanic and Atmospheric Administration and the Department of Defense (DOD). NPP transfers critical research instruments to operational agencies and maintains data continuity for NASA sponsored scientific investigations.

- $60 million for the Landsat data continuity mission, which is an innovative program to seek partnerships with industry to continue receiving critical land remote sensing data.

- $524 million for research and modeling that help answer critical scientific questions on climate change to aid policy and economic decision-makers.

### New Initiative – Climate Change Research Initiative Acceleration

Request includes $26 million for this new initiative ($72 million over five years):

- Accelerates evaluation of non-carbon dioxide ($CO_2$) impact on climate change. These factors potentially have as much or more influence as $CO_2$, which is the focus of most studies, and can be reduced with far less economic impact and with added benefits to public health and agriculture.

- To greatly enhance our ability to evaluate non-$CO_2$ forcings, an advanced polarimeter instrument will be flown to measure methane, troposheric ozone, aerosols and black carbon. Troposheric ozone, black carbon (soot) and aerosols are also important public health factors.

- Advanced polarimeter will be launched in the 2007 timeframe, which is about four years earlier than originally planned.

### Major Events in 2004

- Launches of Aura, Cloudsat and Calipso satellites in 2004. The Aura mission will study Earth's ozone, air quality, and climate. Cloudsat will measure the structure of clouds from space to better quantify their key role in the Earth's water cycle and climate system. Calipso, coupled with Aura and the advanced polarimeter, will help determine the role of aerosols in climate, reducing one of the largest uncertainties in climate models.

- Use satellite observations to provide daily and seasonal global atmospheric water vapor, rainfall, snowfall, sea-ice, and ice-sheet maps and use these observations to improve the scientific understanding and models of water cycle thorough the Earth system.

- Use satellite-derived localized temperature and moisture profiles, with unprecedented accuracy and global coverage, to improve predictive capabilities of regional weather models.

- Assimilate satellite and in situ observations into a variety of ocean, atmosphere, and ice models for purposes of estimating the state of Earth's seasonal and decadal climate.

- Demonstrate the benefits of formation flying multiple satellites in a constellation for the first time (i.e. creating a super-satellite) to enable generation of integrated science information products, e.g., aerosol distribution, optical thickness and properties to assess their total effect on climate aerosols.

## Earth Science Applications

Within this theme, NASA works with other federal agencies to apply our research results and Earth observation information products to applications of national priority. We have identified applications where our partner agencies have decision support systems, such as weather prediction models and near-airport terrain databases, that are being improved based on NASA research and technological innovations. For each application, joint applications research and demonstrations are under way or being developed. In addition, the theme develops crosscutting solutions that advance the use of NASA information and technology across a range of potential new applications. Highlights for FY 2004 include:

### Overall budget

FY 2004 request is $75 million, a $6.5 million or 8.0 percent decrease from FY 2003 President's Request (full cost):

- Theme completely revamped to focus on 12 specific applications of national priority where other agencies' decision support systems can be markedly improved based on NASA-provided data and information. Competitive, merit-review will be the hallmark of extramural project selection.

### Major Events in 2004

- Benchmark improvement to at least two national applications: air quality and agricultural productivity.

- Competitively select projects for the Research, Education, Applications Solutions Network (REASoN) program to serve national priorities.

# Biological and Physical Research Enterprise

NASA's Biological and Physical Research Enterprise conducts interdisciplinary fundamental and applied research to address opportunities and challenges of human exploration of space. Access to space provides new opportunities to explore profound questions about the laws of nature. At the same time, we are entering space as an unique environment that poses serious medical and environmental challenges. The Enterprise exploits the rich opportunities of space flight in pursuit of answers to a broad set of scientific questions, including those about the human health risks of space flight. The space environment offers a unique laboratory in which to study biological and physical processes. Access to space allows scientists to conduct research under conditions that are unique in the history of science. Experiments that take advantage of this environment extend from basic biology to quantum mechanics and from fundamental research to research with near-term applications in medicine and industry. The Biological and Physical Research Enterprise is comprised of three themes.

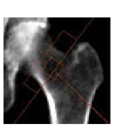
### New Initiative – Human Research Initiative

Request includes $39 million for this new initiative ($347 million over five years). Of the total, $25 million is directed towards Biological Science Research ($283 million over five years) and $14 million towards Physical Sciences Research ($64 million over five years). Goals include:

- Certify crew safety for missions beyond low Earth orbit over 100 days by mitigating the highest risks.

- Enable knowledge and technology to reduce mass to orbit and beyond for life support by a factor of three by 2010.

## Biological Sciences Research



Within this theme, we determine ways to support a safe human presence in space. Space flight exposes humans to physiological and psychological health risks from radiation, reduced gravity, and isolation. We are researching how to define and control these risks. This theme also conducts research and development to improve the performance of life support systems. It includes a basic biology research component that seeks both to pursue fundamental biological research questions from cell to tissues to whole organisms which produce results that can support advanced methods for enabling human exploration of space. Highlights for FY 2004 include:

### Overall budget

FY 2004 request is $359 million, a $55 million or 18 percent increase over FY 2003 President's Request (full cost):

- $210 million for Bioastronautics Research. In response to ReMAP prioritization, expands planned ground research program in countermeasures development by $27 million, which includes an increase of approximately $20 million in funding for the National Space Biomedical Research Institute from $10 million to $30 million and a $7 million increase through the new Human Research Initiative. The initiative also starts a flight program in high priority areas of advanced human support technology by adding $18 million.

- $149 million for Fundamental Space Biology. In response to ReMAP prioritization, adds $20 million for habitat holding rack development, cell culture unit and ground based research, and animal and plant habitats for research on the Space Station Centrifuge.

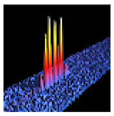
- Adds $12 million to ensure adequate levels of reserves for Space Station hardware development and research operations.

### Major Events in 2004

- 25 biological sciences flight experiments scheduled to be conducted on the Space Shuttle and Space Station.

- Habitat Holding Rack flight hardware available by September 2004.

## Physical Sciences Research



This theme supports research that takes advantage of the unique environment of space to expand our understanding of the fundamental laws of nature. We also support applied physical science research to improve safety and performance for human exploration and research that has applications in terrestrial industry. Highlights for FY 2004 include:

### Overall budget

FY 2004 request is $353 million, a $2.0 million or 0.6 percent increase over FY 2003 President's Request (full cost):

- Responds to the ReMAP prioritization external study by realigning Physical Sciences Research funds. Provides adequate funding and reserve levels for the major PSR International Space Station Research Capability Development facility class space flight hardware, while reducing funding for lower priority areas such as biomolecular technology, and structural biology future facility class space flight hardware, and level II program management support. Increases funding for research of strategic importance to NASA's long-range goals, including radiation protection and basic research in power and propulsion technologies. Rephases deployment of Low Temperature Microgravity Physics Facility consistent with the availability of the Japanese Experiment Module (JEM) Exposed Facility.

- Reallocates $11 million in FY 04 reserves to ensure adequate levels of reserves for Space Station hardware development (Fluids and Combustion Facility, Low Temperature Microgravity Physics Facility, and Materials Science Research Rack) and research operations.

- Reallocates $28 million for Space Station research equipment initial deployment of the Combustion Integration Rack (CIR) component of the Fluids and Combustion Facility ($22 million) and Materials Science Research Rack (MSRR) ($6 million).

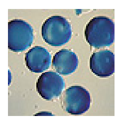
### Major Events in 2004

- 6 physical sciences flight experiments scheduled to be conducted on the Space Shuttle and Space Station.

- Delivery of the first major PSR research facility rack to the International Space Station, the Combustion Integrated Rack (CIR) on ULF-2. Beginning of prime research facility operations on the ISS, a new phase of Space Station utilization.

- Fluids Integrated Rack (FIR) flight hardware available by August 2004.

## Research Partnerships and Flight Support



This theme establishes policies and allocates space resources to encourage and develop research partnerships in the pursuit of NASA missions and Enterprise scientific objectives. This research supports product development on Earth and leverages industry resources to accelerate progress in our strategic research areas. Ultimately, research partnerships may support development of an infrastructure that can be applied to human exploration. Highlights for FY 2004 include:

### Overall budget

FY 2004 request is $261 million, a $6.8 million or 2.7 percent increase over FY 2003 President's Request (full cost):

- $49 million for Space Product Development. Restructures program by aligning industrial partnerships with NASA mission needs and Enterprise scientific objectives. Will review the existing research partnership centers to determine those centers to be retained. The focus will remain on the flight program.

- As part of the FY 2003 Budget Amendment, provides funding for additional research/logistics missions to Space Station beginning in FY 2006. Of the total $113 million over five-years added to budget for these research missions, Space Product Development has $4 million over five years and Multi-User Systems and Support has $93 million. The remaining $16 million is distributed between Biological Sciences Research and Physical Sciences Research.

- $212 million for Multi-User Systems and Support funding.

- Space Product Development budget was augmented by two activities: (1) the transfer of the Anti-Matter Spectrometer program management and budget from Physical Sciences Research; and (2) the consolidation of the Enterprise Support program content and budget, previously diffused across various programmatic components.

**Major Events in 2004**

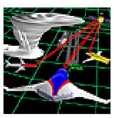
- 12 flight experiments from Space Product Development scheduled to be conducted on the Space Shuttle and Space Station.

- Multi-User Systems and Support will be involved in preparation of CIR and Express Research launches to Station in July 2004 and Europe's five research racks and two attached payloads planned for launch with the Columbus Module in October 2004, the first international partner laboratory module to be deployed on the Space Station.

# Aerospace Technology Enterprise

The Aerospace Technology Enterprise contributes to the NASA Vision by pioneering and developing advanced technologies. These technologies in turn improve the air transportation system, access to space, and science missions. This Enterprise helps others use NASA technology for non-aerospace commercial purposes and develops technology partnerships with industry and academia outside traditional aerospace fields. The Aerospace Technology Enterprise is comprised of four themes described below.

## Aeronautics Technology



This theme plays a key role in creating a safer, more secure, environmentally friendly and efficient air transportation system, increasing performance of military aircraft, and developing new uses for science or commercial missions. This theme also enhances the Nation's security through its partnerships with the DOD and Federal Aviation Administration (FAA). Research areas include advanced propulsion technologies, lightweight high-strength adaptable structures, adaptive controls, advanced vehicle designs, and new collaborative design and development tools. In collaboration with the FAA, research is conducted in air traffic management technologies for new automation tools and concepts of operations. Highlights for FY 2004 include:

**Overall budget**
FY 2004 request is $959 million, a $10 million or 1.0 percent increase over FY 2003 President's Request (full cost).

- $169 million for Aviation Safety and Security projects aimed at reducing accident and fatality rates.
- $217 million for Airspace Systems projects to provide technologies that can dramatically increase the capacity and mobility of the nation's air transportation system.

NASA graphical cockpit weather displays provide real time information that can help aircrews avoid areas of hazardous weather.

- $574 million for Vehicle Systems projects focused on development of breakthrough technologies for future aircrafts and air vehicles.

**New Initiative – Aviation Security**
Request includes $20 million for this new initiative ($195 million over five years):

- Addresses critical aviation security needs that NASA is uniquely qualified to provide.
- Develops technology for commercial aircraft and airspace protection, including development of damage-tolerant structures and autonomous and reconfigurable flight controls technology to prevent aircraft from being used as weapons and to protect against catastrophic loss of the aircraft in the event of damage from sabotage or explosives.

**New Initiative – National Airspace System Transition Augmentation**
Request includes $27 million for this new initiative ($100 million over five years):

- Enables technology, in cooperation with FAA, to transition to a next-generation National Airspace System that would increase the capacity, efficiency, and security of the system to meet the mobility and economic-growth needs of the Nation, reducing delays and increasing air transportation efficiency.

#### New Initiative – Quiet Aircraft Technology Acceleration

Request includes $15 million for this new initiative ($100 million over five years):

- Accelerate development and transfer of technologies that will reduce perceived noise in half by 2007 compared to the 1997 state-of-the-art.

- Fully implemented throughout the system, eliminates unacceptable noise outside the boundary of the airport.

#### Major Events in 2004

- Experimentally demonstrate a highly-efficient, light-weight compressor to decrease engine emissions.

- Complete validation and assessment of NASA-developed decision-support air traffic controller aids in support of the FAA's Operational Evolution Plan.

- Prototype inherently failure resistant engine components to improve aircraft safety.

### Space Launch Initiative

This theme ensures safe, affordable, and reliable access to space. New space transportation capabilities are needed to ensure that America continues its leadership in space. The theme gives special emphasis to NASA's unique needs, including crew escape and survival systems. It helps create a more secure world by collaborating with the DOD on critical access to space and hypersonics technologies that support future civil and military aerospace missions. Highlights for FY 2004 include:

#### Overall budget

FY 2004 request is $1,065 million, a $85 million or 7.4 percent decrease from FY 2003 President's Request (full cost):

- $550 million for Orbital Space Plane program to develop a crew return capability from Space Station by 2010 and crew transfer capability atop an expendable launch vehicle by 2012. Funding supports technology demonstrators such as X-37 and advanced design studies.

- $515 million for Next Generation Launch Technology program to meet NASA's future space launch needs. Funding includes advanced kerosene engine development and hypersonic propulsion research and testing.

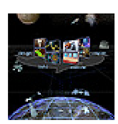
#### Major Events in 2004

- Test flight of DART vehicle to demonstrate autonomous rendezvous technology between a chase vehicle and an on-orbit satellite.

- Drop test of X-37 vehicle from carrier aircraft to demonstrate autonomous landing capability as a precursor to a planned orbital demonstration.

- Conceptual design review of Orbital Space Plane with sufficient cost, schedule, technical and risk definition to enable a full-scale development decision.

### Mission and Science Measurement Technologies



This theme is responsible for developing crosscutting technology for a variety of aviation and space applications, such as communications, power and propulsion systems, micro-devices and instruments, information technology, nanotechnology, and biotechnology. These technology advances will have the potential to open a new era in aviation and allow space missions to expand our knowledge of Earth and the Universe. Our technologies are unique to NASA because we focus on space mission applications. Highlights for FY 2004 include:

**Overall budget**

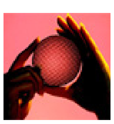
FY 2004 request is $438 million, a $4 million or 0.9 percent increase over FY 2003 President's Request (full cost):

- $233 million for Computing, Information, and Communications Technologies program including intelligent and autonomous systems for science exploration missions.
- $44 for Engineering for Complex Systems program including develop of engineering tools to improve safety and mission success.
- $161 million for Enabling Concepts and Technologies program including development of revolutionary technologies in support of NASA's other Enterprises.

**Major Events in 2004**

- Demonstrate technologies for millimeter precision formation flying.
- Demonstrate spacecraft communications technologies achieving 1Gbps or greater for near Earth, and 1Mbps or greater for deep space applications.
- Demonstrate lightweight, sub-kilowatt ion engine for small spacecraft.
- Develop prototype workstation that provides capability to identify, track, and trade-off risk.

## Innovative Technology Transfer Partnerships



Under this theme, we will work to develop partnerships with industry and academia to develop new technology that supports Enterprise programs; commercialize and transfer NASA technology to U.S. industry; and enhance NASA technology and commercial objectives through the Small Business Innovation Research and Small Business Technology Transfer (SBIR/STTR) programs. Highlights for FY 2004 include:

**Overall budget**

FY 2004 request is $169 million, a $14 million or 7.6 percent decrease from FY 2003 President's Request (full cost):

- $5 million for Enterprise Engine being introduced to create partnerships with innovators to sponsor dual use technologies to further NASA's mission and meet our future technology needs.
- $29 million for discontinuing the existing commercial technology promotion efforts and, instead, recompeting and refocusing our technology transfer programs to maximize benefits to the taxpayer.
- $135 million for SBIR/STTR programs.

**Major Events in 2004**

- Award SBIR and STTR grants.
- Establish partnerships with innovators under the operation of the Enterprise Engine.

# Education Enterprise

Education, our newest Enterprise, was established in 2002 to inspire more students to pursue the study of science, technology, engineering and mathematics, and ultimately to choose careers in aeronautics and space-related fields. This new Enterprise will unify the educational programs in NASA's other five enterprises and at the 10 field centers under a *One NASA Education* vision. NASA Education will permeate and be embedded within all the Agency's activities. The Education Enterprise includes the Education Programs theme.

## Education Programs

The Education Enterprise will provide unique teaching and learning experiences, as only NASA can, through the Agency's research and flight capabilities. Students and educators will be able to work with NASA and university scientists to use real data to study the Earth, explore Mars, and conduct other scientific investigations. They will work with our engineers to learn what it takes to develop the new technology required to reach the farthest regions of the solar system and to live and work in space. It is important that the next generation of explorers represents the full spectrum of the U.S. population, including minority students and those from low-income families. To ensure the diversity in NASA's workforce, our educational programs pay particular attention to under-represented groups. NASA Education will support our Nation's universities to educate more students in science and engineering by providing meaningful research and internship opportunities for qualified students, plus a roadmap for students to seek NASA careers. Highlights for FY 2004 include:

### Overall budget

FY 2004 request is $170 million, a $10 million or 6.1 percent increase over FY 2003 President's Request (full cost):

- $78 million for education programs including the continuation of pipeline development programs for students at all educational levels and the continuation of the Space Grant/EPSCOR programs, providing a national link with the higher education community.
- $92 million for minority university research and education including funding opportunities for minority institutions to increase the number and percentage of state-certified mathematics, science, or technology teachers.
- Education Enterprise funding is coordinated with an estimated $55 million in education-related funding managed by the five other NASA Enterprises.

### New Initiative – Education Initiative

Request includes $26 million for this new initiative ($130 million over five years):

- $2 million for the Educator Astronaut Program that will select teachers and transport them into space to inspire and motivate students.
- $13 million for the NASA Explorer Schools Program that will provide target middle schools with a customized and sustained learning environment using NASA's most recent discoveries and latest technologies to garner greater interest in science and engineering careers.
- $9 million for Scholarship for Service that will link scholarship with service at a NASA Center and help NASA better attract top students into our workforce.
- $2 million for Explorer Institutes, NASA's direct link with the informal education community (science centers and museums) through openly competed grants.

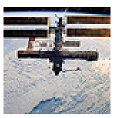
### Major Events in 2004

- New solicitation for the university research center program that will further expand and strengthen the research capacity of minority institutions.
- Selection of the first class of educator astronauts.
- Pilot implementation of approximately 50 Explorer Schools.

# Space Flight Enterprise

The Space Flight Enterprise provides many critical enabling capabilities that make possible much of the science, research and exploration achievements of the rest of the Agency. The Space Flight Enterprise does this through three themes described below:

## International Space Station



This theme supports activities for establishing a permanent human presence in Earth orbit – the International Space Station. The Space Station provides a long-duration habitable laboratory for science and research activities to investigate the limits of human performance, expand human experience in living and working in space, and enable commercial development of space. The Space Station will allow unique, long-duration, space-based research in cell and developmental biology, plant biology, human physiology, fluid physics, combustion science, materials science, and fundamental physics. It will also provide a unique platform for observing the Earth's surface and atmosphere, the Sun, and other astronomical objects. Highlights for FY 2004 include:

**Overall budget**

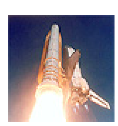
FY 2004 request is $1,707 million, a $144 million or 7.8 percent decrease from FY 2003 President's Request (full cost):

- Funding drops as planned as development activities near an end and on-orbit operations and research becomes the focus of the program.
- Maintains proposal in FY 2003 Budget Amendment including additional funds for reserves plus funding Node 3 and Environmental Closed Life Support System (ECLSS) in FY 2004.
- Continues significant progress toward resolving the Space Station management and cost control issues that confronted the program at the end of 2001. Many changes based on recommendations of the ISS Management and Cost Evaluation (IMCE) task force have increased NASA's confidence in achieving success with the U.S. Core Complete station.
- A new management team is in place with the authority to control program content, to ensure station capabilities are driven by science requirements, and to make the appropriate decisions as the program moves from development into its operational phase.
- The development of NASA's integrated financial management core system and a management information system are progressing on schedule.
- The Space Station program is well on its way to completing work on the U.S. Core Complete configuration. Flight elements undergoing ground integration and test are proceeding on schedule, and the last U.S. flight element is scheduled for delivery to NASA by the spring of 2003.

**Major Events in 2004**

- Achieve U.S. core complete by spring 2004.
- 12 U.S. racks available for research.
- Expect awards for new contract opportunities for Space Station support.

## Space Shuttle



This theme builds on the Shuttle's primacy as the world's most reliable and versatile launch system. The shuttle, first launched in 1981, provides the only capability in the United States for human access to space. In addition to transporting people, materials, and equipment, the Space Shuttle allows astronauts to service and repair satellites and build the Space Station. The Space Shuttle can be configured to carry different types of equipment, spacecraft, and scientific experiments that help scientists understand and protect our home planet, explore the Universe, and inspire the imagination of the American people. Highlights for FY 2004 include:

**Overall budget**
FY 2004 request is $3,968 million, a $183 million or 4.8 percent increase over FY 2003 President's Request (full cost):

- Supports steady state flight rate of five per year.

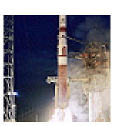
- Provides $379 million ($1.7 billion over five-years) for Space Shuttle Service Life Extension, a program to improve safety and infrastructure needs to allow flying Space Shuttle into the next decade.

- Exploring all alternatives for competitive sourcing of Shuttle flight operations following the conclusion of the current Space Flight Operations Contract in order to best fly safely, meet flight schedule, and improve the existing Shuttle system.

**Major Events in 2004**
- Five flights focused on Space Station assembly.

- Space Shuttle Main Engine Health Management System ready for first flight.

## Space and Flight Support



This theme encompasses space communication, launch services, rocket propulsion testing, and advanced systems. Space communications consists of the tracking and data relay satellite system (TDRSS), which supports space shuttle, expendable launch vehicles, and research aircraft, and the NASA integrated services network, which provides telecommunications services at facilities such as flight support networks, mission control centers and science facilities, and administrative communications networks for NASA centers. The Launch Services program focuses on meeting the Agency's launch and payload processing requirements by assuring safe and cost effective access to space via the Space Shuttle and expendable launch vehicles. Rocket propulsion testing supports a core of highly trained test and engineering crews and test facilities. Advanced Systems program includes studies of human and robotic exploration of space. Highlights for FY 2004 include:

**Overall budget**
FY 2004 request is $434 million, a $36 million or 7.7 percent decrease from FY 2003 President's Request (full cost):

- $125 million for Space Communications budget. Continues support for formulation phase of TDRS Continuation project.

- $142 million for oversight of expendable launch vehicle flights and supporting payload carriers for Shuttle launches.

- $62 million for rocket propulsion testing.

- $85 million for environmental compliance including $44 million for Plum Brook cleanup.

**Major Events in 2004**
- Commence Plum Brook reactor building demolition and disposal.

- Award of the Space Mission Communication and Data Service Procurement, the follow-on to the Consolidated Space Operations Contract (CSOC).

# Institutional Investments

As a function of full cost management, the following institutional investments are included in the preceding Enterprise budgets as either direct program charges or as Center or Corporate General & Administrative (G&A) charges. These areas are included in the summary below to provide visibility into the resources provided for these activities.

## Center G&A

Center G&A costs include Center security, ground maintenance, fire protection, business computing, public affairs, institutional construction of facilities (CoF), human resources, procurement, budgeting, etc.. FY 2004 highlights include:

| ($ in millions) | FY 2004 |
|---|---|
| Ames Research Center | 129 |
| Glenn Research Center | 100 |
| Dryden Flight Research Center | 41 |
| Goddard Space Flight Center | 171 |
| Johnson Space Center | 159 |
| Kennedy Space Center | 169 |
| Langley Research Center | 143 |
| Marshall Space Flight Center | 146 |
| Stennis Space Center | 39 |
| *Total, Center G&A* | *1097* |

- $1.097 billion total for FY 2004 allocated as shown in the graphic above.
- Includes $24 million additional funding for enhanced security.

## Corporate G&A

Corporate G&A costs include headquarters operations and agency-wide functions. FY 2004 highlights include:

- $613 million total for FY 2004 as shown in the table below.
- Includes $126 million for the Integrated Financial Management Program (IFMP), which plans to complete implementation of the core module by summer 2003, and additional modules by 2006.

| ($ in millions) | FY 2004 |
|---|---|
| Headquarters Corporate Activities | 293 |
| Corporate IFMP | 126 |
| Agency Operations | 68 |
| Safety and Mission Assurance | 35 |
| Chief Engineer | 33 |
| Chief Information Officer | 22 |
| Center-based Corporate (e.g., payroll) | 12 |
| Construction of Facilities | 11 |
| Security Management | 8 |
| Chief Health and Medical Officer | 4 |
| *Total, Corporate G&A* | *613* |

## Workforce

FY 2004 highlights include:

- $2.107 billion for salaries and benefits in support of 18,693 full-time equivalent (FTE) civil service compared to 18,471 FTEs in FY 2002 and estimated 18,837 FTEs in FY 2003.

## Construction of Facilities

FY 2004 highlights include:

- $248 million for Construction of Facilities (CoF), a $26 million or 11 percent increase over FY 2003 President's Budget.
- Includes $64 million for program direct CoF, carried in program budgets.
- Includes $173 million for institutional CoF, carried within Center G&A.
- Includes $10 million for a Facility Demolition initiative, carried within Corporate G&A, to remove unused buildings at the NASA field centers.

## Environmental Compliance

FY 2004 highlights include:

- $85 million for environmental compliance including $44 million for Plum Brook cleanup.

# HIGHLIGHTS OF BUDGET ORGANIZATION CHANGES

| Highlighted Change | Summary |
|---|---|
| Proposed appropriations | This budget request includes the Science, Aeronautics and Exploration (SAE) and the Space Flight Capabilities (SFC) appropriations. |
| Full cost budgeting | This budget request is presented with its full cost. |
| Performance budgeting | The performance plan is included with the budget so that the proposed investment may be directly compared to the proposed return. |
| New budget format | A new format that uses standardized templates lays out the costs, benefits, and risks of each element in a consistent, easy to understand way. |

Each significant change is briefly discussed below and then discussed in depth in the *Statistical and Analytical Perspectives*.

## Proposed Appropriations

NASA's budget request includes the Science, Aeronautics and Exploration (SAE) and the Space Flight Capabilities (SFC) appropriations. The SAE appropriation provides for the full costs associated with NASA's Space Science, Earth Science, Biological and Physical Research, Aeronautics, and Education programs. The SFC appropriation provides funding for the full costs associated with NASA's Space Flight and Crosscutting Technology programs. Full costs include both the direct and the indirect costs supporting the programs, and provides for all of the research; development; operations; salaries and related expenses; design, repair, rehabilitation, and modification of facilities and construction of new facilities; maintenance and operation of facilities; and other general and administrative activities supporting the programs.

NASA's third appropriation, the Inspector General, provides funding for the Office of Inspector General to conduct audits and investigations of agency activities. The Inspector General keeps the Administrator informed of problems and deficiencies in agency programs and operations.

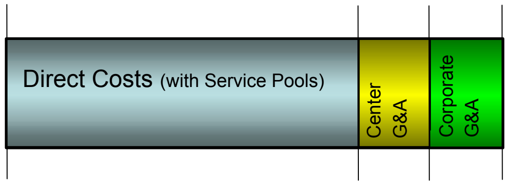
For the proposed appropriation language, please refer to the FY 2004 Budget Data discussion in the *Statistical and Analytical Perspectives*.

## Full Cost Budgeting

The FY 2004 NASA Budget provides, for the first time, NASA's programs and projects in a full cost budget format. "Full cost" means that all Agency direct and indirect costs are identified and included in a given NASA program/project budget. All civil service salaries and other NASA infrastructure costs are included. With full cost budgeting, there is a direct link between each program or project and the infrastructure used by it. Where full cost figures appear on budget tables in this document, they are highlighted in yellow.

With full cost budgeting, each program/ project's budget consists of three new cost categories: Direct (with service pools); Center General and Administrative (G&A); and Corporate G&A. The full cost for a program/project is the sum of these three costs.

Definition of Full Cost Components




The service pool costs included in each budget represents the planned program consumption of service pools that have been established at each center to provide a broad range of support capabilities to programs. The G&A costs represent basic infrastructure at the centers (grounds, security, business functions, etc.) and at the Agency level (Headquarters Operations, Agency-wide functions, etc.) that are allocated to each program/project budget.

On October 1, 2003, NASA is to fully implement the Agency's Full Cost Initiative, of which full cost budgeting is the initial major step. For the first time, NASA will operate in a total full cost environment for: managing its projects from a full-cost perspective; accounting for all NASA costs as direct or as G&A; and budgeting for all appropriate costs. NASA began this important initiative in 1995 in direct response to the need for improved Agency cost information to enhance Agency performance.

A major benefit of full cost budgeting is that it provides the Agency and its managers with better information to support decision-making, and helps the Agency optimize the use of its resources (dollars, workforce, and facilities). Full cost information provides a more complete, "full" disclosure of NASA's activities, clearer linkage between resource inputs and outputs/outcomes, and greater accountability of NASA's use of taxpayer resources.

Applying full cost practices will enable a more efficient use of institutional resources. Program managers will have more insight and a greater role in defining their infrastructure requirements.

For a detailed discussion of the full cost budget, please refer to the Full Cost discussion in the *Statistical and Analytical Perspectives*.

## Performance Budgeting

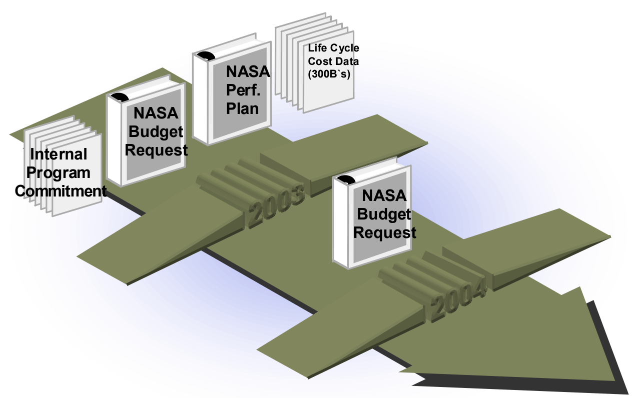
The FY 2004 NASA Budget Request is a performance-based budget. This represents a significant change from past years' budgets and addresses challenges posed by NASA's stakeholders.

"What has been missing:

- Past and planned results are not shown with budget requests, let alone lined in a cost-and-results relationship.
- Program managers responsible for achieving results often do not control the resources they use or have the flexibility to use them effectively.
- Performance and cost data are recorded in separate systems and not integrated to provide timely, analytical, feedback to decision makers and managers.
- Americans cannot readily assess program results, and cannot compare performance and cost across programs."

-- *FY03 President's Budget (Government-Wide Analytical Perspectives pp. 3)*

Many of the documents that in past years were separate, have now been combined into one. Most importantly, this brings together the NASA Budget Request and the NASA Performance Plan. Beyond these two major documents, the data sheets in this new document replace many separately published and maintained data sheets. These include presentations of the life-cycle cost of development programs and projects.




The FY 2004 Budget Request integrates the information that was provided in past years in separate documents.

First, there will be fewer, more informative pages. The same information was provided in multiple documents before. For instance, program descriptions appeared in the Budget Request, the Performance Plan, special life-cycle cost exhibits, and internal commitment agreements. Now, this information is presented once and the chance of a discrepancy between documents is eliminated. There is also a uniformity of information across programs. As part of the integration, a single set of Agency-wide templates was developed. Each Enterprise, Theme, Program, and Project had to provide comparable information in the appropriate template.

Beyond providing consistent and comparable information, the templates are concise. Details about acquisition strategy and technical commitments are presented in one place. In previous years there was a great deal of information that was redundant or excessive, and that has been eliminated. In other areas it might be useful to have access to additional detail. A comprehensive approach was used where hyperlinks are presented so that an interested reader can easily access this detail.

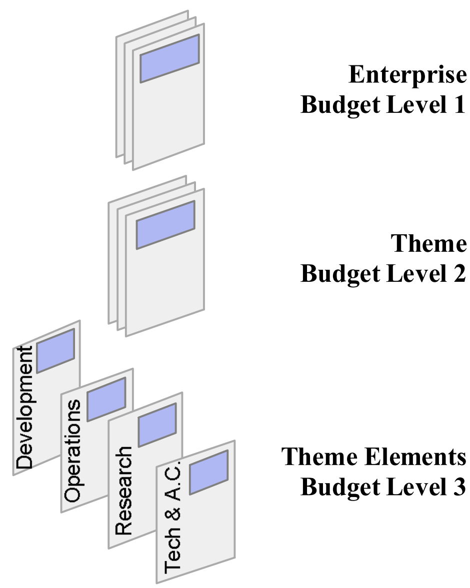
The second major benefit of the integrated budget and performance document is that the same structure is used across all Agency documentation, including the 2003 Strategic Plan, the Budget and Integrated Performance Plan, and the Performance Report. The performance of strategic investments can be directly measured because the investment will be explicitly tracked under one name. Every program or project can be traced from the Agency Vision and Mission, by way of the Strategic Plan.

## New Budget Format

This year, the budget has a new look. The new format was devised as a part of the budget and performance integration effort. It provides an easy way to navigate the budget system to reference all the elements of the NASA FY 2004 Budget. It also presents the costs and benefits of each element in a consistent, easy to understand way.

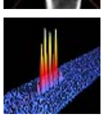
The new look of the budget comes from the use of standardized templates. A different template is used to present each budget level. The templates ensure that the same information is provided for each element of the budget. It is this standardization that makes it easy to navigate through the document to find the information you need and also makes it easy to compare information between two parts of the budget.

For further details on each section and how to interpret the data, please refer to the Special Issues discussion in the *Statistical and Analytical Perspectives*.




The budget is structured in levels. At the first level are the 6 Enterprises. At the second level are the 18 Themes. The third level is split into four categories. Each of these levels is described on a set of uniform sheets. The fourth level provides additional detail and is discussed on the Level 3 sheets.

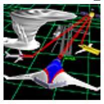
# APPROPRIATION SUMMARY: Science, Aeronautics, and Exploration

| Millions of Dollars | | FY 2002 | FY 2003 President's Budget, as amended | FY 2004 President's Budget |
|---|---|---|---|---|
| **Space Science** | | **2,901.8** | **3,414.3** | **4,007.1** |
|  | **Solar System Exploration** | **638.9** | **975.7** | **1,358.6** |
|  | **Mars Exploration** | **456.9** | **495.5** | **570.2** |
|  | **Astronomical Search for Origins** | **650.1** | **698.1** | **877.0** |
|  | **Structure and Evolution of the Universe** | **350.1** | **331.0** | **431.7** |
|  | **Sun-Earth Connection** | **412.9** | **544.2** | **769.6** |
| | **Institutional Support** | **392.9** | **369.8** | **--** |
| **Earth Science** | | **1,592.2** | **1,628.4** | **1,552.2** |
|  | **Earth System Science** | **1,241.4** | **1,248.8** | **1,477.4** |
|  | **Earth Science Applications** | **94.7** | **61.7** | **74.8** |
| | **Institutional Support** | **256.1** | **317.9** | **--** |
| **Biological and Physical Research** | | **824.0** | **842.3** | **972.7** |
|  | **Biological Sciences Research** | **218.0** | **245.1** | **358.6** |
|  | **Physical Sciences Research** | **227.4** | **247.2** | **353.2** |
|  | **Research Partnerships and Flight Support** | **196.9** | **169.5** | **260.9** |
| | **Institutional Support** | **181.7** | **180.5** | **--** |

**Indicates budget numbers in Full Cost.**

**(continued on reverse)**

# APPROPRIATION SUMMARY: Science, Aeronautics, and Exploration

| Millions of Dollars | FY 2002 | FY 2003 President's Budget, as amended | FY 2004 President's Budget |
|---|---|---|---|
| **Aerospace Technology (Aeronautics)** | **1,031.5** | **986.4** | **959.1** |
|  **Aeronautics Technology** | **645.8** | **541.4** | **959.1** |
| **Institutional Support** | **385.7** | **445.0** | **--** |
| **Education Programs** | **227.3** | **143.7** | **169.8** |
|  **Education Programs** | **227.3** | **143.7** | **169.8** |
| **TOTAL APPROPRIATION** | **6,576.8** | **7,015.1** | **7,660.9** |

**Note: For all formats, the FY 2002 column reflects the FY 2002 Congressional Operating Plan dated 9/30/02. The FY 2003 column reflects the FY 2003 Presidents Budget Submit (PBS) as Amended. FY2004 column is in full cost.**

**Indicates budget numbers in Full Cost.**

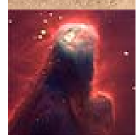
# ENTERPRISE: Space Science

This picture of the Tadpole galaxy was taken by the Advanced Camera for Surveys, which was installed aboard Hubble Space Telescope in March, 2002. The spiral's distorted shape was caused by a small hit-and-run galaxy whose gravitational pull created a long tail of debris of stars and gas. The galactic carnage and torrent of star birth are playing out against a spectacular backdrop: a "wallpaper pattern" of 6,000 galaxies. More information can be found at http://spacescience.nasa.gov/ .

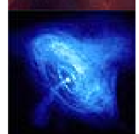
### THEMES

**Solar System Exploration (SSE)**

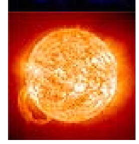
**Mars Exploration (MEP)**



**Astronomical Search for Origins (ASO)**



**Structure and Evolution of the Universe (SEU)**



**Sun-Earth Connection (SEC)**

# SPACE SCIENCE

## PURPOSE

Thousands of years ago, on a small rocky planet orbiting a modest star in an ordinary spiral galaxy, our remote ancestors looked up and wondered about their place between Earth and sky. Like them, we ask the same profound questions, such as how did the universe begin? Today, we are beginning to answer these questions. Using tools of science that range from abstract mathematics and computer modeling to laboratories and observatories, humans are filling in the details of the amazing story of the universe. In the last 40 years, space probes and space observatories have played a central role in this fascinating process, and NASA's Space Science Enterprise will continue to address these four profound questions:

**How did the universe begin and evolve?** We seek to explain the earliest moments of the universe, how stars and galaxies formed, and how matter and energy are entwined on the grandest scales.

**How did we get here?** We investigate how the chemical elements necessary for life have been built up and dispersed throughout the cosmos, for evidence about how the Sun affects Earth, about similarities between Earth and other planets, and how comets and asteroids in our solar system affect Earth.

**Where are we going?** Our ultimate place in the cosmos is wrapped up in the fate of the universe. Humanity has taken its first steps off our home world, and we will contribute to making it safe to travel throughout the solar system.

**Are we alone?** Beyond astrophysics and cosmology, there lies the central human question: Are we on Earth because of an improbable accident of nature? Or is life, perhaps even intelligent life, scattered throughout the cosmos?

Answers to these questions will not be extracted from narrow inquiries, but will be built up by combining innumerable individual clues over the years to come. The broad outlines of much of the puzzle are discernible now, but a clear picture of the whole is years away.

## FY 2002 ACCOMPLISHMENTS

The Mars Odyssey spacecraft went into successful orbit around Mars. Initial findings indicate the presence of huge amounts of subsurface water taking the form of ice close to the surface. This seems likely to confirm what has long been a subject of conjecture, and to strengthen the view of our nearest neighbor as a planet that possesses a key life-enabling feature.

A successful servicing mission by the Space Shuttle installed the new Advanced Camera for Surveys (ACS) on the Hubble Space Telescope and revived Hubble's Near Infrared Camera and Multi-Object Spectrometer (NICMOS). These improvements substantially increased Hubble's capabilities. Initial images were released in March. Among the photographs demonstrating the ACS camera's capabilities is a stunning view of a colliding galaxy dubbed the "Tadpole" which, with its long tail of stars, looks like a runaway pinwheel firework. Another picture depicts a spectacular collision between two spiral galaxies that presages what may happen to our own Milky Way several billion years from now when it collides with a neighboring galaxy in the constellation Andromeda. Closer to home, the camera imaged the "Cone Nebula," a craggy-looking mountaintop of cold gas and dust. Peering into a celestial maternity ward called the Omega Nebula or M17, it also revealed a watercolor fantasy-world of glowing gases, where stars and perhaps embryonic planetary systems are forming.

Investigating our stellar backyard, the NICMOS camera and spectrometer peeled back the outer layers of the Cone Nebula to see its underlying dusty "bedrock." The camera also penetrated the dusty disk of a galaxy like our Milky Way all the way to the galaxy's core. Astronomers were surprised to see what appears to be a ring of stars 720 light-years across encircling the galaxy's nucleus, an unprecedented sight in this type of galaxy. The camera then gazed across the universe and spotted a four-galaxy traffic accident that is creating a torrent of new stars. The colliding galaxies glow fiercely in infrared light due to the dust clouds that the flocks of new stars are generating.

We have long understood that energy flows from the Sun, not only in the form of visible light, but also as solar flares and the "solar wind" made up of atomic particles and magnetism. This energy interacts with Earth and the near-Earth environment, called geospace. But we do not fully understand the details of these processes. The Sun's impact on space weather in Earth's upper atmosphere can affect power grids and communications systems on Earth as well as satellite communications and tracking, spacecraft lifetimes, and the reentry of piloted vehicles. One of the important current puzzles is determining why some solar activity has significant geospace impact and some does not.

## THEME DISTRIBUTIONS

| Budget Authority ($ in millions) | FY 2002 | FY 2003 President's Budget, As Amended | FY 2004 President's Budget |
|---|---|---|---|
| Solar System Exploration | 638.9 | 975.7 | 1,358.6 |
| Mars Exploration | 456.9 | 495.5 | 570.2 |
| Astronomical Search for Origins | 650.1 | 698.1 | 877.0 |
| Structure and Evolution of the Universe | 350.1 | 331.0 | 431.7 |
| Sun-Earth Connection | 412.9 | 544.2 | 769.6 |
| Institutional Support | 392.9 | 369.8 | -- |
| Total | 2,901.8 | 3,414.3 | 4,007.1 |

Note: For all formats, the FY 2002 column reflects the FY 2002 Congressional Operating Plan dated 9/30/02. The FY 2003 column reflects the FY 2003 Presidents Budget Submit (PBS) as Amended. FY2004 column is in full cost.

Indicates budget numbers in Full Cost.

# ENTERPRISE: Space Science

## Solar System Exploration

This theme seeks to understand how our own solar system formed and evolved, and about possible life beyond Earth. The planets of our solar system and the ancient icy bodies far from the Sun are Rosetta stones that can tell unique stories about the evolution of our solar system. As we learn more about the origins of living systems on Earth and our solar system's planets and moons, we may learn that life has also arisen on some of them. Highlights for FY 2004 include:

**Overall budget**
FY 2004 request is $1,359 million, a $312 million or 30 percent increase over FY 2003 President's Request (full cost):

- $177 million for three missions in development; MESSENGER mission to explore Mercury, DAWN mission to orbit around two asteroids, and Deep Impact mission to probe below the surface of a comet.
- $130 million for New Frontiers program to explore the outer planets in the solar system, including funding for the New Horizons mission to Pluto and the Kuiper Belt.
- $68 million for Astrobiology research to improve the ability to find and identify life on other planets.

**New Initiative – Project Prometheus**
Request includes $279 million for this new initiative ($3 billion over five years). This consists of $186 million ($1 billion over five-years) from the Nuclear Systems Initiative introduced in FY 2003 and adds $93 million ($2 billion over five-years) for a first flight mission, Jupiter Icy Moon Orbiter, to be flown within a decade.

- Nuclear technology will enable unprecedented science data return through high power science instruments and advanced communications technology.
- Jupiter Icy Moon Orbiter will search for evidence of global subsurface oceans on Jupiter's three icy Galilean moons: Europa, Ganymede, and Callisto. These oceans may harbor organic material.
- Mission will set the stage for the next phase of exploring Jupiter and will open the rest of the outer solar system to detailed exploration.

**New Initiative – Optical Communications**
Request includes $31 million for this new initiative ($233 million over five years):

- Offers potential for many orders of magnitude improvement in communication data rate. Example: using conventional radio frequency communications, the Mars Reconnaissance Orbiter will take 21 months to map 20 percent of the surface of Mars; if used optical communications then would allow the *entire* surface to be mapped in 4 months.
- Critical technology exists, but must be demonstrated. Plan first demonstration at Mars in 2009 using telecom satellite around Mars that relays data to high-altitude Earth balloons. The balloon receiver technology will be demonstrated by the middle of this decade.
- Promises dramatic reduction in cost per byte of data returned and could, ultimately, replace the Deep Space Network.

## Mars Exploration

This theme explores the mysteries of the history and present conditions on Mars. Dry and cold today, the Martian surface shows the traces of a wet and warmer past. Frozen water at its poles and hints of relatively recent liquid water flows make Mars the most likely place to seek evidence of ancient or present extraterrestrial life. Contrasts between the current and past geology, atmospheres, and magnetic fields of Mars and Earth promise insights into why these neighboring planets differ so much today. Advances in our understanding of Mars would be useful for future human exploration. Highlights for FY 2004 include:

**Overall budget**
FY 2004 request is $570 million, a $20 million or 3.6 percent increase over FY 2003 President's Request (full cost):

- $184 million for development of 2005 Mars Reconnaissance Orbiter, an orbiter that will map Martian surface features as small as a basketball (20-30 cm).
- $29 million for 2007 Scout Mission, a unique opportunity for scientists and industry to compete and provide innovative ideas for Mars exploration.
- $118 million for 2009 Mars Smart Rover/Lander, a rover that will traverse tens of kilometers over Mars and last over a year, digging and drilling for unique samples to study in its onboard laboratory.
- $9 million ($336 million over five-years) added for a new mission, a telecommunications satellite around Mars in 2009, to enhance science data return and demonstrate the first interplanetary optical communications link.

## Astronomical Search for Origins

This theme strives to answer two questions: Where did we come from? Are we alone? The theme seeks to observe the birth of the earliest galaxies and the formation of stars, find planetary systems in our region of the galaxy, including those capable of harboring life, and learn whether life exists beyond our solar system. We need to understand the building blocks of life, the conditions necessary for life to persist, and the signatures it writes on the sky. By exploring the diversity of other worlds and searching for those that may harbor life, we hope to understand the origins of our own world. Highlights for FY 2004 include:

**Overall budget**
FY 2004 request is $877 million, a $78 million or 10 percent increase over FY 2003 President's Request (full cost):

- $239 million for Hubble Space Telescope operations as well as funding for a Shuttle servicing mission in 2005 and a Shuttle retrieval mission in 2010 as the Hubble ends its operations.
- $255 million for development of James Webb Space Telescope planned for launch about 2010 and promising to build on the legacy of Hubble Space Telescope.
- $80 million for development of Space Interferometry Mission planned for launch in 2009 to detect planets around other stars.

# ENTERPRISE: Space Science

## Structure and Evolution of the Universe

This theme seeks to understand the nature and phenomena of the Universe. It seeks to understand the fundamental laws of space, time, and energy and to trace the cycles that have created the conditions for our own existence. This is accomplished in part by observing signals from the Big Bang, mapping the extreme distortions of space-time about black holes, investigating galaxies, and understanding the most energetic events in the universe. We also must try to understand the mysterious dark energy that pervades the universe and determines its ultimate destiny. Highlights for FY 2004 include:

**Overall budget**
FY 2004 request is $432 million, a $33 million or 8.3 percent increase over FY 2003 President's Request (full cost):

- $116 million for development of Gamma-ray Large Area Space Telescope (GLAST), a mission to study high-energy objects like black holes.

**New Initiative – Beyond Einstein**
Request includes $59 million for this new initiative ($765 million over five years):

- Offers potential to answer three questions left unanswered by Albert Einstein's theories: What powered the Big Bang? What happens to space, time, and matter at the edge of a black hole? What is the mysterious dark energy expanding the universe?

- Laser Interferometer Space Antenna (LISA) will use three spacecraft "formation flying" 5 million kilometers apart in a triangle to observe the distortion of space due to gravity waves.

- Constellation-X will use a team of powerful X-ray telescopes working in unison to observe black holes, investigate "recycled" stellar material, and search for the "missing matter" in the universe; it will be 100 times more powerful than any single X-ray telescope that has come before it.

- Einstein Probes, a program that will begin later this decade, consists of fully and openly competed missions (in the manner of the Discovery, Explorers, and New Frontiers programs) to conduct investigations that benefit Structure and Evolution of the Universe science objectives.

## Sun-Earth Connections

This theme investigates our Sun and how its structure and behavior affect Earth. The Sun's energy is responsible for the Earth's present ecosystem, but the Sun is a variable star. Its small variability profoundly affects the Earth. Changes in its long-term brightness cause ice ages, and its 11-year cycle of activity causes aurora and other disturbances on the Earth. Solar flares affect the upper atmosphere and can damage satellites and disable the power distribution grid on the ground. The Sun is also our nearest star and is an ideal laboratory for basic physics and learning about other stars. Highlights for FY 2004 include:

**Overall budget**
FY 2004 request is $770 million, a $95 million or 14 percent increase over FY 2003 President's Request (full cost):

- $166 million for development of STEREO and Solar Dynamics Observatory.

- $212 million for future flight missions.

Reddish spots and shallow pits on the icy surface of Jupiter's moon Europa may indicate pockets of warmer ice rising from below. This upwelling could provide an elevator ride to the surface for material (including any life forms present) in an ocean beneath the ice. The spots and pits visible in this region of Europa's northern hemisphere are each about 10 kilometers (6 miles) across. Exploring Europa is compelling target in our strategy to explore the solar system and search for life. The Jupiter Icy Moons Orbiter should provide an excellent opportunity for discovery with its visit to Europa. More information can be found at http://solarsystem.nasa.gov .

# SOLAR SYSTEM EXPLORATION

## MAJOR EVENTS IN FY 2004

- Deep Impact will launch in January 2004. Deep Impact will fire a projectile at comet Temple-1 to investigate the composition of the comet's interior.
- MESSENGER will launch in March 2004. MESSENGER will conduct a detailed investigation of Mercury, the least explored terrestrial planet.
- Stardust will encounter comet Wild-2 in January 2004 and collect dust samples that will be returned to Earth in 2006.
- Cassini arrives at Saturn in July 2004 following a seven-year journey.
- Genesis returns to Earth in September 2004 with its samples of the solar wind following its two-year "sunbath".

## THEME: Solar System Exploration (SSE)

### OVERVIEW

The Solar System Exploration (SSE) Theme is a three-pronged quest to explore the formation and evolution of our solar system and the Earth within it, seek the origins of life and its existence beyond Earth, and chart our destiny within the solar system. The SSE program will examine potentially habitable environments, search for life, and attempt to understand how solar system processes affect the future of Earth and humanity.

| Missions | Goals supported by this theme | Objectives supporting those goals |
|---|---|---|
| Understand and Protect our Home Planet | 1. Understand the Earth system and apply Earth system science to improve prediction of climate, weather and natural hazards. | 1.4 Catalog and understand potential hazards to Earth from space. |
| Explore the Universe and Search for Life | 5. Explore the solar system and beyond, understand origin/evolution of life, and search for evidence of life elsewhere. | 5.1 Learn how the solar system originated and evolved to its current diverse state. |
| | | 5.2 Determine the characteristics of the solar system that led to the origin of life. |
| | | 5.3 Understand how life begins and evolves. |
| Inspire the Next Generation of Explorers | 6. Inspire and motivate students to pursue careers in science, engineering and mathematics. | 6.1, 6.2, 6.3, 6.4 (Supporting Role) See Education Programs for objectives. |
| | 7. Engage the public in shaping and sharing the experience of exploration and discovery. | 7.1 Improve the capacity of science centers, museums, and other institutions, through the development of partnerships, to translate and deliver engaging NASA content. (Supporting Role) |
| | | 7.2 Improve science literacy by engaging the public in NASA missions and discoveries, and their benefits, through such avenues as public programs, community outreach, mass media, and the Internet. (Supporting Role) |

### RELEVANCE

Our solar system is a place of incredible diversity, extreme environments, and continuous change. Today it is also a natural laboratory, on a grand scale, within which we seek answers to the mysteries of the universe and our place within it. In the forty years since the launch of the first interplanetary probe, our knowledge of the solar system and our ability to explore it have increased at an astonishing pace. Our robotic explorers have traveled throughout the solar system, revealing levels of complexity and diversity that were unimaginable prior to the advent of space exploration. They have also revealed to us the building blocks and chemical origins of life itself. The exploration of our solar system is founded upon the pursuit of three simple yet profound questions: Where do we come from? What is our destiny? Are we alone?

| Education and Public Benefits |
|---|
| The SSE program strives to use our missions, research programs, and the human resources of the Space Science community to enhance the quality of American science, mathematics, and technology education, particularly at the pre-college level. SSE is dedicated to sharing the excitement of discoveries and knowledge generated by Space Science missions and research with the public, as well as contributing to the creation of the talented scientific and technical workforce needed for the 21st century.<br><br>Public benefits from SSE include a growing understanding of the solar system and Earth's significance within it. SSE's Discovery program was among the first at NASA to require a plan for education and public outreach, as NASA recognized the importance of communicating the excitement of space exploration to the public. |

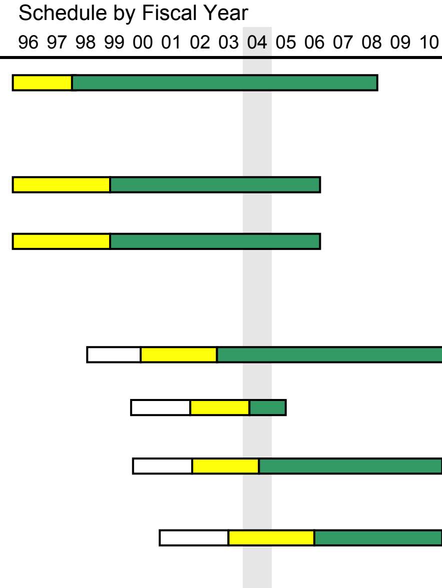
## THEME: Solar System Exploration (SSE)

### IMPLEMENTATION

The Solar System Exploration theme is composed of many elements that work together to achieve the program's goals and objectives. Repeated management and scientific peer reviews ensure that each mission provides data in a cost-effective manner. In many cases, the data obtained from different missions are complementary, and are combined in cross-disciplinary studies by members of the scientific community. Theme responsibility resides in the Office of Space Science at NASA HQ.

Enterprise official is Ed Weiler, Associate Administrator for Space Science. Theme director and point of contact is Colleen Hartman, Director of the Solar System Exploration Division at Headquarters. This theme is in full compliance with NPG 7120.5B.

| Strategy | Schedule by Fiscal Year | Purpose |
|---|---|---|
| Cassini/Huygens | | Scientific investigation of the planet Saturn; probe deployment to Saturn's moon, Titan. |
| Stardust | | Study of, and return of material from, Comet Wild 2. |
| Genesis | | Study the origin of the solar system by collecting and returning samples of charged particles in the solar wind. |
| Rosetta | | Study the nucleus of Comet Wirtanen. |
| Deep Impact | | Excavate the interior of Comet P/Tempel 1. |
| MESSENGER | | Scientific investigation of the planet Mercury. |
| Dawn | | Scientific investigation of Ceres and Vesta -- two small planets in the main asteroid belt. |




Link to Program Implementation Plans

Tech. & Adv. Concept | Development | Operations

| Tailoring |
|---|
| No exceptions to NPG 7120.5B have been taken. |

### STATUS

SSE accomplished the following this past year:

- Integration and Test of U.S.-supplied experiments on ESA's Rosetta has been completed. Rosetta has been shipped to the launch site.

## THEME: Solar System Exploration (SSE)

### PERFORMANCE MEASURES

| Annual Performance Goals | |
|---|---|
| | OUTCOME: A well managed program in accordance with Agency implementing strategies. |
| 4SSE1 | Each Development project will complete its current phase within 10% of total life-cycle cost shown on the table below. |
| 4SSE2 | Each Research project will allocate 75% of its funding competitively during FY04. |
| 4SSE3 | SSE will complete all of its missions within 10% of their baseline schedules. |
| 1.4.1 | OUTCOME: Explore the space environment to discover hazards to Earth. |
| 4SSE4 | Successfully demonstrate progress in determining the inventory and dynamics of bodies that may pose an impact hazard to Earth. Progress towards achieving outcomes will be validated by external review. |
| 4SSE5 | Successfully demonstrate progress in determining the physical characteristics of comets and asteroids relevant to any threat they may pose to Earth. Progress towards achieving outcomes will be validated by external review. |
| 5.1.1 | OUTCOME: Determine how the solar system originated and evolved to its current diverse state. |
| 4SSE6 | Successfully demonstrate progress in understanding the initial stages of planet and satellite formation. Progress towards achieving outcomes will be validated by external review. |
| 4SSE7 | Successfully demonstrate progress in studying the processes that determine the characteristics of bodies in our solar system and how these processes operate and interact. Progress towards achieving outcomes will be validated by external review. |
| 4SSE8 | Successfully demonstrate progress in understanding why the terrestrial planets are so different from one another. Progress towards achieving outcomes will be validated by external review. |
| 4SSE9 | Successfully demonstrate progress in learning what our solar system can tell us about extra-solar planetary systems. Progress towards achieving outcomes will be validated by external review. |
| 5.2.1 | OUTCOME: Determine the characteristics of the solar system that led to the origin of life. |
| 4SSE10 | Successfully demonstrate progress in determining the nature, history, and distribution of volatile and organic compounds in the solar system. Progress towards achieving outcomes will be validated by external review. |
| 4SSE11 | Successfully demonstrate progress in identifying the habitable zones in the solar system. Progress towards achieving outcomes will be validated by external review. |
| 5.3.1 | OUTCOME: Understand how life begins and evolves. |
| 4SSE12 | Successfully demonstrate progress in identifying the sources of simple chemicals that contribute to prebiotic evolution and the emergence of life. Progress towards achieving outcomes will be validated by external review. |
| 4SSE13 | Successfully demonstrate progress in studying Earth's geologic and biologic records to determine the historical relationship between Earth and its biosphere. Progress towards achieving outcomes will be validated by external review. |
| 6.1.1 | OUTCOME: Kindergarten through graduate students will be more proficient in science, technology, engineering, and mathematics (STEM). |
| 4SSE14 | Provide opportunities for students to work directly with NASA space science missions, facilities, and data. |
| 6.2.1 | OUTCOME: More students from diverse communities motivated to pursue careers in STEM. |
| 4SSE15 | Provide new opportunities for participation in the space science program by an increasingly diverse population, including opportunities for minorities and minority universities to compete for and participate in space science missions, research, and education programs. |
| 6.3.1 | OUTCOME: Improve quality of STEM instruction. |
| 4SSE16 | Provide high quality educational materials and teacher training based on Theme content and focused on national curriculum standards. |
| 4SSE17 | Provide exhibits, materials, workshops, and personnel at national and/or regional education and outreach conferences. |
| 6.4.1 | OUTCOME: More students prepared to enter the STEM workforce. |
| 4SSE18 | Provide higher education opportunities offered through OSS research awards and other NASA research and education programs. |
| 7.1.1 | OUTCOME: Improve the capacity of science centers, museums, and other institutions, through the development of partnerships, to translate and deliver engaging NASA content. |
| 4SSE19 | Through partnerships with major science museums or planetariums, put on display or on tour major exhibitions or planetarium shows based on Theme content. |
| 4SSE20 | Provide materials and technical expertise to support the development of exhibits and programs at science museums and planetariums. |
| 7.2.1 | OUTCOME: Engage the public in NASA missions and discoveries through such avenues as public programs, community outreach, mass media, and the Internet. |
| 4SSE21 | Seek out and capitalize on special events and particularly promising opportunities in the Theme science program to bring space science to and involve the public in the process of scientific discovery. |

## THEME: Solar System Exploration (SSE)

### INDEPENDENT REVIEWS

| Types of Review | Performer | Last Review | Next Review | Purpose |
|---|---|---|---|---|
| Nat'l Academy | Space Studies Board | 7/02 | N/A | Effectiveness and quality of the program |
| Advisory Council | NAC | 9/02 | 3 times/year | Review science strategy, prog. implementation strategy |
| | SScAC | 8/02 | 3 times/year | Review science strategy, prog. implementation strategy |
| | SSE Sub-Committee | 9/02 | 3 times/year | Review science strategy, prog. implementation strategy |

### BUDGET

| Budget Authority ($millions) | | FY02 | FY03 | Chng | FY04 | Comments |
|---|---|---|---|---|---|---|
| **Solar System Exploration** | | **638.9** | **975.7** | **382.8** | **1358.5** | |
| Development | | 210.6 | 164.3 | +12.3 | 176.6 | |
| | CONTOUR | 19.7 | | | | |
| | Messenger | 97.4 | 68.0 | -30.0 | 38.0 | Project preparing for March 2004 launch. |
| | Deep Impact | 90.9 | 59.1 | -46.1 | 13.0 | Project preparing for January 2004 launch. |
| | Dawn | 1.0 | 36.3 | +89.3 | 125.6 | Project preparing to enter Development phase. |
| | Small Projects | 1.6 | 0.9 | -0.9 | | |
| Operations | | 119.9 | 310.6 | -0.7 | 309.9 | |
| Research | | 226.9 | 254.7 | +67.0 | 321.7 | |
| Technology and Advanced Concepts | | 81.5 | 246.1 | +304.3 | 550.4 | Includes New Initiatives under Project Prometheus and Optical Communications (see SAE 2-19). |

Note: For all formats, the FY 02 column reflects the FY 2002 Congressional Operating Plan dated 9/30/02. The FY 03 column reflects the FY 2003 Presidents Budget Submit (PBS) as Amended. The Change column includes both programmatic and full cost adjustments. FY 2004 column is in full cost.

Indicates budget numbers in full cost.

Indicates changes since the FY 2003 President's Budget Submit.

FY 2002, FY 2003, Prior and BTC are not in full cost.

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| THEME: | Solar System Exploration (SSE) |
|---|---|
| **DEVELOPMENT:** | MESSENGER |

## PURPOSE

| Objectives | | Performance Measures |
|---|---|---|
| 1.4, 5.1, 5.2, 5.3, 6.1, 6.2, 6.3, 6.4, 7.1, 7.2 | Reference 2003 Strategic Plan | 4SSE1-3, 7-21 |

The MErcury Surface, Space ENvironment, GEochemistry and Ranging (MESSENGER) project will determine: (1) the chemical composition of Mercury's suface; (2) Mercury's geological history; (3) the nature of Mercury's magnetic field; (4) the size and state of Mercury's core; (5) the volatile inventory of Mercury's poles; and (6) the nature of Mercury's exosphere and magnetosphere.

## OVERVIEW

MESSENGER will orbit Mercury following two flybys of that planet. The orbital phase will use the flyby data as an initial guide to perform a focused scientific investigation of Mercury. MESSENGER's propulsion system is integrated into the spacecraft structure to make economical use of mass. The miniaturized instruments are located on a science deck facing Mercury, while the spacecraft is shielded from the blistering sunlight by a lightweight thermal shade. Most of the instruments are fixed-mounted, so coverage of Mercury is obtained by spacecraft motion over the planet. The imaging system uses a miniature scan mirror so it can quickly collect image mosaics.

MESSENGER Homepage: http://messenger.jhuapl.edu/index.html

## PROGRAM MANAGEMENT

MESSENGER is a project in the Discovery Program with project responsibility delegated to the Principal Investigator at the Carnegie Institution of Washington. The Johns Hopkins University's Applied Physics Laboratory (APL) Space Department Management Committee (SDMAC) is the governing Program Management Council (PMC). Enterprise Official is Ed Weiler, Associate Administrator for Space Science at Headquarters. Theme Director and point of contact is Colleen Hartman, Director of the Solar System Exploration Division at Headquarters. This program is in full compliance with NPG7120.5B.

## TECHNICAL COMMITMENT

The baseline for this technical commitment was made in 6/2001 and is detailed in Appendix 7 of the Discovery Program Plan.

| Technical Specifications | **FY04 President's Budget** | **Change from Baseline** |
|---|---|---|
| Launch Vehicle: | Delta 7925H-9.5 | -- |
| Operational capability: | MESSENGER's 12 months in orbit cover 2 Mercurean solar days. (The Mercurean solar day, from sunrise to sunrise, is equal to 176 Earth days.) | -- |
| Science Instruments: | 7 science instruments: Mercury Dual Imaging System (MDIS), Gamma-Ray and Neutron Spectrometer (GRNS), X-Ray Spectrometer (XRS), Magnetometer (MAG), Mercury Laser Altimeter (MLA), Mercury Atmospheric and Surface Composition Spectrometer (MASCS), Energetic Particle and Plasma Spectrometer (EPPS) | -- |

| THEME: | Solar System Exploration (SSE) |
|---|---|
| **DEVELOPMENT:** | **MESSENGER** |

| Schedule | FY04 President's Budget | Change from Baseline |
|---|---|---|
| Start of Formulation | Dec-99 | -- |
| Start of Implementation | Jul-01 | -- |
| Critical Design Review | Mar-02 | -- |
| Launch | Mar-04 | -- |
| Venus Flybys | June 2004 and March 2006 | -- |
| Mercury Flybys | July 2007 and April 2008 | -- |
| Enter Mercury Orbit | Apr-09 | -- |
| End of Orbital data collection | Apr-10 | -- |
| End of DA/Archive | Apr-11 | -- |

## ACQUISITION STRATEGY & PERFORMING ORGANIZATIONS

Carnegie Insitute of Washington, under contract to NASA, provides the PI, Science Team Co-Investigators (Co-Is), and Education and Public Outreach (EPO) Team members. Johns Hopkins University/Applied Physics Laboratory, under contract to NASA, provides Science Team Co-Is, project management, mission design, systems engineering, and the spacecraft. Compositie Optics, Inc. provides the structure and Gencorp Aerojet provides the propulsion system. The payload is provided by JHU/APL, NASA/GSFC, the University of Colorado Laboratory for Atmospheric and Space Physics (LASP), and the University of Michigan Space Physics Research Laboratory (SPRL). The Mission Operations Center and Science Operations Center will be developed by JHU/APL.

| Current Acquisitions | Actual * | Selection Method | Actual * | Performer | Actual * |
|---|---|---|---|---|---|
| Cooperative Agreemt. | 0% | Full & Open Competition | 100% | Industry | 25% |
| Cost Reimbursable | 80% | Sole Source | 0% | Government | 0% |
| Fixed Price | 11% | | 100% | NASA Intramural | 9% |
| Grants | 0% | | | University | 66% |
| Other | 9% | Sci Peer Review | 100% | Non Profit | % |
| * as % of FY02 direct procurement | 100% | * as % of FY02 direct procurement | | * as % of FY02 direct procurement | 100% |

| Future Acquisitions - Major | Selection | Goals |
|---|---|---|
| 1. None - all major contracts are in place | N/A | N/A |

## AGREEMENTS

*Internal:* The program is not dependent on other NASA activities outside of the control of the Associate Administrator for Space Science. *External:* None. **Changes since FY03 Pres. Budget: None.**

## INDEPENDENT REVIEWS

| Types of Review | Performer | Last Review | Next Review | Purpose |
|---|---|---|---|---|
| Confirmation Assess. (PDR) | HQ | May 01 | N/A | Confirm readiness to enter implementation phase |
| Independent Assessment | Discovery PO | Mar 02 | Sep 03 | Critical Design Review; Pre-Environmental Review |

## BUDGET/LIFE CYCLE COST

Total budget authority represents the Life Cycle Cost (LCC).

| Budget Authority ($ in millions) | Prior | FY02 | FY03 | FY04 | FY05 | FY06 | FY07 | FY08 | BTC | Total | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|
| FY 2004 President's Budget | 63.1 | 97.4 | 68.0 | 42.5 | 7.4 | 7.8 | 9.0 | 11.1 | 31.4 | 337.7 | |
| Development | 63.1 | 97.4 | 68.0 | 38.0 | | | | | | 266.5 | |
| Operations | | | | 3.0 | 4.3 | 4.4 | 4.4 | 5.5 | 14.2 | 35.9 | |
| Data Analysis | | | | 1.5 | 3.1 | 3.4 | 4.6 | 5.6 | 17.2 | 35.3 | |
| Changes since FY 03 PBS | 0.0 | +3.1 | +0.0 | +3.4 | +0.3 | +0.3 | +0.3 | +11.1 | +0.0 | +18.5 | ***Reason for Change:*** |
| Development | | +3.1 | | +3.3 | | | | | | +6.4 | 02 growth/full cost |
| Operations | | | | +0.1 | +0.2 | +0.2 | +0.2 | +5.5 | | +6.3 | Full cost |
| Data Analysis | | | | | +0.1 | +0.1 | +0.1 | +5.6 | | +5.8 | Full cost |
| FY 2003 President's Budget | 63.1 | 94.3 | 68.0 | 39.1 | 7.1 | 7.5 | 8.7 | 0.0 | 42.2 | 330.0 | |
| Development | 63.1 | 94.3 | 68.0 | 34.7 | | | | | | 260.1 | |
| Operations | | 0.0 | | 2.9 | 4.1 | 4.2 | 4.2 | | 19.5 | 34.9 | |
| Data Analysis | | 0.0 | | 1.5 | 3.0 | 3.3 | 4.5 | | 22.7 | 35.0 | |
| Initial Baseline (LCC) | 63.1 | 94.3 | 68.0 | 39.1 | 7.1 | 7.5 | 8.7 | 0.0 | 42.2 | 330.0 | FY 2003 Pres. Budget |
| Development | 63.1 | 94.3 | 68.0 | 34.7 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 260.1 | |
| Operations | 0.0 | 0.0 | 0.0 | 2.9 | 4.1 | 4.2 | 4.2 | 0.0 | 19.5 | 34.9 | |
| Data Analysis | 0.0 | 0.0 | 0.0 | 1.5 | 3.0 | 3.3 | 4.5 | 0.0 | 22.7 | 35.0 | |

Indicates budget numbers in full cost.

Indicates changes since the FY 2003 President's Budget Submit.

FY 2002, FY 2003, Prior and BTC are not in full cost.

| THEME: | Solar System Exploration (SSE) |
|---|---|
| **DEVELOPMENT:** | **Deep Impact** |

## PURPOSE

| Objectives | | Performance Measures |
|---|---|---|
| 1.4, 5.1, 5.2, 5.3, 6.1, 6.2, 6.3, 6.4, 7.1, 7.2 | Reference 2003 Strategic Plan | 4SSE1-7, 9-21 |

Deep Impact will reveal the composition of the interior of a comet, increasing our understanding of the formation of the solar system. Data from the mission may also provide some insight into avoiding Near-Earth Object collisions with the Earth.

## OVERVIEW

The Deep Impact mission will send a large copper projectile crashing into the surface of a comet at more than 20,000 miles per hour, creating a huge crater and revealing never before seen materials and the internal compostion and structure of a comet. The impact will excavate a crater of approximately 100 meters in diameter and 25 meters in depth. Deep Impact will observe how the crater forms, measure the crater's depth and diameter, measure the composition of the interior of the crater and its ejecta and determine the changes in natural outgassing produced by the impact. Dramatic images from both the flyby spacecraft and the impactor will be sent back to distant Earth in near-real time. Amateur astronomers, some already tracking the comet, will offer the public a first-hand look at this incredible July 2005 encounter.

DEEP IMPACT Homepage: http://deepimpact.umd.edu/

## PROGRAM MANAGEMENT

Deep Impact is a project in the Discovery Program with project responsibility delegated to the Principal Investigator (PI) at University of Maryland. The JPL Program Management Council (PMC) has Deep Impact governing responsibility. Enterprise Official is Ed Weiler, Associate Administrator for Space Science at Headquarters. Theme Director and point of contact is Colleen Hartman, Director of the Solar System Exploration Division at Headquarters. This program is in full compliance with NPG7120.5B.

## TECHNICAL COMMITMENT

The baseline for this technical commitment was made in 5/01 and is detailed in Appendix 8 of the Discovery Program Plan.

| Technical Specifications | FY04 President's Budget | Change from Baseline |
|---|---|---|
| Mission requirement | Fly to comet Tempel 1 | -- |
| Payload | High Resolution Imager (HRI), Medium Resolution Imager (MRI) and Impactor Target Sensor (ITS) | -- |
| Launch Vehicle | Delta II | -- |
| Launch Mass | 1,020 kg | -- |
| Prime antenna diameter | 1 meter (parabolic) | -- |
| Communications bandwidths | x-band for flyby spacecraft (uplink command and downlink telemetry) and s-band for impactor communication to/from the flyby spacecraft | -- |
| Max Data Rate | 175 kbps | -- |
| Max solar array power | 620 W at encounter | -- |

| Schedule | FY04 President's Budget | Change from Baseline |
|---|---|---|
| Start of Formulation | Nov-99 | -- |
| Start of Implementation | Jun-01 | -- |
| Critical Design Review | Jan-02 | -- |
| Launch | Jan-04 | -- |
| Earth/Moon Flyby | Jan-05 | -- |
| Encounter | Jul-05 | -- |
| End of Mission | Aug-05 | -- |
| End of DA/Archive | Apr-06 | -- |

| | |
|---|---|
| **THEME:** | Solar System Exploration (SSE) |
| **DEVELOPMENT:** | Deep Impact |

## ACQUISITION STRATEGY & PERFORMING ORGANIZATIONS

University of Maryland provides the PI and the science team for the overall science inputs to the mission design. JPL provides the project management, mission design, systems engineering and mission operations. Ball Aerospace and Technology Corporation provides the flyby and impactor spacecraft and the HRI, MRI and ITS instruments. **Changes since FY03 Pres. Budget: None.**

| Current Acquisitions | Actual * | Selection Method | Actual * | Performer | Actual * |
|---|---|---|---|---|---|
| Cooperative Agreements | 0% | Full & Open Competition | 100% | Industry | 64% |
| Cost Reimbursable | 10% | Sole Source | 0% | Government | 0% |
| Fixed Price | 90% | | 100% | NASA Intramural | 21% |
| Grants | 0% | | | University | 15% |
| Other | 0% | Sci Peer Review | 100% | Non Profit | 0% |
| * as % of FY02 direct procurement | 100% | * as % of FY02 direct procurement | | * as % of FY02 direct procurement | 100% |

| Future Acquisitions - Major | Selection | Goals |
|---|---|---|
| 1. None - all major contracts are in place | N/A | N/A |

## AGREEMENTS

Internal: The project is not dependent on other NASA activities outside of the control of the Associate Administrator for Space Science. External: There are no other non-NASA organizations (other than Deep Impact team members) on which the project depends for mission success. **Changes since FY03 Pres. Budget: None.**

## INDEPENDENT REVIEWS

| Types of Review | Performer | Last Review | Next Review | Purpose |
|---|---|---|---|---|
| Initial Confirmation Asses. | HQ | May 01 | N/A | Approval to continue to Phase C/D |
| Independent Assessment | Discovery PO | Feb 02 | Feb 03 | CDR Review; Baseline Confirmation/Risk Review |

## BUDGET/LIFE CYCLE COST

Total budget authority represents the Life Cycle Cost (LCC).

| Budget Authority ($ in millions) | Prior | FY02 | FY03 | FY04 | FY05 | FY06 | FY07 | FY08 | BTC | Total | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|
| FY 2004 Pres. Bud. (LCC) | 96.9 | 90.9 | 59.1 | 21.7 | 11.3 | 2.0 | 0.0 | 0.0 | | 281.9 | |
| Development | 96.9 | 90.9 | 59.1 | 13.0 | | | | | | 259.9 | |
| Operations | | | | 6.9 | 8.3 | 0.4 | 0.0 | | 0.0 | 15.7 | |
| Data Analysis | | | | 1.8 | 3.0 | 1.6 | | | | 6.4 | |
| Changes since FY 03 Pres. Bud. | | +5.7 | | +0.7 | +0.2 | 0.0 | | | | +6.6 | ***Reason for Change:*** |
| Development | | +5.7 | | +0.4 | | | | | | +6.1 | growth in 02, full cost in 04 |
| Operations | | | | +0.1 | +0.1 | +0.1 | | | | +0.4 | full cost |
| Data Analysis | | | | +0.2 | +0.1 | -0.1 | | | | +0.2 | full cost |
| FY 2003 Pres. Bud. (LCC) | 96.9 | 85.2 | 59.1 | 21.0 | 11.1 | 2.0 | 0.0 | 0.0 | | 275.3 | |
| Development | 96.9 | 85.2 | 59.1 | 12.6 | | | | | | 253.8 | |
| Operations | | | | 6.8 | 8.2 | 0.3 | | | | 15.3 | |
| Data Analysis | | | | 1.6 | 2.9 | 1.7 | | | | 6.2 | |
| Initial Baseline (LCC) | 96.9 | 85.2 | 59.1 | 21.0 | 11.1 | 2.0 | 0.0 | 0.0 | 0.0 | 275.3 | FY 2003 Pres. Budget |
| Development | 96.9 | 85.2 | 59.1 | 12.6 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 253.8 | |
| Operations | 0.0 | 0.0 | 0.0 | 6.8 | 8.2 | 0.3 | 0.0 | 0.0 | 0.0 | 15.3 | |
| Data Analysis | 0.0 | 0.0 | 0.0 | 1.6 | 2.9 | 1.7 | 0.0 | 0.0 | 0.0 | 6.2 | |

Indicates budget numbers in full cost.

Indicates changes since the FY 2003 President's Budget Submit.

FY 2002, FY 2003, Prior and BTC are not in full cost.

| THEME: | Solar System Exploration (SSE) |
|---|---|
| **DEVELOPMENT:** | **Dawn** |

## PURPOSE

| Objectives | | Performance Measures |
|---|---|---|
| 1.4, 5.1, 5.2, 5.3, 6.1, 6.2, 6.3, 6.4, 7.1, 7.2 | Reference 2003 Strategic Plan | 4SSE1-21 |

The Dawn mission's primary objective is to significantly increase our understanding of the conditions and processes acting during the solar system's earliest history, by examing the geophysical and geochemical properties of the main belt asteroids 1 Ceres and 4 Vesta. This will be accomplished by sending a spacecraft to orbit these asteroids and perform science investigations using imaging, spectroscopy, magnetism, altimetry, and radio science.

## OVERVIEW

Dawn has a focused set of science and measurement objectives to be obtained through radio science and five instruments. The mission launches in May 2006 during a 21-day launch window and uses Solar Electric Propulsion to reach and orbit each asteroid for approximately 11 months, performing science investigations at various altitudes and lighting conditions. The use of Solar Electric Propulsion readily mitigates launch injection errors and is used during the interplanetary cruise to match trajectories with the asteroid. The simple interplanetary trajectory requires no gravity assists, no critical sequences, and a maximum of 1 thruster operating at a time (there are 3 thrusters on the spacecraft). Stay times at Vesta and Ceres can easily be extended. The five instruments have functional overlaps allowing graceful degradation of science objectives if any instrument fails. Two of the instruments are fully redundant and three are partially redundant. The spacecraft electronics are fully redundant. The total mission duration is nine years.

DAWN Homepage: http://www-ssc.igpp.ucla.edu/dawn/

## PROGRAM MANAGEMENT

Dawn is a project in the Discovery Program with project responsibility delegated to the Principal Investigator (PI) at University of California, Los Angeles (UCLA). The Jet Propulsion Laboratory (JPL) Program Management Council (PMC) has Dawn governing responsibility. Enterprise Official is Ed Weiler, Associate Administrator for Space Science at Headquarters. Theme Director and point of contact is Colleen Hartman, Director of the Solar System Exploration Division at Headquarters. This program is in full compliance with NPG7120.5B.

## TECHNICAL COMMITMENT

The baseline for this technical commitment will be set at Confirmation Review.

| Technical Specifications | FY04 President's Budget | Change from Baseline |
|---|---|---|
| Payload: | The five instruments are a Framing Camera, Mapping Spectrometer, Gamma Ray/Neutron Spectrometer, Laser Altimeter, and Magnetometer | -- |
| Launch Vehicle: | Delta 2925H | -- |
| Cruise: | 3 NSTAR Xenon (Xe) thrusters, one at a time, Maximum fuel mass: 288 kg to Vesta and 89 kg to Ceres | -- |
| Vesta: | Orbit at 700 and 120 km alt., 11 months | -- |
| Ceres: | Orbit at 890 and 140 km alt., 11 months | -- |

| Schedule | FY04 President's Budget | Change from Baseline |
|---|---|---|
| Start of Formulation | Sep 02 | -- |
| Preliminary Design Review | Aug 03 | -- |
| Critical Design Review | Apr 04 | -- |
| Launch | May 06 | -- |
| Vesta Encounter | Jul 10 | -- |
| Ceres Encounter | Aug 14 | -- |
| End of Mission & Data Archiving | Jul 16 | -- |

| | |
|---|---|
| **THEME:** | Solar System Exploration (SSE) |
| **DEVELOPMENT:** | Dawn |

## ACQUISITION STRATEGY & PERFORMING ORGANIZATIONS

UCLA provides the Principal Investigator and the science team, Education and Public Outreach, and the magnetometer instrument. The Jet Propulsion Laboratory is responsible for project management, mission and system engineering, mission assurance, the ion propulsion subsystem, navigation and mission operations. Orbital Sciences Corporation, under subcontract to JPL, is responsible for the spacecraft and flight software. Goddard Space Flight Center is responsible for the Laser Altimeter. Los Alamos National Laboratory is responsible for the Gamma Ray/Neutron Spectrometer. The German Aeorspace Center is responsible for the Framing Camera, and the Italian Space Agency is responsible for the Mapping Spectrometer. **Changes since FY03 Pres. Budget: None.**

| Current Acquisitions | Actual * | Selection Method | Actual * | Performer | Actual * |
|---|---|---|---|---|---|
| Cooperative Agmt. | 0% | Full & Open Competition | 100% | Industry | 31% |
| Cost Reimbursable | 100% | Sole Source | 0% | Government | 0% |
| Fixed Price | 0% | | 100% | NASA Intramural | 0% |
| Grants | 0% | | | University | 69% |
| Other | 0% | Sci Peer Review | 100% | Non Profit | 0% |
| * as % of FY02 direct procurement | 100% | * as % of FY02 direct procurement | | * as % of FY02 direct procurement | 100% |

| Future Acquisitions - Major | Selection | Goals |
|---|---|---|
| None - all major acquisitions are in place. | N/A | N/A |

## AGREEMENTS

Internal: The program is not dependent on other NASA activities outside of the control of the Associate Administrator for Space Science. External: Provision of the Framing Camera instrument from the German Aerospace Center (DLR) and the Mapping Spectrometer instrument from the Italian Space Agency (ASI). Letters of Agreement are in development. **Changes since FY03 Pres. Budget: None.**

## INDEPENDENT REVIEWS

| Types of Review | Performer | Last Review | Next Review | Purpose |
|---|---|---|---|---|
| Confirmation Asses. | HQ | N/A | Aug 03 | Confirmation Review |
| Independent Asses. | Disc. PO | N/A | Apr 04 | CDR Review; Pre-Environmental Review |

## BUDGET/LIFE CYCLE COST

Total budget authority represents the Life Cycle Cost (LCC).

| Budget Authority ($ in millions) | Prior | FY02 | FY03 | FY04 | FY05 | FY06 | FY07 | FY08 | BTC | Total | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|
| FY 2004 President's Budget | 0.5 | 1.0 | 36.3 | 125.6 | 83.5 | 40.9 | 6.2 | 6.5 | 89.6 | 390.2 | Baseline to be established at |
| Development | 0.5 | 1.0 | 36.3 | 125.6 | 83.5 | 39.9 | | | | 286.8 | Confirmation Review; project not |
| Operations | | | | | | 1.0 | 5.1 | 5.2 | 44.9 | 56.3 | yet in implementation. |
| Data Analysis | | | | 0.0 | | | 1.1 | 1.3 | 44.7 | 47.1 | |
| Changes since FY 03 Pres. Budget | +0.5 | +1.0 | +36.3 | +125.6 | +83.5 | +40.9 | +6.2 | +6.5 | +89.6 | +390.2 | ***Reason for Change:*** |
| Development | +0.5 | +1.0 | +36.3 | +125.6 | +83.5 | +39.9 | | | | +286.8 | Mission selection |
| Operations | | | | | | +1.0 | +5.1 | +5.2 | +44.9 | +56.3 | |
| Data Analysis | | | | | | | +1.1 | +1.3 | +44.7 | +47.1 | |
| FY 2003 President's Budget (LCC) | | | | | | | | | | | Mission selected after 03 Bud. |
| Initial Baseline (LCC) | | | | | | | | | | | TBD (see above) |

Indicates budget numbers in full cost.

Indicates changes since the FY 2003 President's Budget Submit.

FY 2002, FY 2003, Prior and BTC are not in full cost.

| THEME: | Solar System Exploration (SSE) |
|---|---|
| **DEVELOPMENT:** | **Solar System Exploration Small Development Projects** |

## PURPOSE

| Objectives | | Performance Measures |
|---|---|---|
| 1.4, 5.1, 5.2, 5.3, 6.1, 6.2, 6.3, 6.4, 7.1, and 7.2 | Reference 2003 Strategic | 4SSE1-14, 21 |

The SSE Small Projects program provides frequent flight opportunities for highly focused, relatively inexpensive missions. Missions are selected through the Announcement of Opportunity (AO) process. Also included in this group are Missions of Opportunity (MO) -- Space Science investigations that are flown as part of a non-NASA space mission.

## OVERVIEW

The mission that is currently included in Solar System Exploration Small Projects is Rosetta, which is an international collaboration to study the origin of comets and the Solar System itself. The U.S. responsibility is to provide four instruments, science participation, Deep Space Network access and nagivational support.

Rosetta program home page: http://sci.esa.int/home/rosetta

## PROGRAM MANAGEMENT

Rosetta is a single project with development responsibility delegated to the Jet Propulsion Laboratory.

## TECHNICAL COMMITMENT

The baseline for Rosetta is detailed in the Program Level I Requirements.

| Technical Specifications | FY04 President's Budget | Change from Baseline |
|---|---|---|
| **Rosetta** | | |
| Microwave Instrument for Rosetta Orbiter (MIRO) | Center-band frequencies of 190 & 564 Ghz | -- |
| ALICE UV Spectrometer | Obtain spectra in the 700-2050Å bandpass | -- |
| Ion Electron Spectrometer (IES) | Operate in three science modes | -- |
| ROSINA | Two spectrometers, a velocity and temperature sensor, and a common data processing unit | -- |

| Schedule | FY04 President's Budget | Change from Baseline |
|---|---|---|
| Rosetta Launch | TBD | TBD |

| THEME: | Solar System Exploration (SSE) |
|---|---|
| **DEVELOPMENT:** | Solar System Exploration Small Development Projects |

## ACQUISITION STRATEGY & PERFORMING ORGANIZATIONS

The Rosetta instrument developers were selected by ESA and endorsed by NASA in February 1996. Selections made were JPL for MIRO, Southwest Research Institute for ALICE and IES, and Lockheed Martin Palo Alto Research Laboratory for ROSINA hardware. **Changes since FY03 Pres. Budget: none.**

| Current Acquisitions | Actual * | Selection Method | Actual * | Performer | Actual * |
|---|---|---|---|---|---|
| Coop. Agmt. | 25% | Full & Open Competition | 100% | Industry | 25% |
| Cost Reimbursable | 25% | Sole Source | 0% | Government | 0% |
| Fixed Price | 0% | | 100% | NASA Intramural | 25% |
| Grants | 50% | | | University | 50% |
| Other | 0% | Sci Peer Review | 100% | Non Profit | 0% |
| * as % of FY02 direct procurement | 100% | * as % of FY02 direct procurement | | * as % of FY02 direct procurement | 100% |

| Future Acquisitions - Major | Selection | Goals |
|---|---|---|
| None - all major acquisitions are in place | N/A | N/A |

## AGREEMENTS

*Internal:* SSE Small projects are not dependent on other NASA activities outside of the control of the Associate Administrator of Space Science.
*External:* MOU between NASA and ESA, 1999. **Changes since FY03 Pres. Budget: None**.

## INDEPENDENT REVIEWS

| Types of Review | Performer | Last Review | Next Review | Purpose |
|---|---|---|---|---|
| N/A | N/A | N/A | N/A | N/A |

## BUDGET/LIFE CYCLE COST

Budget authority rep. the Development Cost. Mission Operations and Data Analysis costs are budgeted elsewhere.

| Budget Authority ($ in millions) | Prior | FY02 | FY03 | FY04 | FY05 | FY06 | FY07 | FY08 | BTC | Total | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|
| FY 2004 President's Budget | 39.5 | 1.6 | 0.9 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 42.0 | |
| Rosetta | 39.5 | 1.6 | 0.9 | | | | | | | 42.0 | Launch TBD |
| Changes since FY 03 Pres. Budget | | +0.3 | | | | | | | | +0.3 | ***Reason for Change:*** |
| Rosetta | | +0.3 | | | | | | | | | Growth |
| FY 2003 President's Budget (LCC) | 39.5 | 1.3 | 0.9 | | | | | | | 0.0 | NASA is making a contribution to this international mission; the NASA component has no initial baseline. |
| Rosetta | 39.5 | 1.3 | 0.9 | | | | | | | | |

Indicates budget numbers in full cost.
Indicates changes since the FY 2003 Presidents Budget Submit.
FY 2002, FY 2003, Prior and BTC are not in full cost.

**THEME:** Solar System Exploration (SSE)

# OPERATIONS

## PURPOSE

| Objectives | | Performance Measures |
|---|---|---|
| 1.4, 5.1, 5.2, 5.3 | Reference 2003 Strategic Plan | 4SSE4-11 |

Maximize the scientific return from NASA's investment in spacecraft and other data collection sources by conducting efficient and reliable operations of the data-collecting hardware which produces scientific discoveries.

## OVERVIEW

SSE Operations funds operational missions that support SSE goals and objectives, and the Deep Space Mission System (DSMS) that provides communications with SSE missions. This includes the construction of the Deep Space Network (DSN) 34-meter Beam Wave Guide (BWG) antenna in Spain to meet DSN loading requirements in 2003/2004.

DISCOVERY Program Homepage: http://discovery.nasa.gov/

CASSINI Homepage: http://www.jpl.nasa.gov/cassini/

DSN Homepage: http://deepspace.jpl.nasa.gov/dsn/

## PROGRAM MANAGEMENT

Enterprise Official is Ed Weiler, Associate Administrator for Space Science at Headquarters. Theme Director and point of contact is Colleen Hartman, Director of the Solar System Exploration Division at Headquarters. SSE mission operations are managed by the Jet Propulsion Laboratory, with the exception of MESSENGER, which is managed by the Johns Hopkins University's Appled Physics Laboratory. This program is in full compliance with NPG7120.5B.

## TECHNICAL COMMITMENT

The baseline for all SSE missions is defined in their respective PCAs.

| Technical Specifications | FY04 President's Budget | Change from Baseline |
|---|---|---|
| All missions will meet Level I specifications as identified in each mission's respective program plan. | | None |

| Schedule | FY04 President's Budget | Change from Baseline |
|---|---|---|
| Stardust | | |
| Encounter/Flyby: Comet Wild 2 | 1/04 | -- |
| Encounter/Flyby: Sample Return | 1/06 | -- |
| End of Mission | 9/06 | -- |
| Genesis | | |
| End of Mission | 9/04 | -- |
| End of Project (including DA) | 9/08 | -- |
| Messenger | | |
| Launch | 3/04 | -- |
| Target Arrival | 4/09 | -- |
| End of Mission | 4/11 | -- |
| Deep Impact | | |
| Launch | 1/04 | -- |
| Target Arrival | 7/05 | -- |
| End of Mission | 8/05 | -- |
| End of Project (including DA) | 4/06 | -- |
| Cassini | | |
| Target arrival | 7/04 | -- |
| Orbital Checkout Complete | 7/04 | -- |
| End of Mission | 7/08 | -- |

**THEME:** Solar System Exploration (SSE)

# OPERATIONS

## ACQUISITION STRATEGY & PERFORMING ORGANIZATIONS

The prime contractor for the Deep Space Mission System is Lockheed Martin under the Consolidated Space Operations Contract (CSOC). This contract was not renewed and will expire after FY03; it will be recompeted in late 2003. The Cassini mission is an international endeavor with JPL, ESA and ASI. Prime contractors for Discovery missions are selected by the Principal Investigator (PI) of each mission. In FY02, direct procurement represented 100% of budget authority. **Changes since FY03 Pres. Budget: None.**

| Current Acquisitions | Actual * | Selection Method | Actual * | Performer | Actual * |
|---|---|---|---|---|---|
| Coop.Agreemnt. | 0% | Full & Open Competition | 15% | Industry | 5% |
| Cost Reimbursable | 100% | Sole Source | 85% | Government | 0% |
| Fixed Price | 0% | | 100% | NASA Intramural | 0% |
| Grants | 0% | | | University | 95% |
| Other | 0% | Sci Peer Review | 100% | Non Profit | 0% |
| * as % of FY02 direct procurement | 100% | * as % of FY02 direct procurement | | * as % of FY02 direct procurement | 100% |

| Future Acquisitions - Major | % of Project | Selection | Goals |
|---|---|---|---|
| 1. CSOC recompetition | 85% | Late 2003 | 100% Full & Open Competition |

## AGREEMENTS

Internal: NASA has a MOA in place among the Office of Space Science, Office of Space Flight, Office of Earth Science, and the Office of Aerospace and Technology regarding Space Communication responsibilities.
External: NASA has international agreements with the European Space Agency (ESA); the German, French, and Italian Space Agencies (DLR, CNES and ASI); and the countries of Spain and Australia. **Changes since FY03 Pres. Budget: None.**

## INDEPENDENT REVIEWS

| Types of Review | Performer | Last Review | Next Review | Purpose |
|---|---|---|---|---|
| Independent Implementation | IRT | May-02 | Mar-03 | Cassini - progress and risk assessment |
| Independent Implementation | IRT | N/A | TBD | DSMS - progress and risk assessment |
| Independent Annual Review | IRT | Sep-02 | Sep-03 | Validate performance of Discovery program against PCAs |

## BUDGET

| Budget Authority ($M) | FY02 | FY03 | FY04 | Comments |
|---|---|---|---|---|
| FY 2004 President's Budget | 119.9 | 310.6 | 309.9 | |
| Stardust | 3.5 | 4.6 | 5.3 | |
| Genesis | 6.0 | 7.2 | 8.2 | |
| Contour | | 2.4 | | |
| Galileo | 1.5 | | | |
| DS-1 | 0.3 | | | |
| Messenger | | | 3.0 | |
| Deep Impact | | | 6.9 | |
| Dawn | | | | |
| Cassini | 30.7 | 31.5 | 30.3 | |
| DSN expansion | 22.0 | 15.3 | 0.7 | |
| DSMS | 55.9 | 249.6 | 255.5 | |
| Changes since FY 03 Pres. Budget | +6.8 | +0.0 | -3.5 | ***Reason for Change:*** |
| Stardust | | | +0.3 | |
| Genesis | -0.2 | | +2.0 | growth |
| Contour | | | -2.0 | spacecraft lost |
| Messenger | | | +0.1 | full cost |
| Deep Impact | | | +0.1 | full cost |
| Dawn | | | | new mission selection |
| Cassini | +1.0 | | +1.0 | full cost |
| DSN expansion | +7.0 | | | |
| DSMS | -1.0 | | -5.0 | includes transfer to Optical Comm |

Indicates budget numbers in full cost.
Indicates changes since the FY 2003 President's Budget Submit.
FY 2002 and FY 2003 are not in full cost.

**THEME:** Solar System Exploration (SSE)

# RESEARCH

## PURPOSE

| Objectives | | Performance Measures |
|---|---|---|
| 1.4, 5.1, 5.2, 5.3, 6.1, 6.2, 6.3, 6.4, 7.1, 7.2 | Reference 2003 Strategic Plan | 4SSE2, 4SSE4-21 |

SSE research develops the theoretical tools and laboratory data needed to analyze flight data, makes possible new and better instruments to fly on future missions, and analyzes the data returned so that we can answer specific questions posed and fit this new knowledge into the overall picture of the solar system.

## OVERVIEW

The SSE research element funds a variety of programs, including SSE Reseach and Analysis (R&A), the analysis of data (DA) from SSE operating missions, and the science data tools and archives needed to perform and catalog the research. DA programs are tied to specific missions, which are focused on the achievement of specific strategic objectives. The scope of R&A programs is generally wider because they must provide the new theories and instrumentation that enable the next generation of flight missions. The alignment of reseach programs with SSE strategic goals is ensured through two mechanisms. First, NASA Research Announcements soliciting R&A proposals contain explicit prioritization criteria with respect to Enterprise objectives. Second, the entire R&A program is reviewed triennially to assess the science quality and productivity of the major components and to adjust plans to best support Enterprise goals. Data Analysis (DA) programs have traditionally been performed by mission instrument teams and interdisciplinary scientists competitively selected for an individual mission for the lifetime of that mission. The DA program includes annual, open and competitive solicitations to all missions that can accommodate "guest investigations."

For more information, go to: http://spacescience.nasa.gov/missions/index.htm
http://research.hq.nasa.gov/code_s/code_s.cfm
http://ssds.nasa.gov/

## PROGRAM MANAGEMENT

NASA Headquarters is responsible for the SSE Research Program. Enterprise Official is Ed Weiler, Associate Administrator for Space Science at Headquarters. Theme Director and point of contact is Colleen Hartman, Director of the Solar System Exploration Division at Headquarters. This program is in full compliance with NPG7120.5B.

## TECHNICAL COMMITMENT

Content of SSE Data Analysis and Research and Analysis is defined in each individual mission PCA or NASA Research Announcement.

| Technical Specifications | FY04 President's Budget | Change from Baseline |
|---|---|---|
| | The OSS Strategic Planning process specifies a series of goals, strategic objectives and research focus areas. The OSS Strategic Plan draws from the Solar System Exploration Decadal Survey (NRC), as well as the road mapping activities by the Solar System Exploration Subcommittee (SSES). All selections processes and reviews of the elements of the SSE research program use these strategic items as guide posts for selection and/or continuation. Proposals for research must relate to these strategic items. | -- |

| Schedule | FY04 President's Budget | Change from Baseline |
|---|---|---|
| R & A | | |
| Research Opportunities In Space Science (ROSS) | Yearly in Feb. | -- |
| Data Analysis | | |
| Senior Reviews | Every Two Years | -- |

**THEME:** Solar System Exploration (SSE)

# RESEARCH

## ACQUISITION STRATEGY & PERFORMING ORGANIZATIONS

The Research and Analysis (R&A) and Data Analysis (DA) programs make awards following peer reviewed competitions under NASA Research Announcements (NRAs), Announcements of Opportunity (AOs) and Cooperative Agreement Notices (CANs). In FY 02, direct procurement represented 100% of budget authority. **Changes since FY 2003 President's Budget: None.**

| Current Acquisitions | Actual * | Selection Method | Actual * | Performer | Actual * |
|---|---|---|---|---|---|
| Cooperative Agreements | 12% | Full & Open Competition | 98% | Industry | 6% |
| Cost Reimbursable | 48% | Sole Source | 2% | Government | 5% |
| Fixed Price | 1% | | 100% | NASA Intramural | 5% |
| Grants | 30% | | | University | 73% |
| Other | 9% | Sci Peer Review | 100% | Non Profit | 11% |
| * as % of FY02 direct procurement | 100% | * as % of FY02 direct procurement | | * as % of FY02 direct procurement | 100% |

| Future Acquisitions - Major | Selection | Goals |
|---|---|---|
| 1. Annual R&A research announcement | late 2003 | 100% Science Peer Review |

## AGREEMENTS

*Internal:* The program is not dependent on other NASA activities outside of the control of the Associate Administrator for Space Science. *External:* Cassini and Rosetta Data Analysis involve agreements with the European Space Agency. **Changes since FY03 Pres. Budget: None.**

## INDEPENDENT REVIEWS

| Types of Review | Performer | Last Review | Next Review | Purpose |
|---|---|---|---|---|
| MO&DA Senior Review | Sr. Review committee | July 2000 | summer 2003 | To recommend approval and funding level for extending the science investigations of the operating SSE missions. |
| R&A peer review | peer review committee | summer 2002 | summer 2003 | To review SSE proposals to the annual R&A announcement. |

## BUDGET

| Budget Authority ($ in millions) | FY02 | FY03 | FY04 | Comments |
|---|---|---|---|---|
| FY 2004 President's Budget | 226.9 | 254.7 | 321.7 | |
| Cassini DA | 31.6 | 33.4 | 45.1 | |
| Miscellaneous DA | 22.9 | 29.6 | 32.3 | |
| SSE R&A | 172.4 | 191.7 | 244.3 | |
| Changes since FY 03 Pres. Budget | -6.1 | | +38.1 | ***Reason for Change:*** |
| Cassini DA | | | +2.1 | full cost |
| Miscellaneous DA | | | +2.2 | full cost; CONTOUR lost |
| SSE R&A | -6.1 | | +33.8 | HQ support reduced in 02; full cost |

Indicates budget numbers in full cost.

Indicates changes since the FY 2003 President's Budget Submit.

FY 2002 and FY 2003 are not in full cost.

| THEME: | Solar System Exploration (SSE) |
|---|---|

# TECHNOLOGY AND ADVANCED CONCEPTS

## PURPOSE

| Objectives | | Performance Measures |
|---|---|---|
| 1.4, 5.1, 5.2, 5.3 | Reference 2003 Strategic Plan | 4SSE4-13 |

The SSE Technology and Advanced Concepts effort develops advanced technologies needed for specific science missions. This process begins with mission studies -- the first phase of the flight program development process. In this phase, scientists work collaboratively with technologists and mission designers to develop the most effective alignment of technology development programs with future mission requirements. This collaboration enables intelligent technology investment decisions through detailed analysis of the trade-offs between design considerations and cost. Technologies critical to the success of future SSE missions include, but are not limited to, new propulsion systems that have greater power and efficiency, advanced communications systems, and advanced avionics capabilities.

## OVERVIEW

The goal of the **In-Space Propulsion (ISP)** program is to develop alternative, more efficient propulsion systems.

The goal of **Project Prometheus** is to develop spacecraft power and propulsion systems that use nuclear power sources. In FY04 the *Jupiter Icy Moons Orbiter (JIMO)* will begin as a new initiative under Project Prometheus. Exploring the habitable water worlds of Jupiter, the spacecraft will search for evidence of global oceans on the Jovian moons Europa, Ganymede and Callisto. JIMO will demonstrate the advantages of using nuclear power and propulsion, setting the stage for the next phase of exploring Jupiter and the rest of the outer solar system.

Another new initiative in FY04 is the development of **Optical Communications** technology. This initiative will improve the communication data rate and lower the cost per byte of data returned by many orders of magnitude. While nuclear propulsion will enable us to get to targets more quickly and nuclear power will allow for extended orbital or surface stay times, optical communication will allow the return of much larger quantities of data.

Besides these core technology programs, Technology and Advanced Concepts also supports the selection of future **Discovery** and **New Frontiers** missions. During FY 2002, the program also supported the **New Horizons Pluto/Kuiper Belt** mission study.

| | |
|---|---|
| SSE TECHNOLOGY Homepage: | http://solarsystem.nasa.gov/technology/tech.html |
| NEW FRONTIERS Homepage: | http://centauri.larc.nasa.gov/newfrontiers/ |
| Discovery Acquisition Homepage: | http://discovery.larc.nasa.gov/discovery/ |
| PLUTO-KUIPER BELT Homepage: | http://solarsystem.nasa.gov/missions/pluto_missns/pluto-pkb.html |

## PROGRAM MANAGEMENT

Enterprise Official is Ed Weiler, Associate Administrator for Space Science at Headquarters. Theme Director and point of contact is Colleen Hartman, Director of the Solar System Exploration Division at Headquarters. This program is in full compliance with NPG7120.5B.

## TECHNICAL COMMITMENT

Project technical baselines are defined by the individual Formulation Authorization Document (FAD), Program Commitment Agreement (PCA) or equivalent documentation.

| Technical Specifications | FY04 President's Budget | Change from baseline |
|---|---|---|
| In-Space Propulsion | Develop alternative, more efficient propulsion systems | -- |
| Project Prometheus: Nuclear Power | Develop power systems that use nuclear energy (radioisotope) | -- |
| Project Prometheus: Nuclear Propulsion | Develop propulsion systems that use nuclear energy (fission) | -- |
| Project Prometheus: JIMO | Use nuclear electric propulsion to conduct an in-depth exploration of Jupiter's icy moons and search for evidence of life | N/A |
| SSE Tech (formerly X-2000) | Develop new remote sensing, autonomy, and comm technologies | -- |
| Future Discovery | Lower-cost, highly focused planetary science investigations | -- |
| New Frontiers | Science-driven, mid-sized planetary missions | -- |
| Optical Communications | Develop prototype system to be demonstrated on Mars '09 mission | N/A |
| New Horizons (PKB) Study | Study mission to visit the planet Pluto and its satellite Charon | -- |

| THEME: | Solar System Exploration (SSE) |
|---|---|

## TECHNOLOGY AND ADVANCED CONCEPTS

### TECHNICAL COMMITMENT

Project technical baselines are defined by the individual Formulation Authorization Document (FAD), Program Commitment Agreement (PCA) or equivalent documentation.

| Technical Specifications | FY04 President's Budget | Change from baseline |
|---|---|---|
| In-Space Propulsion | Develop alternative, more efficient propulsion systems | -- |
| Project Prometheus: | | |
| Nuclear Power | Develop power systems that use nuclear energy (radioisotope) | -- |
| Nuclear Propulsion | Develop propulsion systems that use nuclear energy (fission) | -- |
| JIMO | Use nuclear electric propulsion to conduct an in-depth exploration of Jupiter's icy moons and search for evidence of | N/A |
| SSE Tech (formerly X-2000) | Develop new remote sensing, autonomy, and comm technologies | -- |
| Future Discovery | Lower-cost, highly focused planetary science investigations | -- |
| New Frontiers | Science-driven, mid-sized planetary missions | -- |
| Optical Communications | Develop prototype system to be demonstrated on Mars '09 mission | N/A |
| New Horizons (PKB) Study | Study mission to visit the planet Pluto and its satellite Charon | -- |

| Schedule | FY04 President's Budget | Change from Baseline |
|---|---|---|
| In-Space Propulsion | Ongoing | -- |
| Project Prometheus: Nuclear Power | DOE select contractor for Multi-Mission Radioisotope Thermoelectric Generator (MMRTG) dev't - 2nd Qtr 03 | -- |
| Project Prometheus: Nuclear Power | Stirling Radioisotope Generator PDR - FY 04 | -- |
| Project Prometheus: Nuclear Propulsion | Completion of Phase 1 of Technology NRA work - FY 04 | -- |
| Future Discovery | AO release spring 2003 | -- |
| New Frontiers | Conduct first full and open mission competition | -- |
| Optical Communications | TBD | N/A |

### ACQUISITION STRATEGY & PERFORMING ORGANIZATIONS

Major acquisitions in FY 2002 included a selection for the Next Generation Ion Engine for the ISP program. In FY02, direct procurement represented 100% of budget authority.
**Changes since FY03 Pres. Budget: none.**

| Current Acquisitions | Actual * | Selection Method | Actual * | Performer | Actual * |
|---|---|---|---|---|---|
| Cooperative Agreements | 0% | Full & Open Competition | 74% | Industry | 12% |
| Cost Reimbursable | 79% | Sole Source | 26% | Government | 15% |
| Fixed Price | 2% | | 100% | NASA Intramural | |
| Grants | 0% | | | University | 62% |
| Other | 19% | Sci Peer Review | 100% | Non Profit | 11% |
| * as % of FY02 direct procurement | 100% | * as % of FY02 direct procurement | | * as % of FY02 direct procurement | 100% |

| Future Acquisitions - Major | Selection | Goals |
|---|---|---|
| 1. NRA selection for Nuclear Power | 1st Qtr 2003 | 100% Full & Open Competition |
| 2. NRA selection for Nuclear Propulsion | SEP 2002 | 100% Full & Open Competition |
| 3. NRA selection for High Power Instruments | 4th Qtr 2003 | 100% Full & Open Competition |
| 4. RFP for JIMO Phase A | 4th Qtr 2003 | 100% Full & Open Competition |
| 5. Aerocapture | Fall 2002 | 100% Full & Open Competition |
| 6. Solar Sails | Fall 2002 | 100% Full & Open Competition |
| 7. Advanced Chemical | Summer 2003 | 100% Full & Open Competition |

### AGREEMENTS

*Internal:* The program is not dependent on other NASA activities outside of the control of the Associate Administrator for Space Science. *External:* Project Prometheus is currently working on a Memorandum of Agreement with the Department of Energy. **Changes since FY03 President's Budget: None.**

**THEME:** Solar System Exploration (SSE)

# TECHNOLOGY AND ADVANCED CONCEPTS

## INDEPENDENT REVIEWS

| Types of Review | Performer | Last Review | Next Review | Purpose |
|---|---|---|---|---|
| ISP: Independent Technology Assessment | SSE Subcomm. Tech. Assessment Group | JUL 2002 | JUL 2003 | Evaluate and prioritize ISP technologies |
| Optical Communication: Independent Technology | SSE Subcomm. Tech. Assessment | N/A | 2nd Qtr 2003 | Evaluate and prioritize Optical Communication technology |

## BUDGET

| Budget Authority ($ in millions) | FY02 | FY03 | FY04 | Comments |
|---|---|---|---|---|
| FY 2004 President's Budget | 81.5 | 246.1 | 550.4 | |
| ISP | 19.6 | 62.5 | 75.0 | |
| Project Prometheus | | 125.5 | 279.2 | |
| JIMO | | | 92.6 | New Initiative - JIMO (part of Project Prometheus) |
| Nuclear Power | | 46.5 | 55.7 | |
| Nuclear Propulsion | | 79.0 | 130.9 | |
| Optical Communications | | | 31.2 | New Initiative - Optical Communications |
| X-2000 | 24.1 | 30.0 | 10.8 | |
| Other SSE Tech | 6.9 | | | |
| Future Discovery | 0.9 | 13.1 | 24.0 | |
| New Frontiers | | 15.0 | 130.2 | |
| New Horizons (PKB) | 30.0 | | | |
| Changes since FY 03 Pres. Budget | -9.4 | -61.8 | -88.6 | ***Reason for Change:*** |
| ISP | | | +8.3 | full cost |
| Project Prometheus | | | +64.7 | |
| JIMO | | | +92.6 | New Initiative - JIMO (part of Project Prometheus) |
| Nuclear Power | | -32.5 | -5.3 | full cost; 04 deferral |
| Nuclear Propulsion | | +32.5 | -22.6 | full cost; 04 deferral |
| Optical Communications | | | +31.2 | New Initiative - Optical Communications |
| X-2000 | -6.7 | | -16.7 | redirected to other priorities |
| Other SSE Tech | +6.4 | | | |
| Future Discovery | -9.1 | -61.8 | -151.3 | selected Dawn and Kepler |
| New Frontiers | | | -24.8 | lower flight rate planned |

Indicates budget numbers in full cost.
Indicates changes since the FY 2003 President's Budget Submit.
FY 2002 and FY 2003 are not in full cost.

This picture shows gullies on the walls of an impact crater in Newton Basin in Sirenum Terra, Mars. Similar gullies have been observed in numerous locations across Mars. Gullies in craters originate at a specific layer and may have formed by the release of groundwater to the Martian surface in geologically recent times. The potential presence of water means life might currently be present on Mars. Water on Mars could also be a valuable resource for future exploration. More information can be found at http://mars.jpl.nasa.gov/

# MARS EXPLORATION

## MAJOR EVENTS IN FY 2004

- Mars Exploration Rovers arrive at Mars in January 2004 and will begin science operations. The Rovers are designed to last for 90 days of surface operations and should travel about 600 meters during that time.
- Mars Reconnaissance Orbiter will begin integration and test in preparation for launch in 2005.

## THEME: Mars Exploration Program (MEP)

### OVERVIEW

The Mars Exploration Program (MEP) is a science-driven effort to understand and characterize Mars as a dynamic system, including its past and present geology, interior, climate, environment, and its biological potential. The MEP program seeks to characterize the habitability of Mars and determine whether it was ever or still is inhabited by forms of life. The compelling discoveries expected from the MEP may warrant scientific exploration by humans in the future. The MEP missions will contribute knowledge and capabilities necessary to enable such possibility. The FY04 budget request will enable NASA to operate existing assets at Mars (Mars Global Surveyor and Odyssey), support the operations and landing of the Mars 2003 Rovers, provide science and operational support for Mars Express and ASPERA-3, continue development of the 2005 Mars Reconnaissance Orbiter mission, and continue to invest in Education and Public Outreach (E&PO), technology, R&A, and advanced studies for future missions.

| Missions | Goals supported by this theme | Objectives supporting those goals |
|---|---|---|
| Explore the Universe and Search for Life | 5. Explore the solar system and the universe beyond, understand the origin and evolution of life, and search for evidence of life elsewhere. | 5.4 Understand the current state and evolution of the atmosphere, surface, and interior of Mars.<br>5.5 Determine if life exists or has ever existed on Mars.<br>5.6 Develop an understanding of Mars in support of possible future human exploration. |
| Inspire the Next Generation of Explorers | 6. Inspire and motivate students to pursue careers in science, technology, engineering, and mathematics. | 6.1 Improve student proficiency in science, technology, engineering and mathematics using educational programs, products and services based on NASA's unique missions, discoveries and innovations. (Supporting Role)<br>6.2 Motivate K-16+ students from diverse communities to pursue science and math courses and ultimately college degrees in science, technology, engineering, and mathematics. (Supporting Role)<br>6.3 Improve science, technology, and mathematics instruction with unique teaching tools and experiences that only NASA can provide, that are compelling to teachers and students. (Supporting Role)<br>6.4 Improve higher education capacity to provide for NASA's and the Nation's future science and technology workforce requirements. (Supporting Role) |
| | 7. Engage the public in shaping and sharing the experience of exploration and discovery. | 7.1 Improve the capacity of science centers, museums, and other institutions, through the development of partnerships, to translate and deliver engaging NASA content. (Supporting Role)<br>7.2 Improve science literacy by engaging the public in NASA missions and discoveries, and their benefits, through such avenues as public programs, community outreach, mass media, and the Internet. (Supporting Role) |
| Space Flight Capabilities | 9. Extend the duration and boundaries of human space flight to create new opportunities for exploration and discovery. | 9.5 Create innovative approaches and concepts to inform future decisions concerning systems, infrastructures and missions for human and robotic exploration of space. (Supporting Role) |

### RELEVANCE

The MEP will characterize another silicate planet which, like Earth, bears an atmosphere, and investigate the variability of its climate. This work will provide a quantitative basis for interplanetary comparative climatology.

The MEP seeks to understand the "habitability of a silicate planet" and to develop predictive models that pertain to sustainability and habitability. Current scientific knowledge suggests that the conditions for the onset of terrestrial life existed in the early history of Mars (as on Earth) and subsequently planetary evolution caused a divergence. Preserved climatologically and geological records on Mars may be relevant to the earliest history and sustainability of life on Earth. MEP will integrate investigations of climate, geology, and global thermal evolution to focus the search for evidence of life in accessible places on Mars. The investigation by the MEP as to whether Mars ever harbored any kind of life contributes to NASA's overall efforts to explore the Universe and search for life. By careful study of the planet, we may generate a level of understanding that will enable us to better understand and predict the environmental evolution and habitability of planet Earth.

## THEME: Mars Exploration Program (MEP)

### RELEVANCE (continued)

The MEP is the world's only comprehensive program designed to collect and interpret such a broad panoply of scientific knowledge concerning another planet, while setting the context to answer whether life exists elsewhere other than Earth. Mars, by its visible presence, appeals to the imagination, and its regular close proximity to the Earth (every 26 months) makes it a unique frontier than can be explored by robots, and perhaps eventually by humans. The MEP represents one of the U.S. government's strongest efforts to inspire the next generations of scientists, engineers, and explorers.

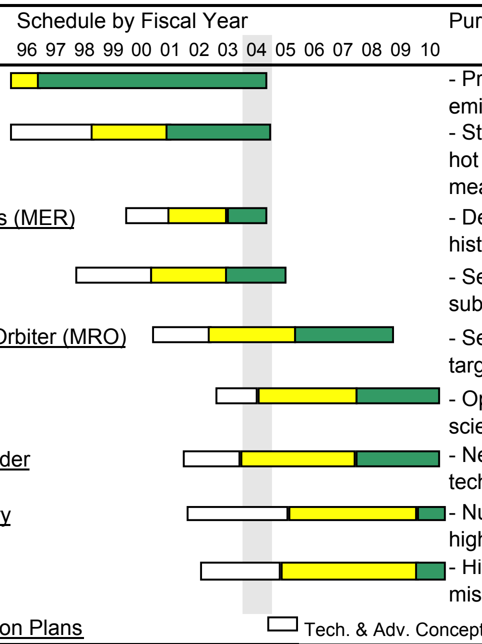
#### Education and Public Benefits

Public benefits from MEP include understanding another world whose evolution is likely to have been similar to Earth's (where all records of the first 1 billion years have been eradicated). Developing technologies and know-how to enable a comprehensive physics- and chemistry-based search for evidence of life, including non-Earth-centric varieties, is of intrinsic value. Discovering that life exists any place other than Earth would be a profound revelation of historic importance, altering humanity's perception of its place in the universe. A scientific understanding of the potential evolution (and potential demise) of life on Mars is directly relevant to the habitability of Earth. Mars exploration technology is also applicable to other solar system missions, to Earth observation, and potentially to biological research on Earth, including mechanisms for detection and mitigation of bioterrorism.

### IMPLEMENTATION

The Mars Exploration Program theme is composed of many elements that work together to achieve the program's goals and objectives. Repeated management and scientific peer reviews ensure that each mission provides data in a cost-effective manner. In many cases, the data obtained from different missions are complementary, and are combined in cross-disciplinary studies by members of the scientific community.

Theme responsibility is in the NASA HQ Office of Space Science. The Enterprise official is Dr. Edward Weiler, Associate Administrator for Space Science. The Theme Director and Point of Contract is Mr. Orlando Figueroa, Director of the Mars Exploration Program at HQ. This theme is in full compliance with NPG7120.5B.




| Strategy | Purpose |
|---|---|
| Mars Global Surveyor (MGS) | - Provide global visible, topographic and thermal emission spectroscopy data of Mars |
| 2001 Mars Odyssey | - Study mineralogic, elemental, chemical, thermal hot spots, and near environment radiation measurements at global scales |
| 2003 Mars Exploration Rovers (MER) | - Determine the aqueous, climatic, and geologic history of 2 sites on Mars |
| Mars Express | - Search for prel. evidence of water in the subsurface and as surface deposits |
| 2005 Mars Reconnaissance Orbiter (MRO) | - Search for local evidence of water at globally targeted sites, and monitor climate |
| 2007 Mars Scout | - Openly competed mission flight opportunity for the science community |
| 2007 CNES Orbiter & NetLander | - Network science, and orbital science and technology demonstration |
| 2009 Mars Science Laboratory | - Nuclear powered mobile analytical laboratory at high priority site |
| 2009 Telecom Orbiter | - High data rate telecomm capability to support Mars missions |

Link to Program Implementation Plans

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

# THEME: Mars Exploration Program (MEP)

## STATUS

The Mars Exploration Program accomplished the following this past year:
- Mars Global Surveyor started second science mission extension;
- Odyssey was inserted into Mars science orbit successfully with all the instruments fully operational;
- 2003 Mars Exploration Rovers completed critical design phase and started Assembly, Test, Launch Operations (ATLO) in preparation for launches in May and June of 2003;
- Delivered to ESA the Mars Express instruments (Radar Sounder [MARSIS] Antenna and Transmitter and RF subsystems);
- Mars Reconnaissance Orbiter completed its formulation phase successfully;
- Released an Announcement of Opportunity (AO) for the 2007 Mars Scout mission; 25 proposals received, with 4 selected for concept studies in December 2002;
- Released Mars Instrument Develoment Program (MIDP) NRA; 15 proposals selected in late August 2002 for award; and
- Released Mars Fund. Research Program NRA; 93 proposals received in May 2002, with 31 selected for award.

By February of 2003, the Mars Exploration Program will have:
- Completed Mars Reconnaissance Orbiter instruments Critical Design Reviews (CDR); and
- Started preship review for Mars Exploration Rovers.

## PERFORMANCE MEASURES

| Annual Performance Goals | |
|---|---|
| | OUTCOME: A well managed program in accordance with Agency implementing strategies. |
| 4MEP1 | Each Development project will complete its current phase within 10% of total life-cycle cost shown on the table below. |
| 4MEP2 | Each Research project will allocate 75% of its funding competitively during FY04. |
| 4MEP3 | MEP will complete all of its missions within 10% of their baseline schedules. |
| 5.4.1 | OUTCOME: Understand the current state and evolution of the atmosphere, surface, and interior of Mars. |
| 4MEP4 | Successfully demonstrate progress in characterizing the present climate of Mars and determine how it has evolved over time.<br>Progress towards achieving outcomes will be validated by external review. |
| 4MEP5 | Successfully demonstrate progress in investigating the history and behavior of water and other volatiles on Mars.<br>Progress towards achieving outcomes will be validated by external review. |
| 4MEP6 | Successfully demonstrate progress in studying the chemistry, mineralogy, and chronology of martian materials.<br>Progress towards achieving outcomes will be validated by external review. |
| 4MEP7 | Successfully demonstrate progress in determining the characteristics and dynamics of the interior of Mars.<br>Progress towards achieving outcomes will be validated by external review. |
| 5.5.1 | OUTCOME: Determine whether life exists or has ever existed on Mars. |
| 4MEP8 | Successfully demonstrate progress in investigating the character and extent of prebiotic chemistry on Mars.<br>Progress towards achieving outcomes will be validated by external review. |
| 4MEP9 | Successfully demonstrate progress in searching for chemical and biological signatures of past and present life on Mars.<br>Progress towards achieving outcomes will be validated by external review. |
| 5.6.1 | OUTCOME: Develop an understanding of Mars in support of possible future human exploration. |
| 4MEP10 | Successfully demonstrate progress in identifying and studying the hazards that the martian environment will present to human explorers.<br>Progress towards achieving outcomes will be validated by external review. |
| 4MEP11 | Successfully demonstrate progress in inventorying and characterizing martian resources of potential benefit to human exploration of Mars.<br>Progress towards achieving outcomes will be validated by external review. |
| 6.1.1 | OUTCOME: Kindergarten through graduate students will be more proficient in science, technology, engineering, and mathematics (STEM). |
| 4MEP12 | Provide opportunities for students to work directly with NASA space science missions, facilities, and data. |
| 6.2.1 | OUTCOME: More students from diverse communities motivated to pursue careers in STEM. |
| 4MEP13 | Provide new opportunities for participation in the space science program by an increasingly diverse population, including for minorities and minority universities to compete for and participate in space science missions, research, and education programs. |

## THEME: Mars Exploration Program (MEP)

### PERFORMANCE MEASURES (continued)

| Annual Performance Goals | |
|---|---|
| 6.3.1 | OUTCOME: Improve quality of STEM instruction. |
| 4MEP14 | Provide high quality educational materials and teacher training based on Theme content and focused on national curriculum standards. |
| 4MEP15 | Provide exhibits, materials, workshops, and personnel at national and/or regional education and outreach conferences. |
| 6.4.1 | OUTCOME: More students prepared to enter the STEM workforce. |
| 4MEP16 | Provide higher education opportunities offered through OSS research awards and other NASA research and education programs. |
| 7.1.1 | OUTCOME: Improve the capacity of science centers, museums, and other institutions, through the development of partnerships, to translate and deliver engaging NASA content. |
| 4MEP17 | Through partnerships with major science museums or planetariums, put on display or on tour major exhibitions or planetarium shows based on Theme content. |
| 4MEP18 | Provide materials and technical expertise to support the development of exhibits and programs at science museums and planetariums. |
| 7.2.1 | OUTCOME: Engage the public in NASA missions and discoveries through such avenues as public programs, community outreach, mass media, and the Internet. |
| 4MEP19 | Seek out and capitalize on special events and particularly promising opportunities in the Theme science program to bring space science to and involve the public in the process of scientific discovery. |
| 9.5.2 | OUTCOME: Develop innovative approaches and concepts to inform future decisions concerning systems, infrastructures and missions for human and robotic exploration of space. |
| 4MEP20 | Develop advanced concepts for Mars missions where human intervention can significantly increase the scientific return, and develop a technology roadmap for critical technologies that can be demonstrated effectively in the robotic program. |

### INDEPENDENT REVIEWS

| Types of Review | Performer | Last Review | Next Review | Purpose |
|---|---|---|---|---|
| COMPLEX | NRC | 1999 | N/A | MEP architecture, scientific strat./implem. |
| MEP Independent Assessment Team | Tom Young Committee | 1999 | N/A | MEP architecture, scientific strat./implem. MEP architecture, scientific strat./implem. |
| Nat'l Academy | Space Study Board | 7/02 | N/A | Effectiveness and quality of the program. |
| Advisory Council | NAC | 9/02 | Annually | Report progress towards science goals, and assess implementation strategies. |
| | SsAC | 8/02 | 3 times/year | Report progress towards science goals, and assess implementation strategies. |
| | Solar System Sub-Committee | 9/02 | 3 times/year | Report progress towards science goals, and assess implementation strategies. |
| Mars Exploration Program Analysis Group (MEPAG) | Peer/Mars Scientist | 9/02 | 2 times / year | Refine and evaluate the scientific objectives and research focus areas. |

### BUDGET

| Budget Authority ($millions) | FY02 | FY03 | Chng | FY04 | Comments |
|---|---|---|---|---|---|
| **Mars Exploration Program** | **456.9** | **495.5** | **74.8** | **570.3** | |
| Development | 342.8 | 266.5 | -72.7 | 193.8 | |
| 2003 Mars Exploration Rovers | 277.6 | 113.9 | -113.9 | 0.0 | Launch in May/June 2003. |
| 2005 Mars Reconnaissance Orbiter | 58.0 | 143.5 | +40.0 | 183.5 | Start full scale development in FY04. |
| Mars Small Missions - under $100M | 7.2 | 9.1 | +1.2 | 10.3 | |
| - Mars Express | 4.4 | 3.4 | -3.4 | 0.0 | Launch June 2003. |
| - ASPERA-3 | 0.6 | 0.5 | -0.5 | 0.0 | Launch June 2003. |
| - NetLander | 2.2 | 5.2 | +5.1 | 10.3 | Start full scale development. |
| Operations | 24.8 | 26.0 | +18.8 | 44.8 | MER launches in May & June 2003, and will |
| Technology and Advanced Concepts | 65.9 | 177.5 | +97.9 | 275.4 | start mission Ops. |
| Research | 23.4 | 25.5 | +30.7 | 56.2 | |

Note: For all formats, the FY 02 column reflects the FY 2002 Congressional Operating Plan dated 9/30/02. The FY 03 column reflects the FY 2003 Presidents Budget Submit (PBS) as Amended. The Change column includes both programmatic and full cost adjustments. FY 2004 column is in full cost.

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**THEME:** Mars Exploration Program (MEP)

# DEVELOPMENT: 2003 Mars Exploration Rovers

## PURPOSE

| Objectives — Reference 2003 Strategic Plan | Performance Measures |
|---|---|
| 5.4; 5.6; 6.1 thru 6.4; 7.1; 7.2 | 4MEP1,3,5,6,12-19 |

The goal of both Mars Exploration Rovers (MERs) will be to learn about the history of ancient water and its role in the geology and climate of Mars. The rovers (MER-A and B) will be robotic field geologists, equipped to read the geologic record at their landing sites and to learn what the conditions were like when the rocks and soils there were formed. They will also have the mobility to travel up to 600 meters across the Martian landscapes measuring the chemical character of the soils, rocks, and even the previously inaccessible interiors of rocks where unaltered materials may lie.

## OVERVIEW

The Mars Exploration Rover-2003 mission consists of two identical flight systems, a launch vehicle for each flight system, and the terrestrial ground data processing stations. Each flight system consists of an Earth-Mars cruise spacecraft, entry-descent-landing system, and a mobile science rover with an integrated instrument package. The two flight systems, known as MER-A and MER-B, will be launched in May/June 2003 and June/July 2003 from the Eastern Test Range at Cape Canaveral, Florida.

http://mars.jpl.nasa.gov/missions/future/2003.html

## PROGRAM MANAGEMENT

The Mars Exploration Rover-2003 Project is organized and managed as a project within the Mars Exploration Program (MEP) at the Jet Propulsion Lab (JPL). JPL has the end-to-end responsibility for program implementation. The Agency Program Management Council (PMC) has MER governing responsibility. The Enterprise official is Dr. Edward Weiler, Associate Administrator for Space Science at HQ. The Theme Director and the Point of Contact is Mr. Orlando Figueroa, Director of the Mars Exploration Program at HQ. This project is in full compliance with NPG7120.5B

## TECHNICAL COMMITMENT

Baseline Commitment as of 02/2001. Mars Exploration Program Plan: Program Level Requirements for the Mars Exploration Rover-2003 Project.

| Technical Specifications | FY04 President's Budget | Change from Baseline |
|---|---|---|
| Mission Life | 90 days per rover | -- |
| Launch | Delta 7925-9.5/7925H-9.5 | -- |
| Rover mass | 330lb each | -- |
| Rover Traverse Capability | 600 meters | -- |
| Imaging | Image at least one 360-degree panorama of landing sites, at .3mrad/pixel | -- |

| Schedule | FY04 President's Budget | Change from Baseline |
|---|---|---|
| Mission Selection | 4Q/FY00 | -- |
| Mission PDR | 1Q/FY01 | -- |
| Mission CDR | 4Q/FY01 | -- |
| Start S/C level I&T | 2Q/FY02 | -- |
| Launch - 1st Lander | May/June 2003 | -- |
| Launch - 2nd Lander | June/July 2003 | -- |

**THEME:** Mars Exploration Program (MEP)

# DEVELOPMENT: 2003 Mars Exploration Rovers

## ACQUISITION STRATEGY & PERFORMING ORGANIZATIONS

The MER Project is being implemented in an "in-house" mode at JPL. Approximately 49% of the budget allocated for the Project goes out of house. The rover science instruments, which have been selected and procured following an open Announcement of Opportunity (AO), will be integrated onto the rovers at JPL. In FY 2002, direct procurement represented 100% of budget authority. **Changes since FY 2003 Pres. Budget: None.**

| Current Acquisitions | Actual * | Selection Method | Actual * | Performer | Actual * |
|---|---|---|---|---|---|
| Cooperative Agreements | 0% | Full & Open Competition | 55% | Industry | 24% |
| Cost Reimbursable | 44% | Sole Source | 45% | Government | 2% |
| Fixed Price | 56% | | 100% | NASA Intra | 0% |
| Grants | 0% | | | University | 74% |
| Other | 0% | Sci Peer Review | 100% | Non Profit | 0% |
| * as % of FY02 direct procurement | 100.0% | * as % of FY02 direct procurement | | | 100% |

| Future Acquisitions - Major | Selection | Goals |
|---|---|---|
| None - all major acquistions are in place | | |

## AGREEMENTS

*Internal:* None. *External:* DOE is responsible for the provision of safety analysis, and safety and emergency response at the launch site related to the Radioactive Heater Units (RHU). Gutenberg University in Germany will be providing the Mossbauer Spectrometer. **Changes since FY 2003 Pres. Budget: None.**

## INDEPENDENT REVIEWS

| Types of Review | Performer | Last Review | Next Review | Purpose |
|---|---|---|---|---|
| Preliminary Mission & System Design Review | NASA IRT; JPL Review | Jun 27-28, 2000 | N/A | Phase A review of Mission Design and project implementation. |
| PDR | NASA IRT; JPL Review | Jan 31-Feb 2 2001 | N/A | Evaluate the technical, cost, and schedule commitments of the project. |
| CDR | NASA IRT; JPL Rev Bd | Aug 21-23, 2001 | N/A | Asses risk posture for technical margins, ATLO obj, and completion w/in budget commitments. |
| Project ATLO Readiness Review | NASA IRT; JPL Rev Bd | Jan 23-24, 2002 | N/A | Assess readiness of major project systems (Science, Flt, Miss. Ops) to enter ATLO phase. |
| Mission Readiness Review | JPL Rev Bd | N/A | May 2003 | Assess the readiness of the project for launch. |

## BUDGET/LIFE CYCLE COST

| Budget Authority ($ in millions) | Prior | FY02 | FY03 | FY04 | FY05 | BTC | Total | Comments |
|---|---|---|---|---|---|---|---|---|
| FY 2004 President's Budget (LCC) | 337.9 | 277.6 | 122.1 | 51.8 | 11.5 | | 800.9 | |
| Phase A | [5.4] | | | | | | [5.4] | |
| Development | 337.9 | 277.6 | 113.9 | | | | 729.4 | |
| Operations | | | 5.9 | 26.6 | 4.5 | | 37.0 | |
| Data Analysis | | | 2.3 | 25.2 | 7.0 | | 34.5 | |
| Changes since FY 03 Pres. Budget | | +32.4 | | +10.7 | -5.5 | | +37.6 | ***Reason for Change:*** |
| - Development | | 32.4 | | | | | 32.4 | Resolving mass & sched prob. |
| - Operations | | | | 0.9 | 0.1 | | 1.0 | |
| - Data Analysis | | | | 9.8 | -5.6 | | 4.2 | Added sci seq contingency. |
| FY 2003 President's Budget (LCC) | 337.9 | 245.2 | 122.1 | 41.1 | 17.0 | | 763.3 | |
| Development | 337.9 | 245.2 | 113.9 | | | | 697.0 | |
| Operations | | | 5.9 | 25.7 | 4.4 | | 36.0 | |
| Data Analysis | | | 2.3 | 15.4 | 12.6 | | 30.3 | |
| Initial Baseline (LCC) | 343.9 | 207.0 | 118.5 | 48.6 | 4.7 | | 722.7 | |
| Development | 343.9 | 207.0 | 106.3 | | | | 657.2 | Includes ELV. |
| Operations | | | 3.6 | 27.3 | 4.7 | | 35.6 | |
| Data Analysis | | | 8.6 | 21.3 | | | 29.9 | |

Indicates budget numbers in full cost.

Indicates changes since the FY 2003 Presidents Budget Submit.

FY 2002, FY 2003, Prior and BTC are not in full cost.

| THEME: | Mars Exploration Program (MEP) |
|---|---|
| **DEVELOPMENT:** | **2005 Mars Reconnaissance Orbiter (MRO)** |

## PURPOSE

| Objectives Reference 2003 Strategic Plan | Performance Measures |
|---|---|
| 5.4; 5.5; 5.6; 6.1 thru 6.4; 7.1; 7.2 | 4MEP1,3-7,9-19 |

The goal of the Mars Reconnaissance orbiter (MRO) is to understand the history of water on Mars by observing the planet's atmosphere, surface, and subsurface in unprecedented detail. This mission will identify the best sites for a new generation of landed vehicles to explore, by virtue of its ability to find local evidence of the chemical and geological "fingerprints" of water and other critical processes. MRO will explore from orbit hundreds of locations on the surface of Mars, observing details that were previously only visible to landers. MRO will focus on locations identified as most promising by Mars Global Surveyor and Odyssey, searching for the presence of surface materials conducive to biological activity or having the potential for preserving biogenic materials.

## OVERVIEW

The MRO will be launched in August 2005 by an intermediate-class expendable launch vehicle from Cape Canaveral Air Station, and will enter Mars Orbit in 2006. The MRO mission will use its science payload and engineering systems to acquire global mapping, regional survey, and globally distributed targeted observations from a low-altitude, near-polar, mid-afternoon (dayside) Mars Primary Science Orbit (PSO). Currently, the goal is to achieve a near-polar 255x320 km PSO with closest approach to Mars over the planet's south pole. The MRO willl observe the planet's surface and atmosphere and explore its upper crust from the PSO during a Primary Science Phase, lasting one Martian year (687 Earth days).

http://mars.jpl.nasa.gov/missions/future/2005-plus.html

## PROGRAM MANAGEMENT

The Mars Reconnaissance Orbiter (MRO) Project is organized and managed as a project within the Mars Exploration Program (MEP) at the Jet Propulsion Lab (JPL). The Agency Program Management Council (PMC) has MRO governing responsibility. The Enterprise official is Dr. Edward Weiler, Associate Administrator for Space Science at HQ. The Theme Director and the Point of Contact is Mr. Orlando Figueroa, Director of the Mars Exploration Program at HQ. This project is in full compliance with NPG7120.5B.

## TECHNICAL COMMITMENT

Baseline Commitment as of 7/02, as established in the Program-Level Requirements for the Mars Reconnaissance Orbiter-2005 (MRO) Project.

| Technical Specifications | FY04 President's Budget | Change from Baseline |
|---|---|---|
| End of Nominal Life | 5.4 years after launch; December 31, 2010 | -- |
| Primary Science Phase | Dec. 2006 thru Dec. 2008 | -- |
| Mass | 2,000 kg | -- |
| Power | 5 kW (Beginning of Mission [BOM] at Earth) | -- |
| Raw Data Volume | 26 Tbits | -- |
| Mapping Targeted Imaging | 30cm/pixel ground sampling monochromatic imaging;<br>< 40m/pixel ground sampling for mineralogical mapping | -- |
| Imaging Capability | <7.5 m/pixel ground sampling context imaging from 300 km alt. | -- |
| Primary science orbit (PSO) | 255 X 320 km | -- |

| Schedule | FY04 President's Budget | Change from Baseline |
|---|---|---|
| Instruments selection | Nov-01 | -- |
| Mission PDR | Jul-02 | -- |
| NAR | Jul-02 | -- |
| Mission CDR | 3Q/FY03 | -- |
| Start S/C level I&T | 3Q/FY04 | -- |
| Ship to launch site | 3Q/FY05 | -- |
| Launch | 4Q/FY05 | -- |

| THEME: | Mars Exploration Program (MEP) |
|---|---|
| **DEVELOPMENT:** | 2005 Mars Reconnaissance Orbiter (MRO) |

## ACQUISITION STRATEGY & PERFORMING ORGANIZATIONS

Lockheed Martin Astronautics (LMA) has been selected to build the spacecraft. The orbiter system contract with LMA for Phase C/D is implemented in the cost plus fixed/incentive fee contract. Launch vehicle procured via a competitive Launch Services Task Order (LSTO) on the NASA Launch Services (NLS) contract. All science investigations and instruments for the MRO mission were competitively selected under a NASA Announcement of Opportunity (AO). In FY 2002, direct procurement represented 100% of budget authority. **Changes since FY 2003 Pres. Budget: None.**

| Current Acquisitions | Actual * | Selection Method | Actual * | Performer | Actual * |
|---|---|---|---|---|---|
| Cooperative Agreements | 0% | Full & Open Competition | 73% | Industry | 54.0% |
| Cost Reimbursable | 99% | Sole Source | 27% | Government | 0.3% |
| Fixed Price | 1% | | 100% | NASA Intramural | 0.2% |
| Grants | 0% | | | University | 45.5% |
| Other | 0% | Sci Peer Review - sci budget | 34% | Non Profit | |
| * as % of FY02 direct procurement | 100% | * as % of FY02 direct procurement | | * as % of FY02 direct procurement | 100.0% |

| Future Acquisitions - Major | Selection | Goals |
|---|---|---|
| No major acquistions planned for FY04. | | |

## AGREEMENTS

*Internal:* Program is not dependent on other NASA activities outside of the control of the Associate Administrator of Space Science. *External:* The Agenzia Spaziale Italiana (ASI) will provide the Shallow Radar (SHARAD) radar for this mission. **Changes since FY 2003 Pres. Budget: None.**

## INDEPENDENT REVIEWS

| Types of Review | Performer | Last Review | Next Review | Purpose |
|---|---|---|---|---|
| Preliminary Mission System | -IPAO | Jan-02 | N/A | Transition from Phase A to Phase B. |
| PDR | -IPAO | Jul-02 | N/A | Transition from Phase B to C/D. |
| Independent Annual Review | -IPAO | Jul-02 | N/A | Evaluates project readiness for implementation. |
| Non-Advocate Review | -SAIC | Jul-02 | N/A | Evaluate formulation planning, tech., & cost b/l |
| CDR | -IPAO Sys. | N/A | Jul-03 | Transition from design to build. |

## BUDGET/LIFE CYCLE COST

Total budget authority represents the Life Cycle Cost (LCC), these figures include concept studies through the end of the prime science mission.

| Budget Authority ($ in millions) | Prior | FY02 | FY03 | FY04 | FY05 | FY06 | FY07 | FY08 | BTC* | Total | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|
| FY 2004 President's Budget (LCC) | 12.0 | 58.0 | 143.5 | 183.5 | 109.1 | 33.7 | 37.8 | 31.1 | 38.2 | 646.9 | |
| Pre-Dev | 12.0 | 58.0 | | | | | | | | 70.0 | |
| Development | | | 143.5 | 183.5 | 103.5 | | | | | 430.5 | |
| Operations | | | | | 4.1 | 22.6 | 20.4 | 16.1 | 30.6 | 93.8 | |
| Data Analysis | | | | | 1.4 | 11.1 | 17.4 | 15.0 | 7.6 | 52.6 | |
| Changes since FY 03 Pres. Budget | | +0.1 | | +10.1 | +5.9 | +1.7 | +1.1 | +31.1 | -28.0 | +22.1 | ***Change Reason:*** |
| - Pre-Dev | | +10.0 | | | | | | | | +10.0 | |
| - Dev | | -9.9 | | +10.1 | +5.7 | | | | | +5.9 | JPL burden rate |
| - MO | | | | | +0.2 | +1.4 | +0.6 | +16.1 | -15.8 | +2.5 | and full cost |
| - DA | | | | | | +0.3 | +0.5 | +15.0 | -12.2 | +3.7 | changes. |
| FY 2003 President's Budget (LCC) | 12.0 | 57.9 | 143.5 | 173.4 | 103.1 | 32.0 | 36.7 | | 66.2 | 624.8 | |
| Pre-Dev | 12.0 | 48.0 | | | | | | | | 60.0 | |
| Development | | 9.9 | 143.5 | 173.4 | 97.8 | | | | | 424.6 | |
| Operations | | | | | 3.9 | 21.2 | 19.8 | | 46.4 | 91.3 | |
| Data Analysis | | | | | 1.4 | 10.8 | 16.9 | | 19.8 | 48.9 | |
| Initial Baseline (LCC) | 12.0 | 58.0 | 147.8 | 175.4 | 103.4 | 32.8 | 36.7 | 30.3 | 36.1 | 632.5 | |
| Pre-Dev | 12.0 | 58.0 | | | | | | | | 70.0 | |
| Development | | | 147.8 | 175.4 | 98.0 | | | | | 421.2 | |
| Operations | | | | | 4.0 | 22.0 | 19.8 | 15.7 | 28.5 | 90.0 | |
| Data Analysis | | | | | 1.4 | 10.8 | 16.9 | 14.6 | 7.6 | 51.3 | |

Indicates budget numbers in full cost.
Indicates changes since the FY 2003 President's Budget Submit.
FY 2002, FY 2003, Prior and BTC are not in full cost.

**THEME:** Mars Exploration Program (MEP)

# DEVELOPMENT: Mars Exploration Program Small Development Projects

## PURPOSE

| Objectives | | Performance Measures |
|---|---|---|
| 5.4; 5.6; 6.1 thru 6.4; 7.1; 7.2 | Reference 2003 Strategic Plan | 4MEP1,3-5,7,10,12-19 |

The Red Planet is a source of intrigue and fascination, currently the only other planet where a strong possibility of finding life exists--past or present. NASA is part of two major international missions; ESA Mars Express and CNES Premier 2007 (NetLander). The overall science objective is to understand the fate of the Martian water supply. This is crucial in resolving the mystery of whether life ever existed on Mars.

## OVERVIEW

NASA is part of the Mars Express, an European Space Agency(ESA) and Agenzia Spaziale Italiana (ASI) planned mission to explore the Mars atmosphere and surface from polar orbit. The spacecraft will carry a science payload with European instruments from the ill-fated Russian Mars 96 mission, a communications relay to support lander missions, and a small lander (called Beagle II). NASA's involvement includes a joint radar instrument with ASI; U.S. science co-investigators support; radio relay systems ensuring various spacecrafts operate together; hardware for energetic neutral atoms analyzer instrument; and backup tracking support during critical mission phases by Deep Space Network. Also, there is the development and data analysis of the Swedish ASPERA-3 experiment (a funded Discovery Program Mission of Opportunity), to study the solar wind and Martian atmosphere interaction.

NetLander is as a Discovery Program Mission of Opportunity. It is the first planetary mission focusing on Mars investigations and its large-scale atmosphere circulation. This project consists of four landers, each carrying instruments to study Mars' interior, atmosphere and subsurface, as well as ionosphere structure and geodesy. NetLander will launch on the Centre National d'Etudes Spatiales (CNES) Mars 2007 Premier spacecraft. The U.S. contribution is the ATMospheric Instrumentation System (ATMIS), NetLander Ionosphere and Geodesy Experiment (NEIGE), and SEISmology Experiment (SEIS).

http://mars.jpl.nasa.gov/missions/future/express.html http://www.geo.fmi.fi/PLANETS/NetLander.html

## PROGRAM MANAGEMENT

The Mars Express, ASPERA-3, and Netlander projects are delegated to the Jet Propulsion Laboratory (JPL). The Agency Program Management Council (PMC) has Mars Express, ASPERA-3 and NetLander governing responsibility. The Enterprise official is Dr. Edward Weiler, Associate Administrator for Space Science at HQ. The Theme Director and the Point of Contact is Mr. Orlando Figueroa, Director of the Mars Exploration Program at HQ. These projects are in full compliance with NPG7120.5B.

## TECHNICAL COMMITMENT

Mars Express baselined per the MEP Program Commitment Agreement (PCA);
NetLander and ASPERA-3 per Discovery PCA.

| Technical Specifications | FY04 President's Budget | Change from Baseline |
|---|---|---|
| Mars Express & ASPERA-3 | | -- |
| Launch | June 2003 | |
| Launch Vehicle | Soyuz Fregat Launcher, from Baikonur in Kazakhstan | |
| Mission Life | One Martian Year (687 Earth days) | |
| NetLander | | -- |
| Launch | September 2007 | |
| Launch Vehicle | Ariane V, from Kouros launch complex in French Guiana | |
| Mission Life | One Martian Year (687 Earth days) | |

| Schedule | FY04 President's Budget | Change from Baseline |
|---|---|---|
| Mars Express (Mars) & ASPERA-3 (Discovery MoO) | | -- |
| Launch | Jun-03 | |
| Mars Orbit Insertion | Dec-03 | |
| NetLander (Discovery) | CNES schedule/budget under review; decision to be made by end of CY 2002 | -- |
| PDR | 4QTR/FY02 | |
| CDR | 2QTR/FY03 | |
| Delivery to CNES for I&T | 2QTR/FY06 | |
| Launch | Sep-07 | |
| Land | 4QTR/FY08 | |

| | |
|---|---|
| **THEME:** | Mars Exploration Program (MEP) |
| **DEVELOPMENT:** | Mars Exploration Program Small Development Projects |

## ACQUISITION STRATEGY & PERFORMING ORGANIZATIONS

Mars Express is European Space Agency (ESA) mission; ESA has overall responsibility. ASPERA-3 is a joint NASA-Agenzia Spaziale Italiana (ASI) instrument development. University of Iowa is responsible for the Mars Express Radio Frequency System (the Integrated Receiver, Transmitter, and Antenna Subsystems). ASI is responsible for Digital Electronic Subsystem, subsystem integration, and delivery. The PI for the ASPERA-3 is at Southwest Research Institute, and is responsible for its development and operation. The Centre National d'Etudes Spatiales (CNES) is the leading organization for the overall NetLander mission. The U.S.-provided experiments were openly competed as a Mission of Opportunity under the Discovery Program. The U.S.-provided experiments are integrated into NetLander experiment packages, and have a cost cap as stated in the Phase B Selection Letter. In FY 2002, direct procurement represented 100% of budget authority. **Changes since FY 2003 Pres. Budget: None.**

| Current Acquisitions | Actual * | Selection Method | Actual * | Performer | Actual * |
|---|---|---|---|---|---|
| Cooperative Agreements | 0% | Full & Open Competition | 92% | Industry | 11% |
| Cost Reimbursable | 48% | Sole Source | 8% | Government | |
| Fixed Price | 52% | | 100% | NASA Intramural | 1% |
| Grants | 0% | | | University | 86% |
| Other | 0% | Sci Peer Review | 39% | Non Profit | 2% |
| * as % of FY02 direct procurement | 100% | * as % of FY02 direct procurement | | * as % of FY02 direct procurement | 100% |

| Future Acquisitions - Major | Selection | Goals |
|---|---|---|
| No major acquisitions planned for FY04. | | |

## AGREEMENTS

*Internal:* Program is not dependent on activities outside the control of the Space Science Associate Administrator. *External:* ESA has overall Mars Express mission program management. CNES has overall program management for the entire 2007 Mars Premier mission. DOE and NASA are in negotiations for provision of Radioactive Heater Units (RHU's) required for the NetLander mission. **Changes since FY 2003 Pres. Budget: None.**

## INDEPENDENT REVIEWS

| Types of Review | Performer | Last Review | Next Review | Purpose |
|---|---|---|---|---|
| **Mars Express** | | | | Delivered to ESA 7/02 |
| - Project Confirmation | JPL | Sep-00 | N/A | Phase C/D Development |
| - Critical Design Review | ESA | Apr-02 | N/A | Transition from design to build |
| - MARSIS Peer Review/ | JPL | Feb-02 | N/A | Flight Hardware delivery |
| - ESA Flight Readiness Review | ESA | N/A | Jan-03 | June 2003 launch |
| **ASPERA-3** | LaRC/TMCO | 5/99 | N/A | Mission selection |
| **Netlander** | IRT | Oct-01 | Sep-02 | Preliminary Design Review (PDR) |

## BUDGET/LIFE CYCLE COST

Budget authority represents the Development Cost, including launch services for NASA missions. Mission Operations and Data Analysis costs are budgeted elsewhere.

| Budget Authority ($ in millions) | Prior | FY02 | FY03 | FY04 | FY05 | FY06 | FY07 | FY08 | BTC* | Total | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|
| FY 2004 President's Budget (Dev.on | 16.2 | 7.2 | 9.1 | 10.3 | 8.1 | 4.4 | 2.3 | 2.5 | | 60.1 | |
| Mars Express | 12.9 | 4.4 | 3.4 | | | | | | | 20.7 | |
| ASPERA-3 | 3.0 | 0.6 | 0.5 | | | | | | | 4.1 | |
| Netlander | 0.3 | 2.2 | 5.2 | 10.3 | 8.1 | 4.4 | 2.3 | 2.5 | | 35.3 | |
| Changes since FY 03 Pres. Budget | +0.4 | +0.6 | | +1.7 | +1.8 | +0.4 | -0.1 | +2.5 | -8.0 | -0.7 | ***Reason:*** |
| - Mars Express | +0.1 | +0.6 | | -0.1 | | | | | | +0.6 | Instrum. delay. |
| - NetLander | +0.3 | | | +1.8 | +1.8 | +0.4 | -0.1 | +2.5 | -8.0 | -1.3 | Rephased. |
| FY 2003 President's Budget (Dev. o | 15.8 | 6.6 | 9.1 | 8.6 | 6.3 | 4.0 | 2.4 | | 8.0 | 60.8 | |
| Mars Express | 12.8 | 3.8 | 3.4 | 0.1 | | | | | | 20.1 | |
| ASPERA-3 | 3.0 | 0.6 | 0.5 | | | | | | | 4.1 | |
| Netlander | | 2.2 | 5.2 | 8.5 | 6.3 | 4.0 | 2.4 | | 8.0 | 36.6 | |
| Initial Baseline (LCC) | 8.8 | 7.5 | 5.2 | 8.3 | 5.3 | 4.6 | 0.3 | | | 40.0 | |
| Mars Express | 6.0 | 6.8 | 4.6 | 7.6 | 4.5 | 3.9 | | | | 33.4 | Lifecycle; 9/00 |
| ASPERA-3 | 2.8 | 0.7 | 0.6 | 0.7 | 0.8 | 0.7 | 0.3 | | | 6.6 | Lifecycle; 11/99 |
| Netlander | | | | | | | | | | | N/A-not confirm |

Indicates budget numbers in full cost.

Indicates changes since the FY 2003 Presidents Budget Submit.

FY 2002, FY 2003, Prior and BTC are not in full cost.

| THEME: | Mars Exploration Program (MEP) |
|---|---|

## OPERATIONS

### PURPOSE

| Objectives | Reference 2003 Strategic Plan | Performance Measures |
|---|---|---|
| 5.4 thru 5.6 | | 4MEP4-11 |

Maximize the scientific return from NASA's investment in spacecraft and other data collection sources by efficiently and reliably operating the data-collecting hardware that enables scientific discoveries.

### OVERVIEW

- The Mars Surveyor Program, approved by Congress in FY 1994, was initiated with the **Mars Global Surveyor (MGS)** mission. MGS was launched in November 1996 and began mapping operations in March 1999. MGS carries five instruments and is orbiting Mars mapping the atmosphere, surface, and magnetic field. MGS will provide measurement of potential Mars Exploration Rovers (MER) landing sites, and support UHF relay of engineering data during MER descent and landing.
- The **2001 Mars Odyssey** mission, launched in April 2001, consists of an orbiter to map surface mineralogy,elemental composition, and the radiation environment. Its objective is to determine the elemental and chemical composition and map the mineralogy and morphology of the surface, and measure the radiation environment around Mars.
- The science goal of the **2003 Mars Exploration Rovers**, scheduled for launches in May and June 2003, is to learn the history of ancient water and its role in the geology and climate of Mars. Each of the rovers (MER-A and B) will "act" as a robotic field geologist, equipped to read the geologic record at its landing site and learn what conditions were when the rocks and soils were formed. They each can travel up to 1,000 meters across the Martian landscapes measuring the chemical character of the soils, rocks, and previously inaccessible interiors of rocks where unaltered materials may lie.
- **Mars Multi-Mission Operations** supports the development and operations of systems for Mars projects. The goal is to provide an effective and efficient mission operations system for each project with commonality across projects where feasible, while recognizing that each project is an independent entity and has unique requirements.

### PROGRAM MANAGEMENT

The MEP mission operations responsibility is delegated to JPL. The Program Management Council (PMC) has MEP governing responsibility. The Enterprise official is Dr. Edward Weiler, Associate Administrator for Space Science at HQ. The Theme Director and the Point of Contact is Mr. Orlando Figueroa, Director of the Mars Exploration Program at HQ. This program is in full compliance with NPG7120.5B.

### TECHNICAL COMMITMENT

The baseline is based on the MEP Program Commitment Agreement (PCA).

| Technical Specifications | FY04 President's Budget | Change from Baseline |
|---|---|---|
| Mars Global Surveyor (MGS) | | |
| Extended Science (E2) | continue through 9/04 | additive to the original baseline |
| 2001 Mars Odyssey | | |
| Primary Science | 917 Days | -- |
| Prime Mission - Relay Support | 2/02 through 8/04 | -- |
| 2003 Mars Exploration Rovers (MER) | | |
| MER - Mission Life | 90 sols for each rover | -- |
| MER - Rover Traverse Capability | Up to 1 Km from landing site | -- |
| Mars Multi-Mission Operations | | |
| Continue to provide tools and training to the Mars mission for efficient operations support | | -- |

| Schedule | FY04 President's Budget | Change from Baseline |
|---|---|---|
| Mars Global Surveyor (MGS) | | |
| Primary Mapping Phase | 3/99 through 1/01 | -- |
| Extended Phase | 2/01 through 9/04 | -- |
| 2001 Mars Odyssey | | |
| Primary Science Mission - Phase E | 4/01 through 9/04 | -- |
| 2005 Mars Reconnaissance Orbiter (MRO) | | |
| Launch | Aug-05 | -- |
| End of Primary Science Mission | Dec-10 | -- |
| 2003 Mars Exploration Rovers (MER) | | |
| Launch | May 2003 & June 2003 | -- |
| End of Prime Science Mission | 2004 | -- |
| Mars Multi-Mission Operations | On-going | -- |

**THEME:** Mars Exploration Program (MEP)

# OPERATIONS

## ACQUISITION STRATEGY & PERFORMING ORGANIZATIONS

The MER Project is being implemented in an "in-house" mode at JPL. Approximately 49% of the budget allocated for the Project goes out of house. The rover science instruments, which have been selected and procured following an open Announcement of Opportunity (AO), will be integrated onto the rovers at JPL. Both the Mars Global Surveyor and the 2001 Mars Odyssey are JPL In-house missions, where JPL is responsible for project management, mission design and operation for both missions. Lockheed-Martin provides operations support for the orbiter/spacecraft under a cost plus fixed and incentive award fee contract. In FY 2002, direct procurement represented 100% of budget authority. **Changes since FY 2003 Pres. Budget: None.**

| Current Acquisitions | Actual * | Selection Method | Actual * | Performer | Actual * |
|---|---|---|---|---|---|
| Cooperative Agreements | 0% | Full & Open Competition | 68% | Industry | 3% |
| Cost Reimbursable | 100% | Sole Source | 32% | Government | 0% |
| Fixed Price | 0% | | 100% | NASA Intramural | 0% |
| Grants | 0% | | | University | 97% |
| Other | 0% | Sci Peer Review | 0% | Non Profit | 0% |
| * as % of FY02 direct procurement | 100% | * as % of FY02 direct procurement | | * as % of FY02 direct procurement | 100% |

| Future Acquisitions - Major | Selection | Goals |
|---|---|---|
| None planned for FY04 | | |

## AGREEMENTS

*Internal:* Program is not dependent on activities outside of the control of the Space Science Associate Administrator. *External:* Two missions in Data Analysis (Mars Express [Mars Express & ASPERA-3] and NetLander) involve agreements with the European Space Agency (ESA), the Centre National d'Etudes Spatials (CNES), and the Italian Space Agency (ASI). **Changes since FY 2003 Pres. Budget: None.**

## INDEPENDENT REVIEWS

| Types of Review | Performer | Last Review | Next Review | Purpose |
|---|---|---|---|---|
| **Senior Review (MGS)** | HQ | 1999 | 2004 | Determine the feasibility of MGS science. |
| **Mars Odyssey** | | | | |
| - Red Team Review (Odyssey) | JPL | 2000 | N/A | Mission design and launch readiness. |
| - Odyssey High Gain Antenna Deployment Review | JPL | Jan. 8, 2002 | N/A | Assess readiness for antenna deployment. |
| - Odyssey Mapping Critical Events Readiness Review | JPL | Jan. 8, 2002 | N/A | Assess readiness for mapping phase. |
| - Odyssey GRS Boom Independent Review | SAID, LaRC, Aerospace | Feb. 2002 | N/A | Assess the Gamma Ray Spectrometer (GRS) boom deployment mechanism and |
| - Odyssey Gamma Ray Spectrometer (GRS) Boom Deployment Critical Events Readiness Review | JPL | Apr. 2002 | N/A | Assess readiness to perform Gamma Ray Spectrometer (GRS) boom deployment. |

## BUDGET

| Budget Authority ($ in millions) | FY02 | FY03 | FY04 | Comments |
|---|---|---|---|---|
| These figures include funding for approved mission operations (MGS thru 9/04; Odyssey thru 9/04; MRO thru 12/10; MER thru 2004) and allow for continuous multi-mission operations support. | | | | |
| FY 2004 President's Budget (Operations) | 24.8 | 26.0 | 44.8 | |
| Mars Global Surveyor (MGS) | 7.4 | 6.0 | 4.4 | |
| 2001 Mars Odyssey | 14.0 | 10.6 | 10.0 | |
| 2003 Mars Exploration Rovers (MER) | | 5.9 | 26.6 | |
| 2005 Mars Reconnaissance Orbiter (MRO) | | | | |
| Mars Multi-Mission Operations | 3.4 | 3.5 | 3.8 | |
| Changes since FY 03 Pres. Budget | | | +1.7 | ***Reason for Change:*** |
| Programmatic Changes | | | +0.1 | |
| 2001 Mars Odyssey | | | +0.1 | |
| 2005 Mars Reconnaissance Orbiter (MRO) | | | | |
| Full Cost Changes | | | +1.6 | Full cost. |

Indicates budget numbers in full cost.
Indicates changes since the FY 2003 Presidents Budget Submit.
FY 2002 and FY 2003 are not in full cost.

**THEME:** Mars Exploration Program (MEP)

# RESEARCH

## PURPOSE

| Objectives | Reference 2003 Strategic Plan | Performance Measures |
|---|---|---|
| 5.4 thru 5.6; 6.1 thru 6.4; 7.1 and 7.2 | | 4MEP2,4-19 |

The objective of the integrated Mars Research Program is to utilize flight mission data to develop a predictive understanding of Mars as a "system." In addition, "Mars Fundamental Research Program" has been developed to foster new investigations that treat the fundamental physics and chemistry of Mars.

## OVERVIEW

**Research & Analysis:** Mars Data Analysis (MDAP) and Mars Characterization support a large group of scientific investigators (largely at universities) whose research is based upon flight mission data. Mars Fundamental Research program supports competitively-selected researchers investigating the basic physics and chemistry of Mars as a system. Funding for this portion of the research efforts are currently being carried under the Solar System Theme; under the Research Program section, Research & Analysis.

**Data Analysis:** The **Mars Global Surveyor (MGS**) has been conducting science mapping operations around Mars since March 1999. The spacecraft, now in its second extended mission, will serve as a communications relay satellite during the entry, descent, and landing phase of the Mars landers planned for 2003. MGS has discovered evidence of a modern water cycle on Mars in the form of mid-latitude gully systems, as well as the former presence of an Earth-magnitude magnetic field whose record is frozen into the crustal rocks.

- The **2001 Odyssey Mars Orbiter** has already discovered high (40% by volume) concentrations of water ice in the first few feet of the Martian surface in the high latitudes, possibly indicating a massive ground ice "reservoir" on Mars. In addition, its THEMIS instrument has observed mineralogic diversity at sub-km scales, suggesting greater compositional heterogeneity than previously thought.
- The science goal of the **2003 Mars Exploration Rovers**, scheduled for launches in May and June 2003, is to learn the history of ancient water and its role in the geology and climate of Mars.
- Included in the Mars Data Analysis are **ASPERA-3 and Mars Express**, part of a European Space Agency (ESA)/Italian space agency mission to be launched in June 2003.

## PROGRAM MANAGEMENT

NASA HQ has responsibility for the Mars Research Program. The Program Management Council (PMC) has governing responsibility. The Enterprise official is Dr. Edward Weiler, Associate Administrator for Space Science at HQ. The Theme Director and the Point of Contact is Mr. Orlando Figueroa, Director of the Mars Exploration Program at HQ. This program is in full compliance with NPG7120.5B.

## TECHNICAL COMMITMENT

The baseline is based on the MEP Program Commitment Agreement (PCA).

| Technical Specifications — FY04 President's Budget | Change from Baseline |
|---|---|
| The integrated Mars Research and Analysis program (MRA) which includes Mars Data Analysis Program (MDAP)/Characterization and Mars Fundamental Research (MFR) solicits research investigations concerning Mars using peer-review (competitive), and is guided by investigation priorities developed by a variety of scientific groups, including the Space Studies Board COMPLEX (National Research Council), the Mars Exploration Program Analysis Group (MEPAG), and the Solar System Decadal Survey (NRC). | -- |
| All program science data, including calibration and relevant spacecraft engineering information, will be archived in the Planetary Data System (PDS) following a short period (no greater than 6 months) for verification, calibration and validation. There shall be no proprietary data rights. | -- |

**Schedule** — FY04 President's Budget

An announcement for the Mars Research Program is released annually via the Research Opportunities in Space Science (ROSS) NRA. Below is the 2002 schedule for the Mars Research & Analysis Program. The schedule for 2003 and beyond will be similar.

| | Release Date | Proposal Due Date | Panel Review | Award | Remark/Comment |
|---|---|---|---|---|---|
| **ROSS NRA** | Jan-02 | | | | Release annually. |
| - Mars Fundamental Sci. | | Mar-2002 | Jun-2002 | Aug-2002 | |
| - Mars Data Analysis | | Aug-2002 | Nov-2002 | Dec-2002 | |

| THEME: | Mars Exploration Program (MEP) |
|---|---|
| **RESEARCH** | |

## ACQUISITION STRATEGY & PERFORMING ORGANIZATIONS

The Research and Analysis (R&A) and Data Analysis (DA) programs make awards following peer-reviewed competitions under NASA Research Announcements (NRAs), Announcements of Opportunity (AOs) and Cooperative Agreement Notices (CANs). In FY 2002, direct procurement represented 100% of budget authority. **Changes since FY 2003 Pres. Budget: None.**

| Current Acquisitions | Actual * | Selection Method | Actual * | Performer | Actual * |
|---|---|---|---|---|---|
| Cooperative Agreements | 3% | Full & Open Competition | 99% | Industry | 6% |
| Cost Reimbursable | 63% | Sole Source | 1% | Government | 7% |
| Fixed Price | 1% | | 100% | NASA Intramural | 2% |
| Grants | 24% | | | University | 79% |
| Other | 9% | Sci Peer Review | 60% | Non Profit | 6% |
| * as % of FY02 direct procurement | 100% | * as % of FY02 direct procurement | | * as % of FY02 direct procurement | 100% |

| Future Acquisitions - Major | Selection | Goals |
|---|---|---|
| 1. Annual R&A research announcement | late 2003 | 100% Science Peer Review |

## AGREEMENTS

*Internal:* The program is not dependent on activities outside of the control of the Space Science Associate Administrator. *External:* Two missions in Data Analysis (Mars Express [Mars Express & ASPERA-3] and NetLander) involve agreements with the European Space Agency (ESA), the Centre National d'Etudes Spatials (CNES), and the Italian Space Agency (ASI). **Changes since FY 2003 Pres. Budget: None.**

## INDEPENDENT REVIEWS

| Types of Review | Performer | Last Review | Next Review | Purpose |
|---|---|---|---|---|
| MO&DA Senior Review | Sr. Review committee | July 2000 | summer 2003 | To review extending mission beyond its primary science phase. |
| R&A peer review | peer review committee | summer 2002 | summer 2003 | Review Mars proposals in response to R&A announcement. |

## BUDGET

| Budget Authority ($ in millions) | FY02 | FY03 | FY04 | |
|---|---|---|---|---|
| FY 2004 President's Budget (Research) | 23.4 | 25.5 | 56.2 | |
| Mars Research & Analysis | | | | |
| Mars Data Analysis | 23.4 | 25.5 | 56.2 | |
| Mars Global Surveyor (MGS) | 6.7 | 4.9 | 2.4 | |
| 2001 Mars Odyssey | 9.1 | 9.8 | 11.0 | |
| 2003 Mars Exploration Rovers (MER) | | 2.3 | 25.2 | |
| Mars Express | | 0.8 | 4.6 | |
| ASPERA-3 | | | 0.8 | |
| 2005 Mars Reconnaissance Orbiter (MRO) | | | | |
| NetLander | | | | |
| Characterization & MSN Extension | 7.6 | 7.7 | 12.2 | |
| Changes since FY 03 Pres. Budget | | | +16.5 | ***Reason for Change:*** |
| Programmatic Changes | | | +14.5 | |
| Characterization | | | | Added for FY 08. |
| 2005 Mars Reconnaissance Orbiter (MRO) | | | | Added for FY 08. |
| 2001 Mars Odyssey | | | +1.2 | Added reserve for science sequencing. |
| 2003 Mars Exploration Rovers (MER) | | | +9.0 | Added reserve for science sequencing. |
| Mars Express | | | +0.3 | Added reserve for science sequencing. |
| Future Mars DA | | | +4.0 | Reduced funding for science extension. |
| Full Cost Changes | | | +2.0 | Full cost. |

Indicates budget numbers in full cost.
Indicates changes since the FY 2003 Presidents Budget Submit.
FY 2002 and FY 2003 are not in full cost.

**THEME:** Mars Exploration Program (MEP)

# TECHNOLOGY AND ADVANCED CONCEPTS

## PURPOSE

| Objectives | Reference 2003 Strategic Plan | Performance Measures |
|---|---|---|
| 5.4 thru 5.6; 6.1 thru 6.4; 7.1; 7.2; 9.5 | | 4MEP11-12,14-15,17-20 |

The Mars Exploration Program (MEP) Technology and Advanced Concepts effort includes future missions still in the formulation phase, and the development of advanced technologies needed for specific science missions. This process begins with mission studies as the first phase of the flight program development process. In this phase, scientists work collaboratively with technologists and mission designers to develop the most effective alignment of technology development programs with future mission requirements. This collaboration enables intelligent technology investment decisions through detailed analysis of the trade-offs between design considerations, risk, and cost. In MEP, future missions will focus on targeted, in-situ, regional, and sample return investigations. Examples of types of technologies critical to the success of these missions include instrumentation, mobility, autonomy, communications, planetary protection, and sample returns.

## OVERVIEW

**The 2007 Opportunity** will include: A competitively selected mission, called Mars Scout. Patterned after the Discovery Program, and similarly capped at $325M (FY03 dollars), these missions will complement and augment the core Program. The first launch is planned for 2007. In 2007, the French space agency (CNES) is planning to launch an orbiter that will deliver to the Martian surface four small landers (NetLanders) to conduct geophysical network science, will provide the platform for the demonstration of NASA-provided search and rendezvous technologies, and will provide an opportunity for additional selectively competed science. NASA's contribution toward the NetLander project includes three instruments which were selected as a Discovery Program Mission of Opportunity.

**The 2009 Opportunity** will include: A roving long-range, long-duration science laboratory that will represent a major leap in surface analytical capability. The roving science laboratory will demonstrate precision landing, and is expected to include a new suite of analytical instruments tuned to seek answers to questions of geochemistry and biological processes. It will measure aspects of the surface and subsurface materials potentially linked with ancient life and climate. The 2009 U.S Telesat will be multi-band (X, Ka, UHF) telecommunications relay satellite located at an optimal orbit to maximize coverage of orbital, sub-orbital, and surface assets on the planet. The U.S. telesat replaces the planned 2007 ASI/G. Marconi and the 2009 NASA/ASI orbiters, which were deleted due to lack of formal commitment from ASI.

**The Technology Program** consists of two principal elements: The Focused Technology Program (targeting near-term missions) and Base Technology Program (targeting mid- and far-term missions). Currently, the emphasis is on the technologies required to implement the Mars Science Laboratory (MSL) mission in 2009. The critical technologies for this mission are Entry, Descent, and Landing (EDL), Long-Life, Go-To capability for a rover, Sample Acquisition, Handling and Processing, and Mars Proximity Telecom. The Base Technology Program addresses those technologies that are applicable for mid- and far-term missions (i.e. missions starting more than five years from now) and that are applicable to multiple missions.

**Next Decade Mars program** is not included in this budget submit. The replanning effort, which includes investigation and programmatic options, is on-going and will be finalized by the end of calendar year 2003.

http://mars.jpl.nasa.gov/missions/future/2003.html

## PROGRAM MANAGEMENT

The program responsibility has been delegated to JPL. The Program Management Council (PMC) has governing responsibility. Each MEP mission will execute the NASA formulation sub-process per NPG 7120.5B to provide high confidence that it will be ready to proceed into implementation. The Enterprise official is Dr. Edward Weiler, Associate Administrator for Space Science at HQ. The Theme Director and the Point of Contact is Mr. Orlando Figueroa, Director of the Mars Exploration Program at HQ.

**THEME:** Mars Exploration Program

# TECHNOLOGY AND ADVANCED CONCEPTS

## TECHNICAL COMMITMENT

The baseline is outlined in the 2002 Mars Exploration Program Plan. If approved after the Preliminary Design Review, a Program Commitment Agreement (PCA) for will be developed and used as the baseline.

| Technical Specifications | FY04 President's Budget | Change from Baseline |
|---|---|---|
| **Mars Scout** | TBD until mission selection (8/03). | N/A; no established b/l |
| **2007 CNES Orbiter**<br>- Operational Life<br>- Payload element | 4 years + 1 year possible extended mission.<br>UHF telecom payload for CNES orbiter. | N/A; no established b/l |
| **2009 Mars Science Laboratory**<br>- Cruise/approach<br>- Entry/Descent/Landing<br>- Surface Mission | 12 months flight time; 5-6 course correction; Lander performs direct entry with altimetry performed in terminal descent; 450-600 kg rover; 500 sol lifetime; 10km mobility. | N/A; no established b/l |
| **2009 U.S. Telecom**<br>- Mission Duration<br>- Payload element | 1 yr. cruise; 6 years on-orbit; Electra UHF plus Xband proximity link and gimbaled camera. | N/A; no established b/l |

| **MARS TECHNOLOGY** | | FY02 | FY03 | FY04 | |
|---|---|---|---|---|---|
| Entry, Descent, and Landing ~10 km landing error | TRL | 3 | 4 | 5 | -- |
| Long-life (surface power & survivability of hardware) | TRL | 3 | 4 | 5 | -- |
| Go-to capability for a Rover; 10+ km | TRL | 3 | 4 | 5 | -- |
| Sample Acquisition, Handling and Processing | TRL | 3 | 4 | 5 | -- |
| Mars Proximity Telecom (radiation tolerant, wireless network node for telecom and nav.) | TRL | 4 | 5 | 6 | -- |
| Subsurface access (up to five meters) | | 3 | 4 | 5 | -- |
| Science Instruments and Systems | TRL | 3 | 4 | 5 | -- |
| Telecom and Navigation | TRL | 2 | 3 | 4 | -- |

Current TRL status relative to FY03 plan (R/Y/G/B) Planned TRL status relative to FY03 plan

| Schedule | FY04 President's Budget | Change from Baseline |
|---|---|---|
| **2007 Mars Scout** | | |
| Select Mission; Formulation start | Aug-03 | N/A - no established baseline until confirmation. |
| PDR | Jul-04 | |
| Implementation start | Aug-04 | |
| CDR | Feb-05 | |
| Launch | Sep-07 | |
| **2007 CNES Prime Mission** | | |
| Formulation start | TBD | N/A - no established baseline. |
| PDR | TBD | |
| Implementation start | TBD | |
| CDR | TBD | |
| Launch | TBD | |
| **2009 MSL** | | |
| Formulation start | Jun-03 | N/A - no established baseline. until confirmation |
| PDR | Jun-05 | |
| Implementation start | Jun-05 | |
| CDR | Aug-06 | |
| Launch | Oct-09 | |
| **2009 U.S. Telecom** | | |
| Formulation start | Mar-04 | N/A - no established baseline until confirmation. |
| PDR | Aug-05 | |
| Implementation start | Oct-05 | |
| CDR | Feb-06 | |
| Launch | Oct-09 | |

**THEME:** Mars Exploration Program

# TECHNOLOGY AND ADVANCED CONCEPTS

## ACQUISITION STRATEGY & PERFORMING ORGANIZATIONS

NASA has set a goal of openly competing at least 75% of budgeted dollars in the Mars Exploration Program. Specific acquisition plans include:
- **2007 Mars Scout** - Full mission competed through Announcements of Opportunity following a process similar to that of the Discovery Program, with a life cycle cost cap at $325M, FY03 dollars.
- The **2007 CNES** mission will be implemented through international partnership when there is a clear mutual scientific benefit. NASA Headquarters will structure such partnerships.
- **2009 Mars Science Laboratory** - Hybrid JPL in-house and industry.
- **2009 U.S. Telecom** mission - fully competed. Will include Government Furnished Equipment (GFE) such as the proximity link (Electra payload) developed under other contracts/tasks managed by JPL. In FY 2002, direct procurement represented 100% of budget authority. **Changes since FY 2003 Pres. Budget: None.**

| Current Acquisitions | Actual * | Selection Method | Actual * | Performer | Actual * |
|---|---|---|---|---|---|
| Cooperative Agreements | 0% | Full & Open Competition | 92% | Industry | 11% |
| Cost Reimbursable | 48% | Sole Source | 8% | Government | |
| Fixed Price | 52% | | 100% | NASA Intramural | 1% |
| Grants | 0% | | | University | 86% |
| Other | 0% | | | Non Profit | 2% |
| * as % of FY02 direct procurement | 100% | * as % of FY02 direct procurement | | * as % of FY02 direct procurement | 100% |

| Future Acquisitions - Major | Selection | Goals |
|---|---|---|
| 1. Scout mission | Fall 03 | 100% Full & Open Competition, 100% Science Peer Review. |
| 2. Technology NRA - released annually | Annually | 100% Full and Open Competition, with 100% Peer Review. |
| 3. PU 238 for Mars Science Laboratory | 1QTR/FY03 | Contract through DOE via sole source International Agreement. |

## AGREEMENTS

*Internal:* The program is not dependent on other NASA activities outside of the control of the Associate Administrator of Space Science.
*External:* DOE for Multi-Missions Radioisotope Thermoelectric Generators (MMRTG), Centre National d'Etudes Spatials (CNES) for the 2007 CNES Mission, and Canadian Space Agency (CSA) for the 2009 Mars Science Laboratory.
**Changes since FY 2003 Pres. Budget: Descoped 2007 CNES Orbiter, deleted 2007 ASI Orbiter and 2009 ASI/SAR, added 2009 U.S. Telecom**

**THEME:** Mars Exploration Program

# TECHNOLOGY AND ADVANCED CONCEPTS

## INDEPENDENT REVIEWS

| Types of Review | Performer | Last Review | Next Review | Purpose |
|---|---|---|---|---|
| Scout Step 1 Proposal Review | LaRC/TMCO | N/A | 9/02 | Select 3-4 mission concepts. |
| Scout Step 2 Concept Study Rev. | LaRC/TMCO | N/A | 3/03 | Select Scout flight mission. |
| 2007 Mars Scout NAR | IPAO | N/A | Jul-2004 | Assess readiness for implementation. |
| 2007 CNES Orbiter | CNES | N/A | TBD | NASA will support CNES review schedule. |
| 2009 MSL NAR | IPAO | N/A | Jun-2005 | Assess readiness for implementation. |
| 2009 U.S. Telecom NAR | IPAO | N/A | Jan-2006 | Assess readiness for implementation. |
| Technology 3 yr Review | Ext Rev Bd | Sep-2002 | Oct-2002 | Assess content, quality and relevance of technology investments. |

## BUDGET

| Budget Authority ($ in millions) | FY02 | FY03 | FY04 | Comments |
|---|---|---|---|---|
| FY 2004 President's Budget | 65.9 | 177.5 | 275.4 | |
| 2007 Scout Mission | 0.2 | 7.1 | 29.1 | |
| 2007 CNES Orbiter | 4.0 | 19.4 | 14.1 | |
| 2007 ASI/GMO | | 3.2 | | |
| 2009 ASI/SAR | | | | |
| 2009 MSL | 5.7 | 21.6 | 118.0 | |
| 2009 US Telesat | | | 9.3 | |
| Mars Technology | 26.5 | 50.0 | 36.3 | |
| Program CoF (JPL Flight Project Bldg) | | 16.5 | | |
| JPL Discrete CoF | | | 15.6 | |
| Mars Program Plan & Architecture | 29.5 | 59.7 | 53.0 | |
| Next Decade Missions | | | | To be addressed in FY 05 budget. |
| Changes since FY 03 PBS | | | +43.7 | ***Reason for Change:*** |
| Programmatic Changes: | | | +32.4 | |
| 2007 Scout Mission | | | +7.5 | Increased cost cap&added Mission of Oppt. |
| 2007 CNES Orbiter | | | -7.6 | Descoped Rendezvous and capture. |
| 2007 ASI/GMO | | | -6.3 | Received no formal commitment from ASI. |
| 2009 ASI/SAR | | | -0.6 | Received no formal commitment from ASI. |
| 2009 MSL | | | +71.7 | MSL Tech and MMRTG funding rephased. |
| 2009 US Telesat | | | +9.0 | Added to replace '07 GMO & '09 ASI/SAR. |
| Mars Technology | | | -37.2 | Moved MSL tech to MSL mission. |
| Program CoF (JPL Flight Project Bldg) | | | | Deferred start from FY 02 to FY 05. |
| JPL Institutional CofF | | | +15.6 | Transfer from Agency CofF. |
| Mars Program Plan & Architecture | | | -19.7 | Transfer funding to Optical Comm; program reserve reduced to fund cost increases. |
| Full Cost Changes | | | +11.3 | Full cost. |

Indicates budget numbers in full cost.
Indicates changes since the FY 2003 Presidents Budget Submit.
FY 2002 and FY 2003 are not in full cost

This giant pillar of gas and dust, called the Cone Nebula, resides in a turbulent star-forming region. Radiation from hot, young stars [located beyond the top of the image] has slowly eroded the nebula over millions of years. Over time, only the densest regions of the Cone will be left; inside these regions, stars and planets may form. The Advanced Camera took this picture for Surveys, which was installed aboard Hubble Space Telescope in March 2002. Such images provide critical evidence for our understanding of how stars and solar systems form.

# ASTRONOMICAL SEARCH FOR ORIGINS

## MAJOR EVENTS IN 2004

- Final preparations for Hubble Space Telescope Servicing Mission-4, which will launch in early 2005. Two new instruments will be installed on this mission: Wide Field Camera-3 and the Cosmic Origins Spectrograph.
- Final preparation for SOFIA airborne observatory first flight in April 2005.
- Initial science operations of Space Infrared Telescope Facility (SIRTF), the final mission of NASA's Great Observatory Program.

## THEME: Astronomical Search for Origins (ASO)

### OVERVIEW

Where did we come from? Are we alone? Astronomers search for answers by looking both far away -- towards the beginning of time -- to see galaxies forming, and close to home, searching for planetary systems like our own around nearby stars. NASA's Astronomical Search for Origins (ASO) is a series of closely linked missions that build on prior accomplishments in the quest for answers to these questions. As each mission makes radical advances in technology, innovations are fed forward, from one generation of missions to the next. In FY04, we will operate ongoing missions such as the Hubble Space Telescope (HST) and the Space Infrared Telescope Facility (SIRTF), and continue development of first and second generation follow-on missions, including the James Webb Space Telescope (JWST), Space Interferometry Mission (SIM), and Terrestrial Planet Finder (TPF).

| Missions | Goals supported by this theme | Objectives supporting those goals |
|---|---|---|
| Explore the Universe and Search for Life | 5. Explore the solar system and the Universe beyond, understand the origin and evolution of life, and search for evidence of life elsewhere. | 5.10 Understand how today's Universe of galaxies, stars, and planets came to be. |
| | | 5.11 Learn how stars and planetary systems form and evolve. |
| | | 5.12 Explore the diversity of other worlds, and search for those that might harbor life. |
| Inspire the Next Generation of Explorers | 6. Inspire and motivate students to pursue careers in science, engineering and mathematics. | 6.1, 6.2, 6.3, 6.4 (Supporting Role) See Education Programs for objectives. |
| | 7. Engage the public in shaping and sharing the experience of exploration and discovery. | 7.1 Improve the capacity of science centers, museums, and other institutions, through the development of partnerships, to translate and deliver engaging NASA content. (Supporting Role) |
| | | 7.5 Improve science literacy by engaging the public in NASA missions and discoveries, and their benefits, through such avenues as public programs, community outreach, mass media, and the Internet. (Supporting Role) |

### RELEVANCE

Knowing where we come from requires understanding how the universe began and how its subsequent evolution culminated in everything we are and observe today. Understanding whether we are alone in the cosmos depends upon our search for life-sustaining planets or moons, and our understanding of the diversity of life here on Earth. ASO programs are aimed at developing the technologies, building the instruments making the observations, and doing the science that will bring us the answers to our questions.

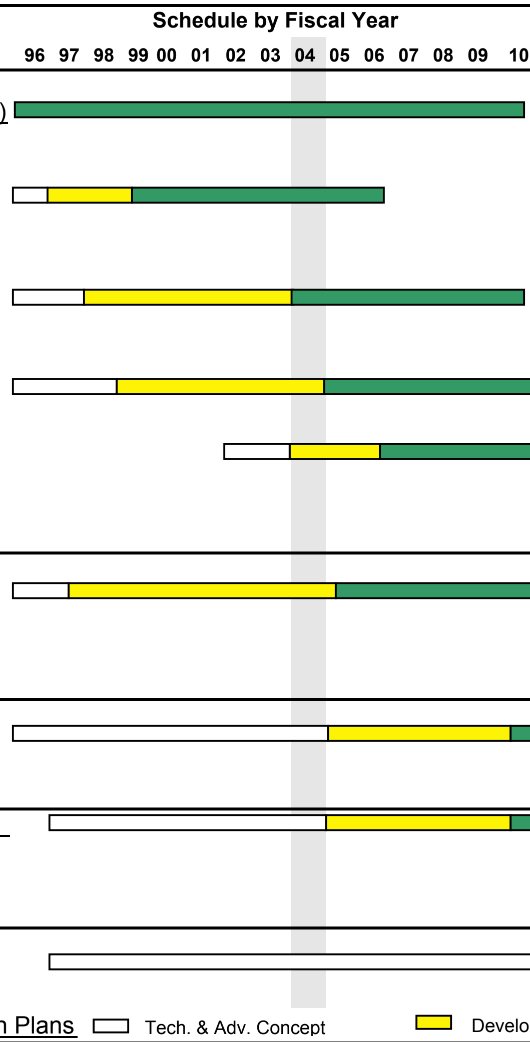
| Education and Public Benefits |
|---|
| Over the last decade, few scientific endeavors have provided the world with more spectacular images or yielded more fascinating results than ASO's flagship: the Hubble Space Telescope (HST). As more sophisticated instruments have been added through the years, we have witnessed the birth of stars, begun to unravel the mysteries of black holes, and looked billions of years into our past. This flood of knowledge -- and questions -- has spread throughout the globe via front page press, television, websites, and school curricula at all levels. ASO will make significant contributions toward meeting national goals for the reform of science, math and technology education and the general elevation of scientific and technological literacy throughout the country. |

### IMPLEMENTATION

The Astronomical Search for Origins theme is composed of many elements that work together to achieve the program's goals and objectives. Repeated management and scientific peer reviews ensure that each mission provides data in a cost-effective manner. In many cases, the data obtained from different missions are complementary, and are combined in cross-disciplinary studies by members of the scientific community. Theme responsibility resides in the Office of Space Science at NASA HQ. Enterprise official is Dr. Edward Weiler, Associate Administrator for Space Science. Theme director and point of contact is Dr. Anne Kinney, Director of the Astronomy and Physics Division at NASA HQ. This theme is in full compliance with NPG 7120.5B.

# THEME: Astronomical Search for Origins (ASO)

## IMPLEMENTATION - CONTINUED




| Strategy | Purpose |
|---|---|
| **Precursor Missions** | |
| Hubble Space Telescope (HST) | Provide a serviceable, state-of-the-art, orbiting observatory to study the history of the Universe. |
| Far Ultraviolet Spectroscopic Explorer (FUSE) | Study physical processes governing the evolution of galaxies; the origin and evolution of stars and planetary systems. |
| Space Infrared Telescope Facility (SIRTF) | Study the formation of stars, galaxies and planets via spectroscopy, high-sensitivity photometry and imaging. |
| Stratospheric Observatory for Infrared Astronomy (SOFIA) | Study the properties of interstellar space as well as planet and star formation. |
| Kepler | Explore the structure and diversity of planetary systems, with a special emphasis on detecting Earth-size planets in the habitable zone around other stars. |
| **Ground-Based Mission** | |
| Keck Interferometer | Characterize exo-zodiacal dust to support TPF design; direct detection of "hot Jupiters" and brown dwarfs; astronomic detection of planets. |
| **First Generation Missions** | |
| Space Interferometry Mission (SIM) | Detect planets outside the solar system by observing thousands of stars; serve as technological pathfinder for TPF. |
| James Webb Space Telescope (JWST) | Provide the next generation space telescope to observe the first stars and galaxies; determine the shape and fate of the Universe. |
| **Second Generation Mission** | |
| Terrestrial Planet Finder (TPF) | Find/characterize Earth-like planets around nearby stars. |
| Link to Program Implementation Plans | |

| Tailoring |
|---|
| No exceptions to NPG 7120.5B have been taken. |

## STATUS

- ASO carried out HST Servicing Mission 3B, including installation of Advanced Camera for Surveys (ACS), new solar arrays, Power Control Unit (PCU), and cryocooler for the Near Infrared Camera and Multi-Object Spectrometer (NICMOS).
- ASO accepted delivery of SOFIA's German-made telescope.
- SIRTF cryogenic telescope assembly delivered for integration into spacecraft.

For more detailed status information: http://origins.jpl.nasa.gov/

## PERFORMANCE MEASURES

| Annual Performance Goals | |
|---|---|
| | OUTCOME: A well managed program in accordance with Agency implementing strategies. |
| 4ASO1 | Each Development project will complete its current phase within 10% of total life-cycle cost as shown in the table below. |
| 4ASO2 | Each Research project will allocate 75% of its funding competitively during FY04. |
| 4ASO3 | ASO will complete all of its missions within 10% of their baseline schedules. |
| 5.10.1 | OUTCOME: Understand how today's Universe of galaxies, stars, and planets came to be. |
| 4ASO4 | Successfully demonstrate progress in learning how the cosmic web of matter organized into the first stars and galaxies and how these evolved into the stars and galaxies we see today. Progress towards achieving outcomes will be validated by external review. |

## THEME: Astronomical Search for Origins (ASO)

| Annual Performance Goals - Continued | |
|---|---|
| 4ASO5 | Demonstrate progress in understanding how different galactic ecosystems of stars and gas formed and which ones might support the existence of planets and life. Progress towards achieving outcomes will be validated by external review. |
| 5.11.1 | OUTCOME: Learn how stars and planetary systems form and evolve. |
| 4ASO6 | Successfully demonstrate progress in learning how gas and dust become stars and planets. Progress towards achieving outcomes will be validated by external review. |
| 4ASO7 | Successfully demonstrate progress in observing planetary systems around other stars and comparing their architectures and evolution with our own. Progress towards achieving outcomes will be validated by external review. |
| 5.12.1 | OUTCOME: Explore the diversity of other worlds and search for those that might harbor life. |
| 4ASO8 | Successfully demonstrate progress in characterizing the giant planets orbiting other stars. Progress towards achieving outcomes will be validated by external review. |
| 4ASO9 | Successfully demonstrate progress in finding out how common Earth-like planets are and seeing if any might be habitable. Progress towards achieving outcomes will be validated by external review. |
| 4ASO10 | Successfully demonstrate progress in tracing the chemical pathways by which simple molecules and dust evolve into the organic molecules important for life. Progress towards achieving outcomes will be validated by external review. |
| 4ASO11 | Successfully demonstrate progress in developing the tools and techniques to search for life on planets beyond our solar system. Progress towards achieving outcomes will be validated by external review. |
| 6.1.1 | OUTCOME: Kindergarten through graduate students will be more proficient in science, technology, engineering, and mathematics (STEM). |
| 4ASO12 | Provide opportunities for students to work directly with NASA space science missions, facilities, and data. |
| 6.2.1 | OUTCOME: More students from diverse communities motivated to pursue careers in STEM. |
| 4ASO13 | Provide new opportunities for participation in the space science program by an increasingly diverse population, including opportunities for minorities and minority universities to compete for and participate in space science missions, research, and education programs. |
| 6.3.1 | OUTCOME: Improve quality of STEM instruction. |
| 4ASO14 | Provide high quality educational materials and teacher training based on Theme content and focused on national curriculum standards. |
| 4ASO15 | Provide exhibits, materials, workshops, and personnel at national and/or regional education and outreach conferences. |
| 6.4.1 | OUTCOME: More students prepared to enter the STEM workforce. |
| 4ASO16 | Provide education opportunities offered through OSS research awards and other NASA research and education programs. |
| 7.1.1 | OUTCOME: Improve the capacity of science centers, museums, and other institutions, through the development of partnerships, to translate and deliver engaging NASA content. |
| 4ASO17 | Through partnerships with major science museums or planetariums, put on display or on tour major exhibitions or planetarium shows based on Theme content. |
| 4ASO18 | Provide materials and technical expertise to support the development of exhibits and programs at science museums and planetariums. |
| 7.2.1 | OUTCOME: Engage the public in NASA missions and discoveries through such avenues as public programs, community outreach, mass media, and the Internet. |
| 4ASO19 | Seek out and capitalize on special events and particularly promising opportunities in the Theme science program to bring space science to and involve the public in the process of scientific discovery. |

## THEME: Astronomical Search for Origins (ASO)

### INDEPENDENT REVIEWS

| Types of Review | Performer | Last Review | Next Review | Purpose |
|---|---|---|---|---|
| Nat'l Acad. of Sciences | Space Studies Board | 7/02 | N/A | Review effectiveness and quality of the program. |
| Advisory Council | NAC | 9/02 | 3 times/year | Review science/program implementation strategies. |
| | SSAC | 8/02 | 3 times/year | Review science/program implementation strategies. |
| | Origins Subcomm. | 9/02 | 3 times/year | Review science/program implementation strategies. |

### BUDGET

| Budget Authority ($millions) | FY02 | FY03 | Chng | FY04 | Comments |
|---|---|---|---|---|---|
| **Astronomical Search for Origins** | **650.1** | **698.1** | **+178.9** | **877.0** | |
| Development | 344.0 | 258.7 | -16.5 | 242.2 | |
| HST | 170.2 | 138.9 | -2.5 | 136.4 | |
| SOFIA | 38.0 | 46.9 | +7.8 | 54.7 | |
| SIRTF | 131.5 | 47.4 | -47.4 | | Mission preparing for launch in April 2003. |
| Kepler | 4.3 | 25.5 | +25.6 | 51.1 | Project in formulation. |
| Operations | 8.5 | 9.7 | +14.9 | 24.6 | |
| Research | 115.7 | 145.9 | +53.1 | 198.9 | Includes ramp-up for beginning of SIRTF research. |
| Technology & Advanced Concepts | 181.9 | 283.8 | +127.4 | 411.2 | Includes JWST, SIM, and TPF increases. |

Note: For all formats, the FY 02 column reflects the FY 2002 Congressional Operating Plan dated 9/30/02. The FY 03 column reflects the FY 2003 President's Budget Submit (PBS) as Amended. The Change column includes both programmatic and full cost adjustments. FY 2004 column is in full cost.

| | |
|---|---|
| (yellow) | Indicates budget numbers in full cost. |
| (blue) | Indicates changes since the FY 2003 President's Budget Submit. |
| | FY 2002, FY 2003, Prior and BTC are not in full cost. |

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| THEME: | Astronomical Search for Origins (ASO) |
|---|---|
| **DEVELOPMENT:** | **Hubble Space Telescope (HST)** |

## PURPOSE

| Objectives | Reference 2003 Strategic Plan | Performance Measures |
|---|---|---|
| 5.10, 5.11, 5.12, 6.1, 6.2 ,6.3, 6.4, 7.1, 7.2 | | 4ASO1,3-8,12-19 |

Since 1990, the Hubble Space Telescope has used its pointing precision, powerful optics and state-of-the-art instruments to explore the visible, ultraviolet and near-infrared regions of the electromagnetic spectrum. With the addition of new instruments currently under development for Servicing Mission 4, Hubble will continue to investigate the formation, structure and evolution of stars and galaxies, studying the history of the universe, and providing a space-based research facility for optical astronomy. HST has already rewritten the textbooks of astronomy, and is expected to do so until decommissioned.

## OVERVIEW

Extending HST's operational life to 2010 requires instrument upgrades to keep the observatory at the forefront of astronomical research throughout the duration of the mission. During Servicing Mission 3B in March 2002, astronauts installed the Advanced Camera for Surveys (ACS) and a cryo-cooler that brought the Near Infrared Camera and Multi-Object Spectrometer (NICMOS) back to life. In 2004, Servicing Mission 4 will add the Cosmic Origins Spectrograph (COS) and Wide Field Camera 3 (WFC3). COS will allow Hubble to observe high-energy activities at near- and mid-ultraviolet wavelengths, such as those found in hot new stars and Quasi stellar objects (quasars). WFC3 will employ the latest charge-coupled device (CCD) technology to extend imaging capability through 2010. In addition to these new instruments, support continues for routine servicing activities, including development of replacement batteries, gyros, and an aft shroud cooling system. Modification and upkeep of ground operations systems, as well as mission development for the telescope's eventual retrieval, are also ongoing.

Link to Hubble Homepage for more information.

## PROGRAM MANAGEMENT

GSFC is responsible for HST project management, including mission and science operations, servicing missions, and all associated development activities. Supporting Centers are Johnson Space Center for shuttle flight services and Kennedy Space Center for launch operations. The HST program consists of two distinct projects: the Operations and Ground Systems Project, and the Flight Systems and Servicing Project. Both are governed by the GSFC Program Management Council. The Agency Program Management Council has oversight responsibility for the the program. Enterprise Official is Dr. Edward Weiler, Associate Administrator for Space Science at NASA HQ. Theme Director and point of contact is Dr. Anne Kinney, Director of Astronomy and Physics at NASA HQ. This program is in full compliance with NPG-7120.5B.

## TECHNICAL COMMITMENT

The baseline technical commitment was made in 10/1999 and is detailed in the HST Program Commitment Agreement.

| Technical Specifications | FY04 President's Budget | Change from Baseline |
|---|---|---|
| Mission Life | 15+ years | -- |
| Science Instruments | up to 5 | -- |
| Stellar Energy within 0.1 arcsec | 70% | -- |
| Image Jitter | < .012 arcsec RMS/24 hr | -- |
| Pointing Error | < .03 arcsec | -- |

| Schedule | FY04 President's Budget | Change from Baseline |
|---|---|---|
| Servicing Mission 4 | CY04 | 1999 baseline CY03 |
| Retrieval Mission | CY10 | -- |

| THEME: | Astronomical Search for Origins (ASO) |
|---|---|
| **DEVELOPMENT:** | **Hubble Space Telescope (HST)** |

## ACQUISITION STRATEGY & PERFORMING ORGANIZATIONS

Replacement and refurbishment of existing flight equipment is handled via contracts with the original manufacturers. Major acquisitions for SM4 are the Cosmic Origins Spectrograph (COS) and the Wide Field Camera 3 (WFC3). COS is being developed by Ball Aerospace, with the University of Colorado acting as Principal Investigator. WFC3 is a facility-class instrument being built by a team of scientific and technical personnel at GSFC in collaboration with the Space Telescope Science Institute, JPL, and Ball Aerospace, making use of hardware, software, and development experience from previous Hubble instruments. **Changes since FY03 Pres. Budget: None.**

| Current Acquisitions | Actual * | Selection Method | Actual * | Performer | Actual * |
|---|---|---|---|---|---|
| Cooperative Agreements | 0% | Full & Open Competition | 55% | Industry | 67% |
| Cost Reimbursable | 93% | Sole Source | 45% | Government | 1% |
| Fixed Price | 5% | | 100% | NASA Intramural | 0% |
| Grants | 1% | | | University | 2% |
| Other | 1% | Sci Peer Review | 100% | Non Profit | 30% |
| * as % of FY02 direct procurement | 100% | * as % of FY02 direct procurement | | * as % of FY02 direct procurement | |

| Future Acquisitions - Major | Selection | Goals |
|---|---|---|
| None for hardware development - all major acquisitions are in place. See also ASO Operations and Research sections. | N/A | N/A |

## AGREEMENTS

*Internal:*
1. OSF Form 1628 between the Office of Space Flight (OSF) and the Office of Space Science (OSS) to provide launch services to conduct servicing missions, signed May 4, 1990.
2. OSF/Space Communications -- agreement between OSF and OSS to provide HST ground systems development, maintenance, and flight-related telecommunications services. Revision 7, September 21, 1990.
*External:* NASA-ESA Memorandum of Understanding, dated October 7, 1977, and including Riders 1, 1A, 1B, and 2.
**Changes since FY03 Pres. Budget: None.**

## INDEPENDENT REVIEWS

| Types of Review | Performer | Last Review | Next Review | Purpose |
|---|---|---|---|---|
| Independent Implementation | IPAO/IRT | Aug-02 | 25-Oct-02 | To ensure compliance with PCA-defined technical, cost and schedule thresholds. |

## BUDGET / LIFE CYCLE COST

These figures include all costs associated with program completion in 2012, including a servicing mission in 2004 and retrieval in 2010.

| Budget Authority ($ in millions) | FY02 | FY03 | FY04 | FY05 | FY06 | FY07 | FY08 | BTC | Total | Comments |
|---|---|---|---|---|---|---|---|---|---|---|
| FY 2004 President's Budget | 256.2 | 228.2 | 238.9 | 142.5 | 147.9 | 168.5 | 219.1 | 452.6 | | |
| Development | 170.2 | 138.9 | 136.4 | 43.0 | 43.7 | 62.8 | 110.0 | 175.9 | | *BTC numbers are not in full cost; |
| Operations | 5.3 | 5.1 | 8.8 | 7.0 | 7.3 | 7.6 | 8.1 | 16.8 | | they include marginal Shuttle |
| Data Analysis | 80.7 | 84.2 | 93.7 | 92.5 | 96.8 | 98.1 | 100.9 | 259.9 | | costs plus HST return mission. |
| Changes since FY03 Pres. Budget | -1.5 | | +74.3 | +16.9 | +17.3 | +33.6 | +219.1 | +452.6 | | ***Reason for Change:*** |
| Development | -1.8 | | +63.1 | +12.2 | +12.1 | +29.7 | +110.0 | +175.9 | +401.2 | Full cost; added 08 & BTC. |
| Operations | +0.3 | | +3.5 | +1.5 | +1.7 | +1.7 | +8.1 | +16.8 | +33.6 | Full cost; added 08 & BTC. |
| Data Analysis | | | +7.7 | +3.2 | +3.4 | +2.2 | +100.9 | +259.9 | +377.3 | Full cost; added 08 & BTC. |
| FY 2003 President's Budget | 257.7 | 228.2 | 164.6 | 125.6 | 130.6 | 134.9 | | | | |
| Development | 172.0 | 138.9 | 73.3 | 30.8 | 31.6 | 33.1 | | | | |
| Operations | 5.0 | 5.1 | 5.3 | 5.5 | 5.6 | 5.9 | | | | |
| Data Analysis | 80.7 | 84.2 | 86.0 | 89.3 | 93.4 | 95.9 | | | | |

Indicates budget numbers in full cost.
Indicates changes since the FY 2003 President's Budget Submit.
FY 2002, FY 2003, Prior and BTC are not in full cost.

| THEME: | Astronomical Search for Origins (ASO) |
|---|---|
| **DEVELOPMENT:** | **Stratospheric Observatory for Infrared Astronomy (SOFIA)** |

## PURPOSE

| Objectives (Reference 2003 Strategic Plan) | Performance Measures |
|---|---|
| 5.11, 5.12, 6.1, 6.2 ,6.3, 6.4, 7.1, 7.2 | 4ASO1,3,6-7,10,12-19 |

The SOFIA program extends the range of astrophysical observations significantly beyond that of previous infrared airborne observatories through increases in sensitivity and angular resolution. SOFIA will be used to study many different kinds of astronomical objects and phenomena, including: star birth and death; solar system formation; complex molecules in space; planets, comets, and asteroids in our solar system; nebulae and dust in galaxies; and black holes at the centers of galaxies.

## OVERVIEW

SOFIA will be an astronomical observatory consisting of a 2.5m aperture telescope permanently installed in a specially modified Boeing 747 aircraft. The aircraft, with its open-port telescope provided through a partnership with the German Aerospace Center (DLR), will provide routine access to nearly all of the visual, infrared, far-infrared, and submillimeter parts of the spectrum. It will operate from Moffett Federal Airfield in Northern California as well as from deployment sites in the Southern Hemisphere and elsewhere, as dictated by its astronomical targets. With its ground basing , the observatory will be able to incorporate, via a peer-review process, new or upgraded instruments over its lifetime. This will allow additional science and the testing and introduction of cutting edge technologies. Most of the instruments will be designed and built by graduate students and postdoctoral scientists, led by an experienced Principal Investigator, in universities throughout the United States. SOFIA will serve as a training ground for the next generations of instrument builders well into the 21st century, while producing new instrumentation important to NASA's future space observatories. SOFIA will have an active Education & Public Outreach Program, which will include flying educators along with astronomers.

Go to SOFIA Homepage for more information: http://sofia.arc.nasa.gov

## PROGRAM MANAGEMENT

SOFIA is a single-project program with program responsibility delegated to the Ames Research Center. The Space Science Enterprise Program Management Council (PMC) has SOFIA governing responsibility. Enterprise Official is Dr. Edward Weiler, Associate Administrator for Space Science at NASA HQ. Theme Director and point of contact is Dr. Anne Kinney, Director of Astronomy and Physics at NASA HQ. This program is in full compliance with NPG7120.5B.

## TECHNICAL COMMITMENT

The baseline for this technical commitment was made in 9/2000 and is detailed in the SOFIA PCA.

| Technical Specifications | FY04 President's Budget | Change from Baseline |
|---|---|---|
| Effective aperture of telescope: | 2.5 meters | -- |
| Telescope wavelength range: | 0.3 to 1,600 microns | -- |
| Optical image quality: | 80 % of visible wavelength encircled energy, from a point source within a 1.5 arcsecond diameter at the focal plane. | -- |
| Image stability of telescope: | 1.1 arcsec root mean square (rms) at first science flight. | -- |
| | 0.2 arcsec rms 3 yrs after first science flight. | -- |
| Operational capability: | Operate in observing configuration for 6 hours or more at altitudes of at least 41,000 feet. Provide 960 research hours per year beginning in the third year of operation. | -- |
| Science Instruments: | 8 science instruments at beginning of operations, 15 after 5yrs, up to 40 investigation teams per year. | -- |

| Schedule | FY04 President's Budget | Change from Baseline |
|---|---|---|
| Start of Formulation | Oct-91 | -- |
| Start of Implementation | Mar-96 | -- |
| Telescope Delivery for Installation | Sep-02 | +10 mos |
| Operations Readiness Review | Mar-05 | +28 mos |
| First Science Flight | Apr-05 | +29 mos |
| Data Proprietary Period | 1 yr after receipt by investigators | -- |
| Observatory Operational Lifetime | 20 years | -- |

**THEME:** Astronomical Search for Origins (ASO)

# DEVELOPMENT: Stratospheric Observatory for Infrared Astronomy (SOFIA)

## ACQUISITION STRATEGY & PERFORMING ORGANIZATIONS

Major acquisitions for SOFIA are: science investigations; aircraft systems and Operations Center development; MOU with the German Aerospace Center (DLR) for Telescope Assembly; and science operations (5 years with 5 year option). Seven instruments were selected for development in September 1997. Calls for proposal (CFPs) to be issued: science instrument development as needed; annually for observing time. Universities Space Research Association (USRA) selected in 1996 as prime contractor for the aircraft, operations center, and first 5 years of operations, with L3 Systems and United Airlines as key subs. **Changes since FY03 Pres. Budget: None.**

| Current Acquisitions | Actual * | Selection Method | Actual * | Performer | Actual * |
|---|---|---|---|---|---|
| Cooperative Agreements | 0% | Full & Open Competition | 100% | Industry | 75% |
| Cost Reimbursable | 83% | Sole Source | 0% | Government | |
| Fixed Price | 0% | | 100% | NASA Intramural | 9% |
| Grants | 0% | | | University | 11% |
| Other | 17% | Sci Peer Review | 100% | Non Profit | 5% |
| * as % of FY02 direct procurement | 100% | * as % of FY02 direct procurement | | * as % of FY02 direct procurement | 100% |

| Future Acquisitions - Major | Selection | Goals |
|---|---|---|
| None - all major acquisitions are in place. | N/A | N/A |

## AGREEMENTS

*Internal:* The program is not dependent on other NASA activities outside of the control of the Associate Administrator for Space Science.

*External:* Provision of the Telescope Assembly and support for observatory operations from the German Aerospace Center (DLR), according to NASA/DARA Memorandum of Understanding, signed December 1996. (Note: DARA was subsequently absorbed into DLR.)

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

## INDEPENDENT REVIEWS

| Types of Review | Performer | Last Review | Next Review | Purpose |
|---|---|---|---|---|
| Independent Annual Review | IRT | 1-Jun-02 | 1-Jun-03 | Assure compliance with PCA defined technical, cost and schedule parameters. |

## BUDGET / LIFE CYCLE COST

| Budget Authority ($ in millions) | Prior | FY02 | FY03 | FY04 | FY05 | FY06 | FY07 | FY08 | BTC | Total | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|
| FY 2004 Pres. Bud. (LCC) | 233.4 | 38.0 | 46.9 | 54.7 | 51.2 | 55.3 | 57.4 | 59.7 | | 596.6 | |
| Development | 233.4 | 38.0 | 46.9 | 54.7 | | | | | | 373.0 | |
| Operations | | | | | 32.9 | 36.1 | 37.5 | 39.2 | Cont. | 145.6 | |
| Data Analysis | | | | | 18.4 | 19.2 | 19.8 | 20.5 | Cont. | 77.9 | |
| Changes since FY03 Pres. Bud. | | | | +13.4 | +12.4 | +12.5 | +13.1 | +59.7 | | +111.1 | ***Reason for Change:*** |
| Development | | | | +13.4 | | | | | | +13.4 | Full cost |
| Operations | | | | | +9.7 | +9.8 | +10.1 | +39.2 | | +68.7 | Full cost |
| Data Analysis | | | | | +2.8 | +2.7 | +2.9 | +20.5 | | +28.9 | Full cost |
| FY 2003 President's Budget | 233.4 | 38.0 | 46.9 | 41.3 | 38.8 | 42.8 | 44.3 | | | 485.5 | Cost growth due to science |
| Development | 233.4 | 38.0 | 46.9 | 41.3 | | | | | | 359.6 | instrument and aircraft aperature |
| Operations | | | | | 23.2 | 26.3 | 27.4 | | Cont. | 76.9 | tech challenges, and added scope |
| Data Analysis | | | | | 15.6 | 16.5 | 16.9 | | Cont. | 49.0 | (data archive). |
| Initial Baseline | 234.8 | 36.6 | 38.0 | 38.9 | 40.1 | 41.3 | | | | 429.7 | FY 1998 President's Budget. |
| Development | 234.8 | | | | | | | | | 234.8 | Operations and DA to continue for |
| Operations | | 36.6 | 38.0 | 38.9 | 40.1 | 41.3 | | | | | 20 years. |

Indicates budget numbers in full cost.

Indicates changes since the FY 2003 President's Budget Submit.

FY 2002, FY 2003, Prior and BTC are not in full cost.

| THEME: | Astronomical Search for Origins (ASO) |
|---|---|
| **DEVELOPMENT:** | Space Infrared Telescope Facility (SIRTF) |

## PURPOSE

| Objectives Reference 2003 Strategic Plan | Performance Measures |
|---|---|
| 5.10, 5.11, 6.1, 6.2, 6.3, 6.4, 7.1, 7.2 | 4ASO1, 4ASO3-7, 4ASO12-19 |

SIRTF will explore the nature of the cosmos through the unique windows available in the infrared portion of the electromagnetic spectrum. These windows allow investigators to explore:
- The cold Universe by viewing heat radiation from objects that are too cool to radiate at optical and ultraviolet wavelengths;
- The hidden Universe by penetrating into dusty regions which are too opaque for exploration in the other spectral bands;
- The distant Universe by virtue of the cosmic expansion, which shifts the ultraviolet and visible radiation from distant sources into the infrared.

## OVERVIEW

Consisting of a 0.85-meter telescope and three cryogenically-cooled science instruments, SIRTF will be the largest infrared telescope ever launched into space. SIRTF will obtain images and spectra by detecting the infrared energy, or heat, radiated by objects in space. Most of this infrared radiation is blocked by the Earth's atmosphere and cannot be observed from the ground. Because infrared is primarily heat radiation, the telescope must be cooled to near-absolute zero (-459 degrees Fahrenheit or -273 degrees Celsius) so that it can observe infrared signals from space without interference from the telescope's own heat. Also, the telescope must be protected from the heat of the Sun and the infrared radiation emitted by the Earth. To do this, SIRTF will carry a solar shield and will be launched into an Earth-trailing solar orbit. SIRTF is the final mission in NASA's Great Observatories Program, following the Hubble Space Telescope, Compton Gamma Ray Observatory, and Chandra X-ray Observatory.

SIRTF is scheduled for launch in the first half of FY 2003. NASA's FY 2004 budget request includes funding for SIRTF under Operations and Data Analysis; no funds are requested for Development.

Go to SIRTF Homepage for more information: http://sirtf.caltech.edu

## PROGRAM MANAGEMENT

SIRTF is a single-project program with program responsibility delegated to the Jet Propulsion Laboratory. The Agency Program Management Council (PMC) has SIRTF governing responsibility. Enterprise Official is Dr. Edward Weiler, Associate Administrator for Space Science at NASA HQ. Theme Director and point of contact is Anne Kinney, Director of Astronomy and Physics at NASA HQ. This program is in full compliance with NPG-7120.5B requirements.

## TECHNICAL COMMITMENT

The baseline for this commitment was made in 3/1998 and is detailed in the SIRTF Program Commitment Agreement.

| Technical Specifications | **FY04 President's Budget** | **Change from Baseline** |
|---|---|---|
| Effective aperture of telescope: | 85 centimeters | -- |
| Telescope operating temperature: | 5.5 degrees Kelvin (~ -268 Celsius) | -- |
| Imaging capability: | 3-180 microns | -- |
| Spectroscopy capability: | 5-100 microns | -- |
| Pointing accuracy/stability: | 5/0.3 arcseconds | -- |
| Focal plane instruments: | 3 | -- |
| Cryogenic lifetime: | minimum: 2.5 years, goal: 5 years | -- |

| Schedule | **FY04 President's Budget** | **Change from Baseline** |
|---|---|---|
| Start of Implementation | Apr-98 | -- |
| Critical Design Review | Sep-98 | -- |
| Launch | Apr-03 | +16 mos |

| THEME: | Astronomical Search for Origins (ASO) |
|---|---|
| **DEVELOPMENT:** | Space Infrared Telescope Facility (SIRTF) |

## ACQUISITION STRATEGY & PERFORMING ORGANIZATIONS

Major acquisitions for SIRTF are: Lockheed Martin, Sunnyvale CA (spacecraft); Ball Aerospace, Boulder CO (cryogenic telescope assembly); and Cornell University, the University of Arizona, the Smithsonian Astronomical Observatory (science instruments), and GSFC. JPL performs work on the project through NASA's contract with the California Institute of Technology.

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

| Current Acquisitions | Actual * | Selection Method | Actual * | Performer | Actual * |
|---|---|---|---|---|---|
| Cooperative Agreements | 0% | Full & Open Competition | 81% | Industry | 47% |
| Cost Reimbursable | 100% | Sole Source | 19% | Government | 0% |
| Fixed Price | 0% | | 100% | NASA Intramural | 0% |
| Grants | 0% | | | University | 53% |
| Other | 0% | Sci Peer Review | 100% | Non Profit | 0% |
| * as % of FY02 direct procurement | 100% | * as % of FY02 direct procurement | | * as % of FY02 direct procurement | 100% |

| Future Acquisitions - Major | Selection | Goals |
|---|---|---|
| 1. None - all major acquisitions are in place. | N/A | N/A |

## AGREEMENTS

*Internal:* The program is not dependent on other NASA activities outside of the control of the Associate Administrator for Space Science.

*External:* None.

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

## INDEPENDENT REVIEWS

| Types of Review | Performer | Last Review | Next Review | Purpose |
|---|---|---|---|---|
| Indep. Implementation Review | SIRTF IRT | Oct-02 | TBD | Assess program readiness, risks, and mitigation plans. |
| Software Flight Readiness | SIRTF IRT | Oct-02 | TBD | Ensure software (flight and science) will operate as planned. |
| Monthly status reports | SIRTF IRT | Sep-02 | TBD | Communicate IRT concerns and address in timely manner. |

## BUDGET / LIFE CYCLE COST

| Budget Authority ($ in millions) | Prior | FY02 | FY03 | FY04 | FY05 | FY06 | FY07 | FY08 | BTC | Total | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|
| FY 2004 President's Budget | 511.5 | 131.5 | 79.1 | 78.4 | 77.2 | 76.3 | 75.8 | 65.3 | 75.5 | 1170.6 | |
| Development | 467.7 | 127.5 | 29.7 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 624.9 | |
| Launch Vehicle | 43.8 | 4.0 | 17.7 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 65.5 | |
| Operations | | 0.0 | 3.2 | 14.4 | 14.0 | 13.5 | 13.7 | 13.3 | 8.6 | 80.6 | |
| Data Analysis | | 0.0 | 28.5 | 64.0 | 63.2 | 62.9 | 62.1 | 52.0 | 66.9 | 399.6 | |
| Changes since FY 03 Pres. Budget | | +18.5 | +0.0 | +9.9 | +7.2 | +6.3 | +2.0 | +65.3 | -79.6 | +29.6 | ***Reason for Change:*** |
| Development | | +36.2 | -17.7 | | | | | | | +18.5 | Launch delay and overrun. |
| Launch Vehicle | | -17.7 | +17.7 | | | | | | | +0.0 | Launch delay. |
| Operations | | | | +7.1 | +7.7 | +8.2 | +7.2 | +13.3 | -0.5 | +42.9 | Launch delay, transfer from DA. |
| Data Analysis | | | | +2.8 | -0.5 | -1.8 | -5.2 | +52.0 | -79.1 | -31.8 | Transfer to Ops. |
| FY 2003 President's Budget | 511.5 | 113.0 | 79.1 | 68.5 | 70.0 | 70.0 | 73.8 | 0.0 | 155.1 | 1141.0 | Spacecraft and instrument cost |
| Development | 467.7 | 91.3 | 47.4 | | | | | | | 606.4 | growth and delays (e.g. software, |
| Launch Vehicle | 43.8 | 21.7 | | | | | | | | 65.5 | dewar); increased testing reqs. |
| Operations | | | 3.2 | 7.3 | 6.3 | 5.3 | 6.5 | | 9.1 | 37.7 | Covers up to 7 years. |
| Data Analysis | | | 28.5 | 61.2 | 63.7 | 64.7 | 67.3 | | 146.0 | 431.4 | Covers up to 7 years. |
| Initial Baseline | 508.3 | 70.2 | 70.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 240.0 | 888.5 | 3/98 PCA, FY 99 PFP |
| Development | 453.5 | 19.2 | | | | | | | | 472.7 | including Phase A. |
| Launch Vehicle | 54.8 | 11.0 | | | | | | | | 65.8 | |
| Operations and Data Analysis | | 40.0 | 70.0 | | | | | | 240.0 | 350.0 | Ops not broken out from DA; covered 5 years. |

Indicates budget numbers in full cost.
Indicates changes since the FY 2003 President's Budget Submit.
FY 2002, FY 2003, Prior and BTC are not in full cost.

| | |
|---|---|
| **THEME:** | Astronomical Search for Origins (ASO) |
| **DEVELOPMENT:** | Kepler |

## PURPOSE

| Objectives Reference 2003 Strategic Plan | Performance Measures |
|---|---|
| 5.11, 5.12, 6.1, 6.2, 6.3, 6.4, 7.1, 7.2 | 4ASO1,3,7-9, 12-19 |

The scientific goal of the Kepler mission is to explore the structure and diversity of planetary systems, with a special emphasis on detecting Earth-size planets in the habitable zones around other stars. The Kepler mission's specific objectives include: (1) determine the frequency of terrestrial and larger planets in or near the habitable zones of a wide variety of spectral types of stars; (2) determine the distribution of planet sizes and their orbital semi-major axes (half the longest diameter of the orbit); (3) estimate the frequency and orbital distribution of planets in multiple-stellar systems; and (4) determine the distributions of semi-major axis, albedo, size, mass, and density of short-period giant planets. The Kepler mission will continuously and simultaneously observe over 100,000 target stars.

## OVERVIEW

The Kepler spacecraft will be launched into an Earth-trailing, heliocentric orbit similar to that of SIRTF. Following a 30-day period during which the photometer and spacecraft are characterized, Kepler begins acquiring its scientific data. It is expected that "hot Jupiters" (giant gas planets) in short period orbits will be identified after the first month of observation. During the first year, terrestrial planets with orbital periods shorter than that of Mercury -- as well as a wide range of larger planets with similar periods -- should be detected. Finally, the anticipated identification of Earth-size planets in the habitable zones of other star systems will begin during the third year of the Kepler mission.

Link to Kepler Homepage for more information: http://www.kepler.arc.nasa.gov

## PROGRAM MANAGEMENT

Kepler is a project in the Discovery Program with project responsibiity delegated to the Principal Investigator (PI) at the Ames Research Center. The JPL Program Management Council (PMC) has Kepler governing responsibility. Enterprise Official is Dr. Edward Weiler, Administrator for Space Science at NASA HQ. Theme Director and point of contact is Dr. Anne Kinney, Director of Astronomy and Physics at NASA HQ. The program is in full compliance with NPG7120.5B.

## TECHNICAL COMMITMENT

The baseline for this technical commitment will be set at Confirmation Review.

| Technical Specifications | FY04 President's Budget | Change from Baseline |
|---|---|---|
| Photometer: | 0.95-m aperture | -- |
| Primary mirror: | 1.4 m dia., 85% lightweighted | -- |
| Detectors: | 42 CCDs - 2200 x 1024 pixels | -- |
| Mass: | 903 kg | -- |
| Power: | 613 W | -- |
| Launch Vehicle | D2925-10L (Delta II) | -- |
| Mission lifetime: | 4 years of flight | -- |
| Telemetry: | Ka-and X-band | -- |

| Schedule | FY04 President's Budget | Change from Baseline |
|---|---|---|
| Start of Implementation: | 4th Qtr 2004 | -- |
| Critical Design Review: | 3rd Qtr 2005 | -- |
| Launch: | Oct-07 | -- |

| THEME: | Astronomical Search For Origins (ASO) |
|---|---|
| **DEVELOPMENT:** | Kepler |

## ACQUISITION STRATEGY & PERFORMING ORGANIZATIONS

Ames Research Center (ARC) provides the Principal Investigator (PI), Deputy PI and some members of the science team. ARC acquires the other science team members through grants and contracts as appropriate. The Jet Propulsion Laboratory (JPL) provides the project management, mission assurance and project system engineering. Ball Aerospace and Technology Corporation provides the spacecraft, photometer and mission operations center. **Changes since FY03 Pres. Budget: None.**

| Current Acquisitions | Actual * | Selection Method | Actual * | Performer | Actual * |
|---|---|---|---|---|---|
| Cooperative Agreements | 100% | Full & Open Competition | 100% | Industry | 95% |
| Cost Reimbursable | 0% | Sole Source | 0% | Government | |
| Fixed Price | 0% | | 100% | NASA Intramural | 5% |
| Grants | 0% | | | University | 0% |
| Other | 0% | Sci Peer Review | 100% | Non Profit | 0% |
| * as % of FY02 direct procurement | 100% | * as % of FY02 direct procurement | | * as % of FY02 direct procurement | 100% |

| Future Acquisitions - Major | Selection | Goals |
|---|---|---|
| None - all major acquisitions are in place. | N/A | N/A |

## AGREEMENTS

*Internal:* The project is not dependent on other NASA activities outside of the control of the Associate Administrator for Space Science.
*External:* None.
**Changes since FY03 Pres. Budget: None.**

## INDEPENDENT REVIEWS

| Types of Review | Performer | Last Review | Next Review | Purpose |
|---|---|---|---|---|
| Confirmation Assessment | HQ/OSS | N/A | TBD | Approval to continue to Phase C/D. |
| Independent Assessment | Disc. PO | N/A | TBD | CDR Review; ATLO (Pre-Environmental Review). |

## BUDGET / LIFE CYCLE COST

| Budget Authority | Prior | FY02 | FY03 | FY04 | FY05 | FY06 | FY07 | FY08 | BTC | Total | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|
| FY 2004 President's Budget | | 4.3 | 25.5 | 51.1 | 133.6 | 113.8 | 62.1 | 26.1 | | 416.4 | Baseline to be established at Confirmation Review; project not yet in implementation. |
| Development | | 4.3 | 25.5 | 48.3 | 105.5 | 87.6 | 39.5 | 11.1 | | 321.8 | |
| Launch Vehicle | | | | 2.7 | 28.1 | 26.2 | 22.6 | | | 79.5 | |
| Operations | | | | | | | | 11.5 | | 11.5 | |
| Data Analysis | | | | | | | | 3.6 | | 3.6 | |
| Changes since FY 03 PBS | | +4.3 | +25.5 | +51.1 | +133.6 | +113.8 | +62.1 | +26.1 | | +416.4 | ***Reason for Change:*** |
| Development | | +4.3 | +25.5 | +48.3 | +105.5 | +87.6 | +39.5 | +11.1 | | +321.8 | New mission selection |
| Launch Vehicle | | | | +2.7 | +28.1 | +26.2 | +22.6 | | | +79.5 | |
| Operations | | | | | | | | +11.5 | | +11.5 | |
| Data Analysis | | | | | | | | +3.6 | | +3.6 | |
| FY 2003 President's Budget (LCC) | | | | | | | | | | | N/A - selected 12/01. |
| Initial Baseline (LCC) | | | | | | | | | | | TBD (See above). |

Indicates budget numbers in full cost.
Indicates changes since the FY 2003 President's Budget Submit.
FY 2002, FY 2003, Prior and BTC are not in full cost.

**THEME:** Astronomical Search for Origins (ASO)

# OPERATIONS

## PURPOSE

| Objectives | Reference 2003 Strategic Plan | Performance Measures |
|---|---|---|
| 5.10, 5.11, 5.12 | | 4ASO4-11 |

Maximize the scientific return from NASA's investment in spacecraft and other data collection sources by efficiently and reliably operating the data-collecting hardware that enables scientific discoveries.

## OVERVIEW

ASO Operations currently supports the Hubble Space Telescope (HST) and the Far Ultraviolet Spectroscopic Explorer (FUSE). HST provides a serviceable, state-of-the-art, orbiting observatory to study the history of the Universe. FUSE studies physical processes governing the evolution of galaxies, as well as the origin and evolution of stars and planetary systems. The Space Infrared Telescope Facility is planned for launch in spring 2003, and will study the formation of stars, galaxies and planets via spectroscopy, high-sensitivity photometry and imaging.

For more information on HST, go to: http://hubble.gsfc.nasa.gov/index.html
For more information on FUSE, go to: http://fuse.pha.jhu.edu/
For more information on SIRTF, go to: http://sirtf.caltech.edu

## PROGRAM MANAGEMENT

Enterprise official is Dr. Edward Weiler, Associate Administrator for Space Science. Theme Director and point of contact is Dr. Anne Kinney, Director of Astronomy and Physics at NASA HQ. HST and FUSE are managed by the Goddard Space Flight Center. SIRTF is managed by the Jet Propulsion Laboratory. This program is in full compliance with NPG7120.5B.

## TECHNICAL COMMITMENT

The baseline is documented in the Program Commitment Agreement for each ASO mission.

| Technical Specifications | FY04 President's Budget | Change from Baseline |
|---|---|---|
| All missions will meet Level I specifications as identified in the Program Plan. | | -- |

| Schedule | FY04 President's Budget | Change from Baseline |
|---|---|---|
| Hubble Space Telescope | Operate until 2010, or until the end of safe recoverable status. | -- |
| Far Ultraviolet Spectroscopic Explorer | Operate through 2006. | -- |
| Space Infrared Telescope Facility | Operate up to 7 years after launch (planned for 4/03). | -- |

**THEME:** Astronomical Search for Origins (ASO)

# OPERATIONS

## ACQUISITION STRATEGY & PERFORMING ORGANIZATIONS

The prime contractor for HST operations is the Consolidated Space Operations Contractor, Lockheed Martin Space Operations. FUSE operations are performed by the Johns Hopkins University. SIRTF operations will be performed by the Jet Propulsion Laboratory. In FY02, direct procurement represented 100% of budget authority. **Changes since FY03 Pres. Budget: None.**

| Current Acquisitions | Actual * | Selection Method | Actual * | Performer | Actual * |
|---|---|---|---|---|---|
| Cooperative Agreements | 0% | Full & Open Competition | 100% | Industry | 66% |
| Cost Reimbursable | 100% | Sole Source | | Government | 0% |
| Fixed Price | 0% | | 100% | NASA Intramural | 0% |
| Grants | 0% | | | University | 0% |
| Other | 0% | Sci Peer Review | 100% | Non Profit | 34% |
| * as % of FY02 direct procurement | 100% | * as % of FY02 direct procurement | | * as % of FY02 direct procurement | 100% |

| Future Acquisitions - Major | Selection | Goals |
|---|---|---|
| CSOC recompetition | late 2003 | 100% Full & Open Competition |

## AGREEMENTS

*Internal:* The program is not dependent on other NASA activities outside of the control of the Associate Administrator of Space Science.

*External:* None.

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

## INDEPENDENT REVIEWS

| Types of Review | Performer | Last Review | Next Review | Purpose |
|---|---|---|---|---|
| Senior Review | Ext. panel | June '02 | Summer '04 | To consider mission extensions and funding levels for operating ASO spacecraft that have completed their prime mission, based on science productivity and cost. |

## BUDGET

| Budget Authority ($ in millions) | FY02 | FY03 | FY04 | Comments |
|---|---|---|---|---|
| FY 2004 President's Budget | 8.5 | 9.7 | 24.6 | |
| HST Operations | 5.3 | 5.1 | 8.8 | |
| SIRTF Operations | | 3.2 | 14.4 | |
| SOFIA Operations | | | | |
| FUSE Operations | 3.2 | 1.4 | 1.5 | |
| Kepler Operations | | | | |
| Changes since FY 03 Pres. Budget | +1.4 | | +10.6 | ***Reason for Change:*** |
| HST Operations | +0.3 | | +3.5 | full cost |
| SIRTF Operations | | | +7.1 | revised estimates |
| SOFIA Operations | | | | full cost |
| FUSE Operations | +1.1 | | +0.1 | recovery from spacecraft anomaly |
| Kepler Operations | | | | new mission selection |

Indicates budget numbers in full cost.

Indicates changes since the FY 2003 President's Budget Submit.

FY 2002 and FY 2003 are not in full cost.

**THEME:** Astronomical Search for Origins (ASO)

# RESEARCH

## PURPOSE

| Objectives | Reference 2003 Strategic Plan | Performance Measures |
|---|---|---|
| 5.10, 5.11, 5.12, 6.1, 6.2, 6.3, 6.4, 7.1, 7.2 | | 4ASO2, 4ASO4-19 |

The Research Program provides fundamental data analysis for operating ASO missions including HST, SIRTF, and FUSE. The Research Program also supports fundamental research and analysis vital to the successful completion of strategic goals and objectives.

## OVERVIEW

The ASO research program supports ASO Reseach and Analysis (R&A) and the analysis of data (DA) from the ASO operating missions, and the science data tools and archives needed to perform the research. DA programs are tied to specific missions, which are focused on the achievement of specific strategic objectives. The scope of R&A programs is generally wider because they must provide the new theories and instrumentation that enable the next generation of flight missions. The alignment of Reseach programs with ASO strategic goals is ensured through two mechanisms. First, NASA Research Announcements soliciting R&A proposals contain explicit prioritization criteria with respect to Enterprise objectives. Second, the entire R&A program is reviewed triennially to assess scientific quality and productivity of the major components and to adjust plans to best support Enterprise goals. Data Analysis (DA) programs have traditionally been performed by mission instrument teams and interdisciplinary scientists competitively selected for an individual mission for the lifetime of that mission. The DA program also includes annual, open and competitive solicitations to all missions that can accommodate "guest investigations."

| | |
|---|---|
| OSS Research Opportunities Site | http://research.hq.nasa.gov/code_s/code_s.cfm |
| Space Science Missions Site | http://spacescience.nasa.gov/missions/index.htm |
| Hubble Site | http://hubble.stsci.edu/ |

## PROGRAM MANAGEMENT

NASA Headquarters is responsible for the ASO Research Program. Enterprise official is Dr. Edward Weiler, Associate Administrator for Space Science at NASA HQ. Theme Director and point of contact is Dr. Anne Kinney, Director of the Astronomy and Physics Division at NASA HQ. This program is in full compliance with NPG7120.5B.

## TECHNICAL COMMITMENT

Baselines for research are consistent with those defined in individual Research Announcements released by the Office of Space Science. Data Analysis baselines are defined by the Program PCA or equivalent document.

| Technical Specifications | FY04 President's Budget | Change from Baseline |
|---|---|---|
| | The NASA Strategic Plan has incorporated results of the OSS Strategic Planning process, which specifies a series of goals, strategic objectives and research focus areas. The OSS Strategic Plan draws from the Astronomy and Physics Decadal Survey (NRC), as well as the road mapping activities by the Astronomical Search for Origins Subcommittee. All selections processes and reviews of the elements of the ASO research program use these strategic items as guide posts for selection and/or continuation. Proposals for research must relate to these strategic items. | -- |

| Schedule | FY04 President's Budget | Change from Baseline |
|---|---|---|
| R & A | | |
| Research Opportunities In Space Science (ROSS) | Yearly in February | -- |
| Data Analysis | | |
| Senior Reviews | Every Two Years | -- |

**THEME:** Astronomical Search for Origins (ASO)

# RESEARCH

## ACQUISITION STRATEGY & PERFORMING ORGANIZATIONS

The Research and Analysis (R&A) and Data Analysis (DA) programs make awards following peer reviewed competitions under NASA Research Announcements (NRAs), Announcements of Opportunity (AOs) and Cooperative Agreement Notices (CANs). In FY 02, direct procurement represented 100% of budget authority.
**Changes since FY 03 Pres. Budget: None.**

| Current Acquisitions | Actual * | Selection Method | Actual * | Performer | Actual * |
|---|---|---|---|---|---|
| Cooperative Agreements | 1% | Full & Open Competition | 98% | Industry | 3% |
| Cost Reimbursable | 32% | Sole Source | 2% | Government | 4% |
| Fixed Price | 7% | | 100% | NASA Intramural | 7% |
| Grants | 49% | | | University | 71% |
| Other | 11% | Sci Peer Review | 100% | Non Profit | 15% |
| * as % of FY02 direct procurement | 100% | * as % of FY02 direct procurement | | * as % of FY02 direct procurement | 100% |

| Future Acquisitions - Major | Selection | Goals |
|---|---|---|
| Annual R&A research announcement | Late 2003 | 100% Science Peer Review |
| Annual HST call for proposals | April 2003 | 100% Science Peer Review |

## AGREEMENTS

*Internal:* The program is not dependent on other NASA activities outside of the control of the Associate Administrator for Space Science.
*External:* HST Data Analysis involves agreements with the European Space Agency.
**Changes since FY03 Pres. Budget: None.**

## INDEPENDENT REVIEWS

| Types of Review | Performer | Last Review | Next Review | Purpose |
|---|---|---|---|---|
| MO&DA Senior Review | Sr. Review committee | June '02 | Summer '04 | To recommend approval and funding level for extending the science investigations of the operating ASO missions. |
| R&A peer review | Peer review committee | Summer '02 | Summer '03 | To review ASO proposals responding to the annual R&A announcement. |

## BUDGET

| Budget Authority ($ in millions) | FY02 | FY03 | FY04 | Comments |
|---|---|---|---|---|
| FY 2004 President's Budget | 115.7 | 145.9 | 198.9 | |
| ASO R&A | 22.3 | 23.6 | 29.3 | |
| ASO Data Analysis | 93.4 | 122.3 | 169.7 | |
| | | | | |
| Changes since FY 03 PBS | -2.1 | | +16.1 | ***Reason for Change:*** |
| ASO R&A | | | +2.0 | full cost |
| ASO Data Analysis | -2.1 | | +14.1 | full cost |

Indicates budget numbers in full cost.
Indicates changes since the FY 2003 President's Budget Submit.
FY 2002 and FY 2003 are not in full cost.

**THEME:** Astronomical Search for Origins (ASO)

# TECHNOLOGY AND ADVANCED CONCEPTS

## PURPOSE

| Objectives | Reference 2003 Strategic Plan | Performance Measures |
|---|---|---|
| 5.10, 5.11, 5.12 | | 4ASO4-9, 11 |

The ASO Technology and Advanced Concepts program includes future missions in formulation, and the development of advanced technologies needed for specific science missions. This process begins with mission studies - the first phase of flight program development. In this phase, scientists work collaboratively with technologists and mission designers to develop the most effective alignment of technology development programs with future mission requirements. This collaboration enables intelligent technology investment decisions through detailed analysis of the trade-offs between design considerations and cost. In ASO, future missions will seek to detect and characterize distant planetary bodies around other stars, probe ever farther into the deepest reaches of space with increasing resolution, and bring us new understanding of the nature of matter and energy. Technologies critical to the success of these missions include interferometry, high performance sensors, lightweight large-aperture reflectors, cryocoolers for infrared detectors, and autonomous information technology.

## OVERVIEW

ASO projects in this phase of implementation during FY04 include the James Webb Space Telescope (JWST), the Space Interferometry Mission (SIM), and the ground-based Keck Interferometer, as well as various smaller efforts, such as the Large Binocular Telescope Interferometer (LBTI). In keeping with the Search for Origins theme, technology development from these missions will serve as stepping stones for eventual launch of the Terrestrial Planet Finder (TPF). The StarLight flight segment has been cancelled, as it was not clear that TPF will require a space-based interferometry demonstration, while ground-based StarLight work has continued in support of the program.

JWST promises to expand upon the legacy of the Hubble Space Telescope, focusing on previously unobserved periods in the development of the Universe (one million to several billion years old). Projects comprising the Navigator Program (including the Space Interferometry Mission, the Terrestrial Planet Finder, and the Keck Interferometer) will seek to detect and characterize Earth-like planets, understand the formation and distribution of planetary systems in our galaxy, and contribute to understanding the formation and evolution of stars, planets and galaxies. For example, by observing thousands of stars, SIM will detect planets through high-resolution and starlight nulling imagery, and serve as a science and technological pathfinder for TPF.

## PROGRAM MANAGEMENT

Program responsibility has been delegated to GSFC for the James Webb Space Telescope, and to Jet Propulsion Laboratory (JPL) for the Navigator Program. The Agency Program Management Council (PMC) has governing responsibility for flight projects; at the time of SRR, the Enterprise Governing Program Management Council has oversight for Navigator ground-based projects. Enterprise official is Dr. Edward Weiler, Associate Administrator for Space Science at NASA HQ. Theme Director and point of contact is Dr. Anne Kinney, Director of Astronomy and Physics at NASA HQ. With the minor exceptions noted in the Navigator Program PCA, this program is in full compliance with NPG7120.5B.

## TECHNICAL COMMITMENT

Project technical baselines are defined by the individual Formulation Authorization Document (FAD), Program Commitment Agreement (PCA) or equivalent documentation.

| Technical Specifications | FY04 President's Budget | Change from Baseline |
|---|---|---|
| Space Interferometry Mission (SIM) | 3 Michelson Stellar Interferometers; 5 year mission life; 10 year goal | No established baseline until confirmation. |
| James Webb Space Telescope (JWST) | 6m-class segmented active optic; wavelength range 0.6 to 28 microns | No established baseline until confirmation. |
| Terrestrial Planet Finder (TPF) | IR Interferometer or Visible Coronagraph | No established baseline until confirmation. |
| Keck Interferometer | Two 10m telescopes and four 1.8m outriggers; 85-meter baseline between telescopes | -- |

**THEME:** Astronomical Search for Origins (ASO)

# TECHNOLOGY AND ADVANCED CONCEPTS

## TECHNICAL COMMITMENT - CONTINUED

| Schedule | FY04 President's Budget | Change from Baseline |
|---|---|---|
| Space Interferometry Mission (SIM) | December 2009 Launch | No established baseline until confirmation. |
| James Webb Space Telescope (JWST) | June 2010 Launch | No established baseline until confirmation. |
| Terrestrial Planet Finder (TPF) | Launch TBD | No established baseline until confirmation. |
| Keck Interferometer | Operational through 2020 | -- |

## ACQUISITION STRATEGY & PERFORMING ORGANIZATIONS

Major acquisitions for JWST include observatory development, with Northrop Grumman Space Technology (formerly TRW) as prime contractor; instrument complement to be acquired under AO.

Navigator acquisition strategy relies on the capabilities of JPL, universities, and other NASA Centers to develop "first application" technologies. Additionally, the program will develop strategic collaborations with appropriate technical entities to acquire proven hardware and promote technology transfer. Where an industrial firm has a unique capability, it may be engaged to develop first technology applications.

Current Navigator participants include Lockheed-Martin Missles and Space, TRW Space and Electronics Group, Ball Aerospace and Technologies, Boeing-SVS, Eastman Kodak, Goodrich Coorporation, CalTech, University of Arizona, MIT, CA Association for Research in Astronomy (CARA), Princeton University and others.
**Changes since FY03 Pres. Budget: None.**

| Current Acquisitions | Actual * | Selection Method | Actual * | Performer | Actual * |
|---|---|---|---|---|---|
| Cooperative Agreements | 4% | Full & Open Competition | 80% | Industry | 12% |
| Cost Reimbursable | 74% | Sole Source | 20% | Government | |
| Fixed Price | 4% | | 100% | NASA Intramural | 16% |
| Grants | 1% | | | University | 64% |
| Other | 17% | Sci Peer Review | 100% | Non Profit | 8% |
| * as % of FY02 direct procurement | 100% | * as % of FY02 direct procurement | | * as % of FY02 direct procurement | 100% |

| Future Acquisitions - Major | Selection | Goals |
|---|---|---|
| 1. JWST Operations - STScI | FY2003 | Sole Source |
| 2. TPF Technology Demonstration Mirror | Q2 FY03 | Full & Open Competition |
| 3. TPF Cryocooler | Q2 FY03 | Full & Open Competition |

**THEME:** Astronomical Search for Origins (ASO)

# TECHNOLOGY AND ADVANCED CONCEPTS

## AGREEMENTS

*Internal:* The program is not dependent on other NASA activities outside of the control of the Associate Administrator of Space Science.
*External:* Memorandum of Understanding (MOU) exists between TPF and the European Space Agency's (ESA) Darwin mission.
**Changes since FY 2003 President's Budget: None.**

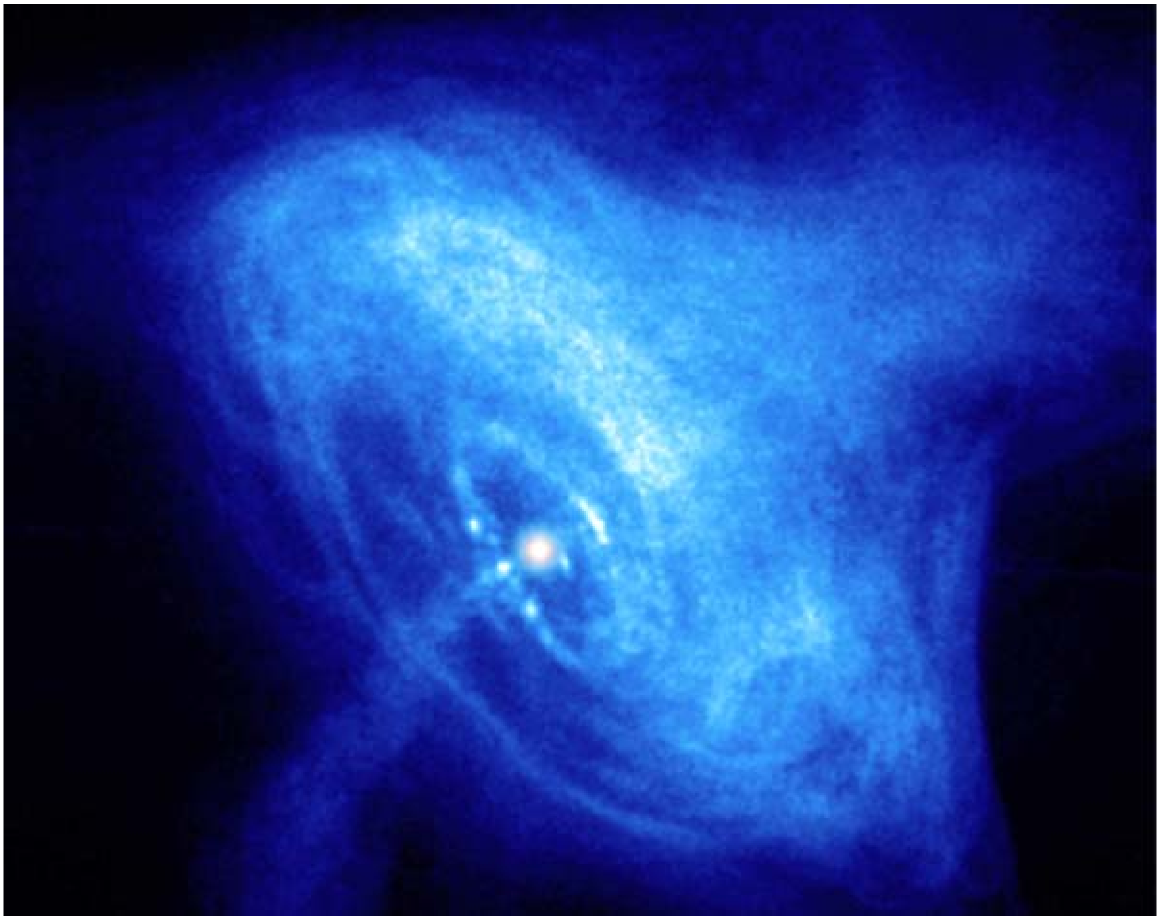
## INDEPENDENT REVIEWS

| Types of Review | Performer | Last Review | Next Review | Purpose |
|---|---|---|---|---|
| Indep. Implementation Reviews | IRT/IPAO | Aug-02 | Nov-02 | To ensure compliance with defined technical, cost and schedule thresholds (PCAs, Roadmaps). |

## BUDGET

| Budget Authority ($ in millions) | FY02 | FY03 | FY04 | Comments |
|---|---|---|---|---|
| FY 2004 President's Budget | 181.9 | 283.8 | 411.2 | |
| SIM | 37.7 | 39.5 | 79.8 | |
| JWST | 83.6 | 126.2 | 254.6 | |
| TPF | 15.0 | 19.7 | 44.2 | |
| StarLight | 17.2 | 67.3 | | Flight segment cancelled. |
| Keck | 6.4 | 9.3 | 9.8 | |
| Other | 22.0 | 21.8 | 22.7 | |
| Changes since FY 03 Pres. Budget | -21.4 | | -56.2 | |
| SIM | +2.8 | | -5.2 | |
| JWST | -8.5 | | +38.6 | |
| TPF | -2.8 | | +24.2 | |
| StarLight | -11.5 | | -119.6 | Flight segment cancelled. |
| Keck | +0.2 | | +0.1 | |
| Other | -1.6 | | +5.6 | |

Indicates budget numbers in full cost.
Indicates changes since the FY 2003 President's Budget Submit.
FY 2002 and FY 2003 are not in full cost.



This image captures the spectacle of matter and antimatter propelled to near the speed of light by the Crab pulsar, a rapidly rotating neutron star the size of Manhattan. The Crab is the result of a supernova (a stellar explosion) that was observed by Chinese astronomers in 1054 A.D. The inner ring is about one light year across. Studies of the Crab are improving our understanding of what happens when a massive star dies and leading us toward a better understanding or the universe. More information can be found at http://universe.nasa.gov/

# STRUCTURE AND EVOLUTION OF THE UNIVERSE

## MAJOR EVENTS IN 2004

- SWIFT gamma-ray burst explorer begins science operations following launch in late 2003.
- GLAST will conduct its Critical Design Review.

## THEME: Structure and Evolution of the Universe (SEU)

### OVERVIEW

The Universe is a dynamic, evolving place. It is governed by cycles of matter and energy, an intricate series of physical processes in which the chemical elements are formed and destroyed, and passed back and forth between stars and diffuse clouds. The SEU theme seeks to understand these cycles and how they created the conditions for our own existence.

In FY04, the President's Budget request for SEU includes additional funding for the Beyond Einstein initiative. How did the Universe begin? Does time have a beginning and an end? Does space ever end? Einstein’s theory of relativity replies to these ancient questions with three startling predictions: that the Universe is expanding from a Big Bang; that black holes so distort space and time that time stops at their edges. Observations confirm these remarkable predictions, the last finding being made only four years ago. Yet Einstein’s legacy is incomplete. His theory raises—but cannot answer—three profound questions:

- What powered the Big Bang?
- What happens to space, time, and matter at the edge of a black hole?
- What is the mysterious, invisible dark energy pulling the Universe apart?

| Missions | Goals supported by this theme | Objectives supporting those goals |
|---|---|---|
| Explore the Universe and Search for Life | 5. Explore the solar system and the universe beyond, understand the origin and evolution of life, and search for evidence of life elsewhere. | 5.7 Discover what powered the Big Bang and the nature of the mysterious dark energy that is pulling the Universe apart. |
| | | 5.8 Learn what happens to space, time, and matter at the edge of a black hole. |
| | | 5.9 Understand the development of structure and the cycles of matter and energy in the evolving Universe. |
| Inspire the Next Generation of Explorers | 6. Inspire and motivate students to pursue careers in science, technology, engineering, and mathematics. | 6.1 Improve student proficiency in science, technology, engineering and mathematics using educational programs, products and services based on NASA’s unique missions, discoveries and innovations. (Supporting Role) |
| | | 6.2 Motivate K-16+ students from diverse communities to pursue science and math courses and ultimately college degrees in science, technology, engineering, and mathematics. (Supporting Role) |
| | | 6.3 Improve science, technology, and mathematics instruction with unique teaching tools and experiences that only NASA can provide, that are compelling to teachers and students. (Supporting Role) |
| | | 6.4 Improve higher education capacity to provide for NASA’s and the Nation’s future science and technology workforce requirements. (Supporting Role) |
| | 7. Engage the public in shaping and sharing the experience of exploration and discovery. | 7.1 Improve the capacity of science centers, museums, and other institutions, through the development of partnerships, to translate and deliver engaging NASA content. (Supporting Role) |
| | | 7.2 Improve science literacy by engaging the public in NASA missions and discoveries, and their benefits, through such avenues as public programs, community outreach, mass media, and the Internet. (Supporting Role) |

# THEME: Structure and Evolution of the Universe (SEU)

## RELEVANCE

The Structure and Evolution of the Universe Theme seeks to answer questions that humankind has been pondering for millennia: How did the Universe begin? How will it end? What are the limits of matter and energy, of space and time? How did the Universe we see arise, and what are the laws of nature that have permitted life to arise in the Universe? These questions have been the basis of mythology and philosophy in the past. They have seemed unanswerable until now. Using cutting edge science and technology, the SEU missions seek the answers.

| Education and Public Benefits |
|---|
| Black holes, the Big Bang, dark matter, and dark energy fascinate the American public and compel the attention of the news media and the entertainment industry. The SEU Theme leverages this fascination, with an education component that engages students in science and math and is aligned with national standards. It is a potent force with which to enhance science education and science literacy.<br><br>The origin of the Universe and black holes are central elements in K-12 science literacy standards and curricula. The television shows and educational materials for “Live from a Black Hole” and “Live from the Edge of Space” reached an estimated five million students. Public television’s NOVA program on dark energy ("Runaway Universe") was seen initially by more than two million Americans. SEU missions will soon provide the majority of materials on these subjects in our nation’s schools, weaving an ongoing story that is one of the most compelling in all science. |

## STATUS

RXTE, Chandra, XMM, HETE-2, MAP, and INTEGRAL are operational and producing outstanding science. In 2002, Chandra uncovered evidence for a new form of matter when it discovered a "strange quark star," even denser than nuclear matter on Earth. Chandra has also tracked the life cycle of x-ray jets being emitted at near-light speed from a black hole. HETE-2 identified a gamma-ray burst, and within seconds provided the an accurate position, so that it could be extensively studied at other wavelengths.

## IMPLEMENTATION

The Structure and Evolution of the Universe theme is composed of many elements that work together to achieve the program's goals and objectives. Repeated management and scientific peer reviews ensure that each mission provides data in a cost-effective manner. In many cases, the data obtained from different missions are complementary, and are combined in cross-disciplinary studies by members of the scientific community.

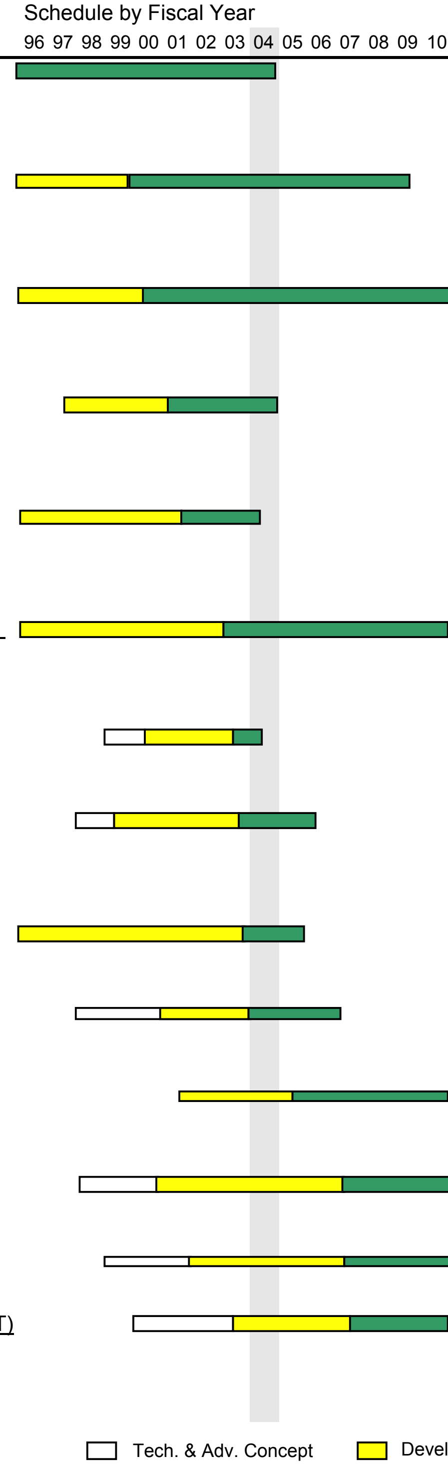
Theme responsibility resides in the Office of Space Science at NASA Headquarters. Enterprise official is Dr. Ed Weiler, Associate Administrator for Space Science. Theme director and point of contact is Dr. Anne Kinney, Director of the Astronomy and Physics Division at Headquarters. This theme is in full compliance with NPG 7120.5B.

## THEME: Structure and Evolution of the Universe (SEU)

### IMPLEMENTATION - CONTINUED

| Strategy | Purpose |
|---|---|
| Rossi X-ray Timing Explorer (RXTE) | Observe the high-energy worlds of black holes, neutron stars, x-ray pulsars and bursts. |
| Chandra X-ray Observatory (CXO) | Explore the hot, turbulent regions in space with images 25 times sharper than previous x-ray pictures. |
| XMM-Newton | Conduct sensitive X-ray spectroscopic observations of a wide variety of cosmic sources. |
| High Energy Transient Experiment (HETE-2) | Carry out a multiwavelength study of gamma ray bursts with UV, X-ray, and gamma ray instruments. |
| Microwave Anisotropy Probe (MAP) | Probe the early universe by measuring the cosmic microwave background radiation over the full sky. |
| International Gamma Ray Astrophysics Laboratory (INTEGRAL) | Unravel the secrets of the highest-energy - i.e. the most violent - phenomena in the Universe. |
| Cosmic Hot Interstellar Plasma Spectrometer (CHIPS) | Study the "Local Bubble" of hot gas surrounding our Solar System. |
| Galaxy Evolution Explorer (GALEX) | Explore the origin and evolution of galaxies and the origins of stars and heavy elements. |
| Gravity Probe-B (GP-B) | Precisely measure an effect that is predicted by all viable relativistic theories of gravity. |
| Swift | Study the position, brightness, and physical properties of gamma ray bursts. |
| Astro-E2 | Unravel complex, high-energy processes and the behavior of matter under extreme conditions. |
| Planck | Testing theories of the early universe and the origin of cosmic structure. |
| Herschel | Help solve the mystery of how stars and galaxies were born. |
| Gamma Ray Large Area Space Telescope (GLAST) | Study the high energy gamma rays from natural particle accelerators throughout the Universe. |

Schedule by Fiscal Year




Link to Additional Mission Information

| Tailoring |
|---|
| No exceptions to NPG 7120.5B have been taken. |

## THEME: Structure and Evolution of the Universe (SEU)

### PERFORMANCE MEASURES

| Annual Performance Goals | |
|---|---|
| | OUTCOME: A well managed program in accordance with Agency implementing strategies. |
| 4SEU1 | Each Development project will complete its current phase within 10% of total life-cycle cost shown on the table below. |
| 4SEU2 | Each Research project will allocate 75% of its funding competitively during FY04. |
| 4SEU3 | SEU will complete all of its missions within 10% of their baseline schedules. |
| 5.7.1 | OUTCOME: Discover what powered the Big Bang and the nature of the mysterious dark energy that is pulling the Universe apart. |
| 4SEU4 | Successfully demonstrate progress in search for gravitational waves from the earliest moments of the Big Bang. Progress towards achieving outcomes will be validated by external review. |
| 4SEU5 | Successfully demonstrate progress in determining the size, shape, and matter-energy content of the Universe. Progress towards achieving outcomes will be validated by external review. |
| 4SEU6 | Successfully demonstrate progress in measuring the cosmic evolution of the dark energy, which controls the destiny of the Universe. Progress towards achieving outcomes will be validated by external review. |
| 5.8.1 | OUTCOME: Learn what happens to space, time, and matter at the edge of a black hole. |
| 4SEU7 | Successfully demonstrate progress in determining how black holes are formed, where they are, and how they evolve. Progress towards achieving outcomes will be validated by external review. |
| 4SEU8 | Successfully demonstrate progress in testing Einstein's theory of gravity and mapping space-time near event horizons of black holes. Progress towards achieving outcomes will be validated by external review. |
| 4SEU9 | Successfully demonstrate progress in observing stars and other material plunging into black holes. Progress towards achieving outcomes will be validated by external review. |
| 5.9.1 | OUTCOME: Understand the development of structure and explore the cycles of matter and energy in the evolving Universe. |
| 4SEU10 | Successfully demonstrate progress in determining how, where, and when the chemical elements were made, and tracing the flows of energy and magnetic fields that exchange them between stars, dust, and gas. Progress towards achieving outcomes will be validated by external review. |
| 4SEU11 | Successfully demonstrate progress in exploring the behavior of matter in extreme astrophysical environments, including disks, cosmic jets, and the sources of gamma-ray bursts and cosmic rays. Progress towards achieving outcomes will be validated by external review. |
| 4SEU12 | Successfully demonstrate progress in discovering how the interplay of baryons, dark matter, and gravity shapes galaxies and systems of galaxies. Progress towards achieving outcomes will be validated by external review. |
| 6.1.1 | OUTCOME: Kindergarten through graduate students will be more proficient in science, technology, engineering, and mathematics (STEM). |
| 4SEU13 | Provide opportunities for students to work directly with NASA space science missions, facilities, and data. |
| 6.2.1 | OUTCOME: More students from diverse communities motivated to pursue careers in STEM. |
| 4SEU14 | Provide new opportunities for participation in the space science program by an increasingly diverse population, including opportunities for minorities and minority universities to compete for and participate in space science missions, research, and education programs. |
| 6.3.1 | OUTCOME: Improve the quality of STEM education. |
| 4SEU15 | Provide high quality educational materials and teacher training based on Theme content and focused on national curriculum standards. |
| 4SEU16 | Provide exhibits, materials, workshops, and personnel at national and/or regional education and outreach conferences. |
| 6.4.1 | OUTCOME: More students prepared to enter the STEM workforce. |
| 4SEU17 | Provide higher education opportunities offered through OSS research awards and other NASA research and education programs. |
| 7.1.1 | OUTCOME: Improve the capacity of science centers, museums, and other institutions, through the development of partnerships, to translate and deliver engaging NASA content. |
| 4SEU18 | Through partnerships with major science museums or planetariums, put on display or on tour major exhibitions or planetarium shows based on Theme content. |
| 4SEU19 | Provide materials and technical expertise to support the development of exhibits and programs at science museums and planetariums. |
| 7.2.1 | OUTCOME: Engage the public in NASA missions and discoveries through such avenues as public programs, community outreach, mass media, and the Internet. |
| 4SEU20 | Seek out and capitalize on special events and particularly promising opportunities in the Theme science program to bring space science to and involve the public in the process of scientific discovery. |

## THEME: Structure and Evolution of the Universe (SEU)

### INDEPENDENT REVIEWS

| Types of Review | Performer | Last Review | Next Review | Purpose |
|---|---|---|---|---|
| Nat'l Academy of Sciences | Space Studies Board | 7/02 | TBD | Effectiveness and quality of the program |
| Advisory Council | NAC | 9/02 | 3 times/year | Review science strategy, prog. Imp. strategy |
| | SSAC | 8/02 | 3 times/year | Review science strategy, prog. Imp. strategy |
| | SEU Subcommittee | 8/02 | 3 times/year | Review science strategy, prog. Imp. strategy |

### BUDGET

| Budget Authority ($millions) | FY02 | FY03 | Chng | FY04 | Comments |
|---|---|---|---|---|---|
| **SEU** | **350.1** | **331.1** | **+100.5** | **431.6** | |
| Development | 198.9 | 144.8 | +28.9 | 173.8 | |
| GP-B | 54.1 | 19.7 | -19.7 | | |
| GLAST | 20.7 | 69.2 | +46.5 | 115.7 | |
| Swift | 66.9 | 33.5 | -33.5 | | |
| Small Projects | 57.3 | 22.4 | +35.7 | 58.1 | |
| Operations | 6.4 | 10.7 | -0.4 | 10.3 | |
| Research | 131.7 | 154.0 | +32.6 | 186.6 | |
| Technology and Advanced Concepts | 13.0 | 21.5 | +39.4 | 60.9 | Includes New Initiative - Beyond Einstein (see SAE 5-2). |

Note: For all formats, the FY 02 column reflects the FY 2002 Congressional Operating Plan dated 9/30/02. The FY 03 column reflects the FY 2003 President's Budget Submit (PBS) as Amended. The Change column includes both programmatic and full cost adjustments. FY 2004 column is in full cost.

Indicates budget numbers in Full Cost.
Indicates changes since the FY 2003 President's Budget Submit.
FY 2002 and FY 2003 are not in full cost.

| THEME: | Structure and Evolution of the Universe (SEU) |
|---|---|
| **DEVELOPMENT:** | Gravity Probe B (GP-B) |

## PURPOSE

| Objectives Reference 2003 Strategic Plan | Performance Measures |
|---|---|
| 5.7, 5.8, 5.9, 6.1, 6.2, 6.3, 6.4, 7.1, 7.2 | 4SEU1,3,8,13-20 |

The purpose of Gravity Probe B is to verify certain extraordinary predictions of Einstein's theory of general relativity. This is the most accepted theory of gravitation and of the large-scale structure of the Universe. General relativity is a cornerstone of our understanding of the physical world, and consequently of our interpretation of observed phenomena. An experiment is needed to explore and test more precisely the predictions of Einstein's theory in two areas: (1) a measurement of the "dragging of space" by rotating matter; and (2) a measurement of space-time curvature known as the "geodetic effect." The dragging of space has never been directly measured, and the geodetic effect needs to be measured more precisely. The precision required to make these measurements can only be achieved in space. Whether the experiment confirms or contradicts Einstein's theory, its results will be of the highest scientific importance. The measurements of both the frame dragging and geodetic effects will allow Einstein's theory to be either rejected or given greater credence. The effect of invalidating Einstein's theory would be profound, and would call for major revisions of our concepts of physics and cosmology.

## OVERVIEW

The GP-B experiment will check, very precisely, tiny changes in the direction of spin of four gyroscopes contained in an Earth satellite orbiting at a 400-mile altitude directly over the poles. So free are the gyroscopes from disturbance that they will provide an almost perfect space-time reference system. They will measure how space and time are warped by the presence of the Earth, and, more profoundly, how the Earth's rotation drags space-time around with it.

GP-B is scheduled for launch in the latter half of FY 2003. NASA's FY 2004 budget request includes funding for GP-B under Operations and Data Analysis; no funds are requested for Development.

## PROGRAM MANAGEMENT

GP-B is a single-project program with program responsibility delegated to the Marshall Space Flight Center. The Agency Program Management Council (PMC) has GP-B governing responsibility. Enterprise official is Dr. Ed Weiler, Associate Administrator for Space Science at HQ. The Theme Director and the Point of Contact is Dr. Anne Kinney, Director of the Astronomy and Physics Division at HQ. This program is in full compliance with NPG7120.5B.

## TECHNICAL COMMITMENT

The baseline for this technical commitment was made in 3/1998 and is detailed in the GP-B Program Commitment Agreement (PCA).

| Technical Specifications | FY04 President's Budget | Change from Baseline |
|---|---|---|
| Geodetic Accuracy | Less than 0.5 milliarcseconds per year. | -- |
| Cryogenic Temperature | Maintained at less than -271 degrees Celsius for at least 16 months. | -- |
| Data Gathering | At least 12 months. | -- |
| Data Telemetry | To Stanford University or backup site. | -- |

| Schedule | FY04 President's Budget | Change from Baseline |
|---|---|---|
| Payload/SC Integration | Oct-01 | +2.0 years |
| Launch | Apr-03 | +2.5 years |

| THEME: | Structure and Evolution of the Universe (SEU) |
|---|---|
| **DEVELOPMENT:** | **Gravity Probe B (GP-B)** |

## ACQUISITION STRATEGY & PERFORMING ORGANIZATIONS

Stanford University is responsible for the scientific payload, and will provide spacecraft tracking and communications. Stanford also subcontracts with Ball Aerospace and Lockheed Martin Astronautics for the rest of the flight hardware. Ball provided the cryogenic dewar, and Lockheed Martin is providing the spacecraft and telescope. In FY02, direct procurement represented 100% of budget authority. **Changes since FY03 Pres. Budget: None.**

| Current Acquisitions | Actual * | Selection Method | Actual * | Performer | Actual * |
|---|---|---|---|---|---|
| Cooperative Agreements | 0% | Full & Open Competition | 6% | Industry | 7% |
| Cost Reimbursable | 92% | Sole Source | 94% | Government | |
| Fixed Price | 3% | | 100% | NASA Intramural | 4% |
| Grants | 0% | | | University | 89% |
| Other | 5% | Sci Peer Review | 100% | Non Profit | 1% |
| * as % of FY02 direct procurement | 100% | * as % of FY02 direct procurement | | * as % of FY02 direct procurement | 100% |

| Future Acquisitions - Major | Selection | Goals |
|---|---|---|
| 1. None - all major acquisitions are in place. | n/a | n/a |

## AGREEMENTS

*Internal:* The program is not dependent on other NASA activities outside of the control of the Associate Administrator for Space Science. *External:* None. **Changes since FY03 Pres. Budget: None.**

## INDEPENDENT REVIEWS

| Types of Review | Performer | Last Review | Next Review | Purpose |
|---|---|---|---|---|
| Schedule assessment | IRT | 19-Apr-02 | TBD | Assess feasibility of schedule plan. |
| Annual Review | IRT | 12-Sep-02 | TBD | Annual review, with focus on mission operations. |

## BUDGET/LIFE CYCLE COST

| Budget Authority ($ in millions) | Prior | FY02 | FY03 | FY04 | FY05 | FY06 | FY07 | FY08 | Total | Comments |
|---|---|---|---|---|---|---|---|---|---|---|
| FY 2004 President's Budget (LCC) | 565.2 | 54.1 | 28.9 | 14.6 | 5.8 | | | | 668.6 | |
| Development | 565.2 | 54.1 | 19.7 | | | | | | 639.0 | |
| Operations | | | 2.0 | 1.1 | | | | | 3.1 | |
| Data Analysis | | | 7.2 | 13.6 | 5.8 | | | | 26.6 | |
| Changes since FY 03 Pres. Budget | +0.5 | +8.0 | | +5.1 | +3.9 | | | | +17.5 | ***Reason for Change:*** |
| Development | +0.5 | +8.0 | | | | | | | +8.5 | Launch delay and assoc. overrun. |
| Operations | | | | +0.1 | | | | | +0.1 | Full cost. |
| Data Analysis | | | | +5.1 | +3.9 | | | | +9.0 | Launch delay and full cost. |
| FY 2003 President's Budget (LCC) | 564.7 | 46.1 | 28.9 | 9.5 | 1.9 | | | | 651.1 | Cost growth due to various |
| Development | 564.7 | 46.1 | 19.7 | | | | | | 630.5 | unanticipated tech challenges, |
| Operations | | | 2.0 | 1.0 | | | | | 3.0 | late delivery of payload. |
| Data Analysis | | | 7.2 | 8.5 | 1.9 | | | | 17.6 | |
| Initial Baseline (LCC) | 550.4 | | | | | | | | 550.4 | FY 97 Budget, Oct. '00 launch. |
| Development | 529.6 | | | | | | | | 529.6 | |
| Operations | 3.0 | | | | | | | | 3.0 | |
| Data Analysis | 17.8 | | | | | | | | 17.8 | |

Indicates budget numbers in full cost.
Indicates changes since the FY 2003 President's Budget Submit.
FY 2002, FY 2003, Prior and BTC are not in full cost.

| THEME: | Structure and Evolution of the Universe (SEU) |
|---|---|
| **DEVELOPMENT:** | Gamma-ray Large Area Space Telescope (GLAST) |

## PURPOSE

| Objectives | | Performance Measures |
|---|---|---|
| 5.7, 5.8, 5.9, 6.1, 6.2, 6.3, 6.4, 7.1, 7.2 | Reference 2003 Strategic Plan | 4SEU1,3,11,13-20 |

The GLAST program improves our understanding of the structure of the Universe, from its earliest beginnings to its ultimate fate, and explores the limits of gravity and energy in the Universe. GLAST measures the direction, energy, and arrival time of celestial high-energy gamma rays. The goal of GLAST is to map the sky with 50 times the sensitivity, resolution, and coverage of previous high-energy gamma-ray missions.

## OVERVIEW

GLAST will provide new insights into the sources of gamma-ray bursts and high-energy cosmic gamma-rays, and reveal the nature of cosmic jets and relativistic flows. GLAST will provide a new tool to study how black holes, notorious for pulling matter in, can accelerate jets of gas outward at fantastic speeds. Physicists will be able to study subatomic particles at energies far greater than those seen in ground-based particle accelerators. They will also gain insight into the puzzling question of how energetic gamma-rays are produced in the magnetosphere of spinning neutron stars. Perhaps the biggest return will come from understanding the nature of the high-energy gamma-ray sources that have escaped detection at other wavelengths; these high-energy sources constitute the bulk of the 273 sources known. GLAST is a collaboration with the Department of Energy, France, Italy, Sweden, and Germany.

## PROGRAM MANAGEMENT

GLAST is a single-project program with program responsibility delegated to the Goddard Space Flight Center. Enterprise official is Dr. Ed Weiler, Associate Administrator for Space Science at NASA HQ. The Theme Director and point-of-contact is Dr. Anne Kinney, Director of the Astronomy and Physics Division at HQ. This program is in full compliance with NPG7120.5B.

## TECHNICAL COMMITMENT

The baseline for this technical commitment is the Formulation Authorization Document (FAD).

| Technical Specifications | FY04 President's Budget | Change from Baseline |
|---|---|---|
| LAT - Large Area Telescope | | |
| - Collection Area | 1,000 - 13,000 sq. centimeters (depends on energy of photon). | -- |
| - Energy Range | 20 MeV - 300 GeV | -- |
| - Spatial Resolution | 5 arcminutes - 5 degrees (depends on energy of photon). | -- |
| GBM - GLAST Burst Monitor | | |
| - Collection Area | 40 - 110 sq. centimeters (depends on photon energy and off-axis angle). | -- |
| - Energy Range | 10 keV - 25 MeV | -- |
| - Spatial Resolution | 3 degrees | -- |
| Spacecraft Pointing Knowledge | 5 arcsec | -- |
| Operational Capability | 5-yr. Life, pointing and scanning modes, immediate burst notice to ground. | -- |

| Schedule | FY04 President's Budget | Change from Baseline |
|---|---|---|
| PDR | Feb-03 | -- |
| NAR | Mar-03 | -- |
| CDR | Feb-04 | -- |
| Launch | Sep-06 | -- |

**THEME:** Structure and Evolution of the Universe (SEU)

# DEVELOPMENT Gamma-ray Large Area Space Telescope (GLAST)

## ACQUISITION STRATEGY & PERFORMING ORGANIZATIONS

Major acquisitions for GLAST are the Large Area Telescope (LAT) at Stanford University and the GLAST Burst Monitor (GBM) at Marshall Space Flight Center. Spectrum Astro Inc. will provide the spacecraft. The Science Operations Center will be a NASA solicitation or GSFC development. Guest Observers will be selected via a NASA solicitation. The Mission Operations Center will be managed in-house by GSFC. **Changes since FY03 Pres. Budget: None.**

| Current Acquisitions | Actual * | Selection Method | Actual * | Performer | Actual * |
|---|---|---|---|---|---|
| Cooperative Agreements | 0% | Full & Open Competition | 100% | Industry | 46% |
| Cost Reimbursable | 88% | Sole Source | 0% | Government | |
| Fixed Price | 5% | | 100% | NASA Intramural | 10% |
| Grants | 0% | | | University | 26% |
| Other | 7% | Sci Peer Review | 100% | Non Profit | 18% |
| * as % of FY02 direct procurement | 100% | * as % of FY02 direct procurement | | * as % of FY02 direct procurement | 100% |

| Future Acquisitions - Major | Selection | Goals |
|---|---|---|
| 1. None - all major procurements are in place | n/a | n/a |

## AGREEMENTS

*Internal:* The program is not dependent on other NASA activities outside of the control of the Associate Administrator of Space Science. *External:* Collaboration with Dept. of Energy, France, Italy, Japan and Sweden. **Changes since FY03 Pres. Budget: None.**

## INDEPENDENT REVIEWS

| Types of Review | Performer | Last Review | Next Review | Purpose |
|---|---|---|---|---|
| Indep Annual Review | TBD | N/A | TBD | Independent Review. |
| Non Advocate Review | IRT | N/A | Feb. 03 | Outside Review. |
| Confirmation Review | TBD | N/A | TBD | Authorization to proceed to development phase. |

## BUDGET/LIFE CYCLE COST

Total budget authority represents the Life Cycle Cost (LCC).

| Budget Authority ($ in millions) | Prior | FY02 | FY03 | FY04 | FY05 | FY06 | FY07 | FY08 | * BTC | Total | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|
| FY 2004 Pres. Bud. (LCC) | 12.6 | 20.7 | 69.2 | 115.7 | 86.6 | 91.2 | 60.4 | 25.1 | 172.5 | 654.0 | |
| ATD | 12.6 | | | | | | | | | 12.6 | |
| Development | | 20.7 | 69.2 | 94.4 | 53.3 | 62.3 | 38.6 | | | 338.6 | |
| Launch Services | | | | 21.3 | 33.3 | 28.9 | | | | 83.5 | |
| Mission Operations | | | | | | | 5.5 | 5.8 | 28.2 | 39.4 | |
| Data Analysis | | | | | | | 16.3 | 19.4 | 144.3 | 179.9 | |
| Changes since FY03 Pres. Bud. | | | | +9.0 | +11.6 | +47.8 | +40.2 | +25.1 | +10.7 | +133.7 | ***Reason for Change:*** |
| Development | | | | +19.8 | +6.0 | +38.9 | +38.6 | | | +103.4 | Full cost plus revised technical requirements. |
| Launch Services | | | | -10.8 | +5.6 | +18.0 | | | | +12.8 | Larger launch vehicle. |
| Mission Operations | | | | | | -2.5 | +0.8 | +5.8 | -5.0 | -1.0 | |
| Data Analysis | | | | | | -6.6 | +0.8 | +19.4 | +15.7 | +29.2 | Full cost; added reserves in BTC. |
| FY 2003 Pres. Bud. (LCC) | 12.6 | 20.7 | 69.2 | 106.7 | 75.0 | 43.4 | 20.2 | | 161.8 | 509.6 | |
| ATD | 12.6 | | | | | | | | | 12.6 | |
| Development | | 20.7 | 69.2 | 74.6 | 47.3 | 23.4 | | | | 235.2 | |
| Launch Services | | | | 32.1 | 27.7 | 10.9 | | | | 70.7 | |
| Mission Operations | | | | | | 2.5 | 4.7 | | 33.2 | 40.4 | |
| Data Analysis | | | | | | 6.6 | 15.5 | | 128.6 | 150.7 | |
| Initial Baseline (LCC) | | | | | | | | | | | Will be established at Confirmation Review. |

Indicates budget numbers in full cost.
Indicates changes since the FY 2003 President's Budget Submit.
FY 2002, FY 2003, Prior and BTC are not in full cost.

| | |
|---|---|
| **THEME:** | Structure and Evolution of the Universe (SEU) |
| **DEVELOPMENT:** | Swift Gamma-Ray Burst Explorer |

## PURPOSE

| Objectives Reference 2003 Strategic Plan | Performance Measures |
|---|---|
| 5.7, 5.8, 5.9, 6.1, 6.2, 6.3, 6.4, 7.1, 7.2 | 4SEU1,3,11,13-20 |

Studying approximately 500 gamma-ray bursts in its two-year prime mission, Swift has the capability to determine the origin of the still-mysterious gamma-ray bursts, and to use them to probe the conditions that existed in the early Universe. Swift is the first mission to focus on studying the afterglow from gamma-ray bursts. Swift will determine redshifts for most of the bursts that it detects (allowing us to know how far away they are and how bright they are in absolute terms), and will also provide detailed multi-wavelength light curves for the duration of the afterglow (allowing us to probe the physical environment in which the event took place).

## OVERVIEW

Swift is a NASA medium-size Explorer (MIDEX) mission being developed by an international collaboration for launch in 2003. Foreign participation includes Italy and the United Kingdom. The Swift mission consists of three science instruments; Burst Alert Telescope (BAT); X-Ray Telescope (XRT); and the UltraViolet/Optical Telescope (UVOT). The Swift spacecraft is being built by Spectrum Astro and will be launched on a Delta 2420.

## PROGRAM MANAGEMENT

Swift is a NASA medium size Explorer (MIDEX) mission with project responsibility delegated to the Goddard Space Flight Center. Enterprise official is Dr. Ed Weiler, Associate Administrator for Space Science at HQ. The Theme Director and the Point of Contact is Dr. Anne Kinney, Director of the Astronomy and Physics Division at HQ. This program is in full compliance with NPG7120.5B.

## TECHNICAL COMMITMENT

The technical commitment was made in 02/01 and is detailed in the SWIFT Level I Requirements Document appended to the Explorers Program Plan.

| Technical Specifications | FY04 President's Budget | Change from Baseline |
|---|---|---|
| Determine the Origin of GRB | Detect and image 300 (+10%). | -- |
| Number of GRBs Observed | Baseline of 300/Minimum of 200. | -- |
| Number of Afterglows Studied | Baseline 200/Mimimum 75. | -- |
| Mission Life | 3 years | -- |
| Operations | All GRB positions will be made available within seconds of their generation. Processed data will be available within 30 minutes. | -- |

| Schedule | FY04 President's Budget | Change from Baseline |
|---|---|---|
| Start of Implementation | Feb-01 | -- |
| Mission Critial Design Review | Jul-01 | -- |
| NSI Instrument Delivery | Nov-02 | -- |
| BAT Instrument Delivery | Feb-03 | -- |
| Complete S/C I & T | Jul-03 | -- |
| Launch | Sep-03 | -- |

| | |
|---|---|
| **THEME:** | Structure and Evolution of the Universe (SEU) |
| **DEVELOPMENT:** | Swift Gamma-Ray Burst Explorer |

## ACQUISITION STRATEGY & PERFORMING ORGANIZATIONS

The Swift project has three instruments: the Burst Alert Telescope built by GSFC; and the X-Ray Telescope and UV/Optical Telescope which are built by Penn State University. The Principal Investigator is located at GSFC. The spacecraft provider is Spectrum Astro Inc. Swift will be launched on a Delta 7320 from the Kennedy Space Center. Operations will be conducted at the Mission Operation Center at PSU. Archive sites are in the USA, UK, and Italy. **Changes since FY03 Pres. Budget: None.**

| Current Acquisitions | Actual * | Selection Method | Actual * | Performer | Actual * |
|---|---|---|---|---|---|
| Cooperative Agrmts. | 0% | Full & Open Competition | 60% | Industry | 80% |
| Cost Reimbursable | 57% | Sole Source | 30% | Government | |
| Fixed Price | 24% | | 100% | NASA Intramural | 2% |
| Grants | 0% | | | University | 18% |
| Other | 19% | Sci Peer Review | 100% | Non Profit | % |
| * as % of FY02 direct procurement | 100% | * as % of FY02 direct procurement | | * as % of FY02 direct procurement | 100% |

| Future Acquisitions - Major | Selection | Goals |
|---|---|---|
| 1. none - all major procurements are in place | n/a | n/a |

## AGREEMENTS

*Internal:* The program is not dependent on other NASA activities outside of the control of the Associate Administrator for Space Science.
*External:* International agreements are with the United Kingdom for the UVOT and XRT, and with Italy for the XRT and ground system support. **Changes since FY03 Pres. Budget: None.**

## INDEPENDENT REVIEWS

| Types of Review | Performer | Last Review | Next Review | Purpose |
|---|---|---|---|---|
| Confirmation Review | GSFC | Feb 16 2001 | N/A | Approval to proceed into Development. |
| Mission Operation Review | GSFC | 1-Aug-02 | N/A | To certify all operations are ready to proceed. |
| Mission Readiness Review | GSFC | N/A | Aug-03 | Verify readiness for launch. |

## BUDGET/LIFE CYCLE COST

Total budget authority represents the Life Cycle Cost (LCC). These figures include ELV costs.

| Budget Authority ($ in millions) | Prior | FY02 | FY03 | FY04 | FY05 | FY06 | FY07 | FY08 | BTC | Total | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|
| FY 2004 President's Budget (LCC) | 72.3 | 66.9 | 33.5 | 6.2 | 5.3 | | | | | 184.2 | |
| Development | 72.3 | 66.9 | 33.5 | | | | | | | 172.7 | |
| Operations | | | | 3.0 | 2.1 | | | | | 5.0 | |
| Data Analysis | | | | 3.2 | 3.3 | | | | | 6.5 | |
| Changes since FY 03 Pres. Budget | | +9.9 | | +2.3 | +2.3 | -2.6 | | | | +11.9 | ***Reason for Change:*** |
| Development | | +9.9 | | | | | | | | +9.9 | BAT instrument overrun. |
| Operations | | | | +0.4 | +0.2 | -1.6 | | | | -1.1 | |
| Data Analysis | | | | +1.9 | +2.2 | -1.0 | | | | +3.1 | |
| FY 2003 President's Budget (LCC) | 72.3 | 57.0 | 33.5 | 3.9 | 3.0 | 2.6 | | | | 172.3 | |
| Development | 72.3 | 57.0 | 33.5 | | | | | | | 162.8 | |
| Operations | | | | 2.6 | 1.9 | 1.6 | | | | 6.1 | |
| Data Analysis | | | | 1.3 | 1.1 | 1.0 | | | | 3.4 | |
| Initial Baseline (LCC) | 75.6 | 47.4 | 33.7 | 3.9 | 3.2 | 3.0 | | | | 166.8 | Launch 09/03. |
| Development | 75.6 | 47.4 | 33.7 | | | | | | | 156.7 | |
| Operations | | | | 2.6 | 1.9 | 2.0 | | | | 6.5 | |
| Data Analysis | | | | 1.3 | 1.3 | 1.0 | | | | 3.6 | |

Indicates budget numbers in full cost.
Indicates changes since the FY 2003 President's Budget Submit.
FY 2002, FY 2003, Prior and BTC are not in full cost.

| THEME: | Structure and Evolution of the Universe (SEU) |
|---|---|
| **DEVELOPMENT:** | Structure and Evolution of the Universe Small Development Projects |

## PURPOSE

| Objectives | Reference 2003 Strategic Plan | Performance Measures |
|---|---|---|
| 5.7, 5.8, 5.9, 6.1, 6.2, 6.3, 6.4, 7.1, 7.2 | | 4SEU1,3,5,9-11,13-20 |

SEU Small Development Projects include relatively low-cost missions that pursue the objectives of the Theme. Herschel will solve the mystery of how stars and galaxies are born, while Planck will examine the first light that filled the universe after the Big Bang. Astro-E2 will investigate the creation of chemical elements, what happens when matter falls into black holes, and the heating of gas to X-Ray-emitting temperatures. GALEX will investigate star formation, the history of the Universe, and the evolution of galaxies and gas. CHIPS will study hot interstellar gas comparatively close to our Solar System, while SPIDR will study filaments of hot gas throughout the cosmos.

## OVERVIEW

The missions in development that are included in SEU Small Projects are described below:
**Herschel** will be an infrared telescope used to study galaxy formation and evolution in the early Universe; the nature of active galaxy power sources; star forming regions and interstellar medium physics in the Milky Way and other galaxies. Herschel is led by the European Space Agency (ESA).
**Planck** will study the global characteristics of the Universe (age, composition, topology, etc.) by its precision all-sky measurement of the cosmic microwave background. Planck is led by the European Space Agency (ESA).
**Astro-E2** is a Japanese x-ray astronomy mission, developed at the Institute of Space and Astronautical Science (ISAS) in collaboration with U.S. (NASA/GSFC, MIT) and Japanese institutions.
**GALEX**, the Galaxy Evolution Explorer, is a NASA UV imaging and spectroscopic survey mission designed to map the global history and probe the causes of star formation and evolution.
**CHIPS** will study the "Local Bubble," a tenuous cloud of hot interstellar gas surrounding our Solar System that extends about 300 light years from the Sun.
**SPIDR** will map the "cosmic web" of hot gas that spans the Universe. This will improve our understanding of the formation and evolution of large structures in the Universe.

## PROGRAM MANAGEMENT

Astro-E2, GALEX, CHIPS, and SPIDR project responsibility is delegated to the Goddard Space Flight Center. Herschel and Planck project responsibility is delegated to the Jet Propulsion Laboratory. Enterprise official is Dr. Ed Weiler, Associate Administrator for Space Science at NASA HQ. The Theme Director and the Point of Contact is Dr. Anne Kinney, Director of the Astronomy and Physics Division at NASA HQ. These projects are in full compliance with NPG7120.5B.

## TECHNICAL COMMITMENT

The technical commitment for each individual project is established in its Program Plan.

| Technical Specifications | FY04 President's Budget | Change from Baseline |
|---|---|---|
| Herschel | 700 hours science per year. | -- |
| Planck | 1 1/2 years mission life. | -- |
| Astro-E2 | detect X-rays with energies ranging from 0.4 to 700 keV. | -- |
| GALEX | Pegasus XL launch, 28 month mission. | -- |
| CHIPS | 1-yr. mission to study hot interstellar gas. | n/a - UNEX mission |
| SPIDR | 3-yr. mission to map "cosmic web" of hot gas. | n/a - new selection |

| Schedule | FY04 President's Budget | Change from Baseline |
|---|---|---|
| INTEGRAL | Launched successfully Oct. 17, 2002. | -- |
| CHIPS | Launched successfully Jan. 12, 2003. | +5 months |
| GALEX | Launch March 2003 | -- |
| Astro-E2 | Launch February 2005 | -- |
| SPIDR | Launch 2005 | n/a - new selection |
| Herschel | Launch 2007 | -- |
| Planck | Launch 2007 | -- |

**THEME:** Structure and Evolution of the Universe (SEU)

# DEVELOPMENT: Structure and Evolution of the Universe Small Development Projects

## ACQUISITION STRATEGY & PERFORMING ORGANIZATIONS

Herschel - ESA mission; launch on Ariane-5 with Planck.
Planck - ESA mission; launch on Ariane-5 with Herschel.
Astro-E2 - Japanese mission; launch from Japan, on an M-V (M-five) with a redesigned first stage.
GALEX - Explorer mission managed by GSFC; launch on Pegasus XL.

| Current Acquisitions | Actual * | Selection Method | Actual * | Performer | Actual * |
|---|---|---|---|---|---|
| Cooperative Agreements | 10% | Full & Open Competition | 100% | Industry | 40% |
| Cost Reimbursable | 40% | Sole Source | % | Government | 15% |
| Fixed Price | 50% | | 100% | NASA Intramural | 15% |
| Grants | 0% | | | University | 30% |
| Other | 0% | Sci Peer Review | 100% | Non Profit | |
| * as % of FY02 direct procurement | 100% | * as % of FY02 direct procurement | | * as % of FY02 direct procurement | 100% |

| Future Acquisitions - Major | Selection | Goals |
|---|---|---|
| 1. none - all major acquisitions are in place | n/a | n/a |

## AGREEMENTS

*Internal:* The program is not dependent on other NASA activities outside of the control of the Associate Administrator for Space Science. *External:* Herschel and Planck are ESA (European Space Agency) missions. Astro-E2 is a Japanese mission. **Changes since FY 2003 President's Budget: None.**

## INDEPENDENT REVIEWS

| Types of Review | Performer | Last Review | Next Review | Purpose |
|---|---|---|---|---|
| GALEX Pre Launch Review | NASA/GSFC | N/A | Jan. 2003 | Final review prior to launch. |

Projects led by our international partners (e.g. Herschel, Planck, Astro-2) are not normally subjected to U.S. independent reviews.

## BUDGET/LIFE CYCLE COST

Budget authority represents the Development Cost, including launch services for NASA missions. Mission Operations and Data Analysis costs are budgeted elsewhere.

| Budget Authority ($ in millions | Prior | FY02 | FY03 | FY04 | FY05 | FY06 | FY07 | FY08 | BTC | Total | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|
| FY 2004 President's Budget | | 57.3 | 22.4 | 58.1 | 31.8 | 12.4 | 11.0 | | | | |
| INTEGRAL | 10.1 | 1.3 | 0.5 | | | | | | | 11.9 | |
| Herschel | 37.7 | 13.5 | 15.4 | 11.8 | 6.0 | 6.4 | 6.0 | | | 96.7 | |
| Planck | 16.8 | 8.5 | 4.9 | 12.5 | 7.5 | 6.0 | 4.9 | | | 61.1 | |
| Astro-E2 | | 13.4 | | 10.1 | 5.3 | | | | | 28.8 | |
| CHIPS | | 6.4 | 1.5 | | | | | | | 7.9 | |
| GALEX | 73.2 | 13.9 | | | | | | | | 87.1 | |
| SPIDR | | 0.2 | | 23.7 | 12.9 | | | | | 36.7 | |
| JPL Support | | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | | | 0.6 | |
| Changes since FY 03 Pres. Budget | | -0.6 | | +45.9 | +21.4 | +0.1 | +0.8 | | | +67.6 | ***Reason for Change:*** |
| Herschel | | -1.1 | | +3.1 | +0.2 | +0.2 | +0.2 | | | +2.5 | Instrument growth. |
| Planck | | +3.7 | | +9.1 | +3.0 | -0.0 | +0.6 | | | +16.4 | Cryocooler growth. |
| Astro-E2 | | +0.8 | | +10.1 | +5.3 | | | | | +16.2 | 04/05 requirements established. |
| CHIPS | | -0.3 | | | | | | | | -0.3 | |
| GALEX | | -3.9 | | | | | | | | -3.9 | |
| SPIDR | | +0.2 | | +23.7 | +12.9 | | | | | +36.7 | New Explorer mission |
| FY 2003 President's Budget | | 57.9 | 22.4 | 12.2 | 10.4 | 12.3 | 10.2 | | | | |
| INTEGRAL | 10.1 | 1.3 | 0.5 | | | | | | | 11.9 | |
| Herschel | 37.7 | 14.6 | 15.4 | 8.7 | 5.8 | 6.2 | 5.8 | | | 94.2 | |
| Planck | 16.8 | 4.8 | 4.9 | 3.4 | 4.5 | 6.0 | 4.3 | | | 44.7 | |
| Astro-E2 | | 12.6 | | | | | | | | 12.6 | |
| CHIPS | | 6.7 | 1.5 | | | | | | | 8.2 | |
| GALEX | 73.2 | 17.8 | | | | | | | | 91.0 | |
| JPL Support | | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | | | | |

Indicates budget numbers in full cost.
Indicates changes since the FY 2003 President's Budget Submit.

| THEME: | Structure and Evolution of the Universe (SEU) |
|---|---|

## OPERATIONS

### PURPOSE

| Objectives | Reference 2003 Strategic Plan | Performance Measures |
|---|---|---|
| 5.7, 5.8, 5.9, 6.1, 6.2, 6.3, 6.4, 7.1, 7.2 | | 4SEU4-12 |

Maximize the scientific return from NASA's investment in spacecraft and other data collection sources by conducting efficient and reliable operations of the data-collecting hardware which produces data that allow scientists to make new discoveries.

### OVERVIEW

*The following SEU missions are expected to be operating during FY 2004:*

The **Rossi X-ray Timing Explorer (RXTE)** was launched into low-Earth orbit on December 30, 1995. RXTE observes the fast-moving, high-energy worlds of black holes, neutron stars, X-ray pulsars and bursts of X-rays.

NASA's **Chandra X-ray Observatory (CXO)** was launched and deployed by Space Shuttle Columbia on July 23, 1999. Chandra utilizes mirrors in conjunction with four science instruments to capture and probe X-rays from astronomical sources, such as the remnants of exploded stars.

The **High Energy Transient Explorer (HETE-2)** was launched 2000 October 9, and studies gamma ray bursts (GRBs) with ultraviolet, x-ray, and gamma ray instruments.

The **Microwave Anisotropy Probe (MAP)** was launched June 30, 2001. MAP will make a map of the temperature fluctuations of cosmic microwave background radiation (radiation left over from the Big Bang).

**GALEX** is scheduled for launch in early 2003 and will use an ultraviolet telescope during its two-year mission to explore the origin and evolution of galaxies and the origins of stars and heavy elements.

**Gravity Probe B (GP-B)** is currently scheduled for a summer 2003 launch. GP-B will test two predictions of Albert Einstein's general theory of relativity.

**Swift Gamma Ray Burst Explorer** is scheduled for a late 2003 launch. SWIFT will produce arcsecond positions and multiwavelength light curves for Gamma Ray Burst (GRB) afterglows.

Operations of **XMM-Newton** are provided by the European Space Agency.

For more information, link to Office of Space Science Missions homepage.
http://spacescience.nasa.gov/missions/index.htm

### PROGRAM MANAGEMENT

Enterprise official is Dr. Ed Weiler, Associate Administrator for Space Science at NASA HQ. Theme Director and Point of Contact is Dr. Anne Kinney, Director of the Astronomy and Physics Division at NASA HQ. CXO is managed by the Marshall Space Flight Center. GP-B is managed by Stanford University. RXTE, HETE-2, MAP, GALEX, and Swift are managed by Goddard Space Flight Center. This program is in full compliance with NPG7120.5B.

### TECHNICAL COMMITMENT

The baseline for all SEU missions is defined in their respective Program Commitment Agreements (PCAs) or equivalent documentation.

| Technical Specifications | FY04 President's Budget | Change from Baseline |
|---|---|---|
| All missions will meet Level I specifications as identified in each mission's respective program plan. | | -- |

| Schedule | FY04 President's Budget | | Change from Baseline |
|---|---|---|---|
| RXTE | Dec. 30, 1995 - TBD | Mission Extended | -- |
| Chandra | July 23, 1999 - July 2009 | Prime Mission | -- |
| HETE-2 | Oct. 9, 2000 - TBD | Mission Extended | -- |
| MAP | June 30, 2001 - TBD | Prime Mission | -- |
| GALEX | Early 2003 - TBD | | -- |
| GP-B | Late 2003; 16 Months of Ops | | Launch delayed |
| Swift | Late 2003 - TBD | | -- |

**THEME:** Structure and Evolution of the Universe (SEU)

# OPERATIONS

## ACQUISITION STRATEGY & PERFORMING ORGANIZATIONS

The prime contractor for Chandra operations is the Smithsonian Astrophysical Observatory (SAO). The contract for Chandra is being renewed in FY03 for a period of five years. XTE and MAP are operated by Lockheed Martin through the Consolidated Space Operations Contract (CSOC), which will be recompeted in late 2003. Lockheed Martin will also operate GALEX and Swift until after the recompetition. GP-B will be operated by Stanford University. In FY02, direct procurement represented 100% of budget authority. **Changes since FY03 Pres. Budget: None.**

| Current Acquisitions | Actual * | Selection Method | Actual * | Performer | Actual * |
|---|---|---|---|---|---|
| Coop. Agrmts. | 0% | Full & Open Competition | 100% | Industry | 33% |
| Cost Reimbursable | 87% | Sole Source | 0% | Government | |
| Fixed Price | 13% | | 100% | NASA Intramural | 5% |
| Grants | 0% | | | University | 0% |
| Other | 0% | Sci Peer Review | 100% | Non Profit | 62% |
| * as % of FY02 direct procurement | 100% | * as % of FY02 direct procurement | | * as % of FY02 direct procurement | 100% |

| Future Acquisitions - Major | Selection | Goals |
|---|---|---|
| 1. CXO contract renewal | FY 03 | Sole source with SAO. |
| 2. CSOC recompetition | late 2003 | 100% Full & Open Competition. |

## AGREEMENTS

*Internal:* The program is not dependent on other NASA activities outside of the control of the Associate Administrator for Space Science. *External:* None. **Changes since FY03 Pres. Budget: None.**

## INDEPENDENT REVIEWS

| Types of Review | Performer | Last Review | Next Review | Purpose |
|---|---|---|---|---|
| Senior Review | External panel | June '02 | Summer '04 | To consider mission extensions and funding levels for operating SEU spacecraft that have completed their prime mission, based on science productivity and cost. |

## BUDGET

| Budget Authority ($ in millions) | FY02 | FY03 | FY04 | Comments |
|---|---|---|---|---|
| FY 2004 President's Budget | 6.4 | 10.7 | 10.3 | |
| Chandra | 3.7 | 3.8 | 4.2 | |
| RXTE | 1.2 | 3.3 | 1.3 | |
| MAP | 1.2 | 1.4 | | |
| GP-B | | 2.0 | 1.1 | |
| GLAST | | | | |
| Swift | | | 3.0 | |
| SWAS | 0.3 | | | |
| GALEX | | 0.2 | 0.7 | |
| Changes since FY 03 Pres. | -0.3 | | -0.2 | ***Reason for Change:*** |
| Chandra | | | +0.6 | Full cost. |
| RXTE | | | -2.0 | Transferred to data analysis. |
| GP-B | | | +0.1 | Full cost. |
| GLAST | | | | Full cost plus launch delay. |
| Swift | | | +0.4 | Full cost; FY 06 offset to Dev. Growth. |
| GALEX | -0.3 | | +0.7 | Full cost plus launch delay. |

Indicates budget numbers in full cost.
Indicates changes since the FY 2003 Presidents Budget Submit.
FY 2002 and FY 2003 are not in full cost.

| THEME: | Structure and Evolution of the Universe (SEU) |
|---|---|

## RESEARCH

### PURPOSE

| Objectives Reference 2003 Strategic Plan | Performance Measures |
|---|---|
| 5.7, 5.8, 5.9, 6.1, 6.2, 6.3, 6.4, 7.1, 7.2 | 4SEU2, 4SEU13-20 |

The Research Program involves the study of cosmology (the large scale structure of the universe), the evolution of stars and galaxies (including the Milky Way and objects with extreme physical conditions), and an examination of the ultimate limits of gravity and energy in the Universe.

### OVERVIEW

The SEU research program supports SEU Reseach and Analysis (R&A) and the analysis of data (DA) from the SEU operating missions, the provision of suborbital balloons for payloads that can use them to achieve their science objectives, and the science data tools and archives needed to perform the research. Data Analysis programs are tied to specific missions, which are focused on the achievement of specific strategic objectives. The scope of R&A programs is generally wider because they must provide the new theories and instrumentation that enable the next generation of flight missions. The alignment of Reseach programs with SEU strategic goals is ensured through two mechanisms. First, NASA Research Announcements soliciting R&A proposals contain explicit prioritization criteria with respect to Enterprise objectives. Second, the entire R&A program is reviewed triennially to assess scientific quality and productivity of the major components and to adjust plans to best support Enterprise goals. Data Analysis programs have traditionally been performed by mission instrument teams and interdisciplinary scientists competitively selected for an individual mission for the lifetime of that mission. The Data Analysis program also includes annual, open and competitive solicitations to all missions that can accommodate "guest investigations."

The Balloon program within the SEU theme area supports twenty plus missions a year and offers capabilities and benefits for scientific research that cannot be duplicated by other methods.

### PROGRAM MANAGEMENT

NASA Headquarters is responsible for the SEU Research Program. Enterprise official is Ed Weiler, Associate Administrator for Space Science at Headquarters. Theme Director and point of contact is Anne Kinney, Director of the Astronomy and Physics Division at Headquarters. This program is in full compliance with NPG7120.5B.

### TECHNICAL COMMITMENT

Baselines for research are consistent with those defined in individual Research Announcements released by the Office of Space Science. Data Analysis baselines are defined by the Program PCA or equivalent document.

| Technical Specifications | FY04 President's Budget | Change from Baseline |
|---|---|---|
| | Building on the FY 2003 NASA Strategic Plan, the OSS Strategic Planning process specifies a series of goals, strategic objectives and research focus areas. The OSS Strategic Plan draws from the Astronomy and Physics Decadal Survey (NRC), as well as the road mapping activities conducted by the Structure and Evolution of the Universe Subcommittee (SEUS).<br>All selections processes and reviews of the elements of the SEU research program use these strategic items as guide posts for selection and/or continuation. Proposals for research must relate to these strategic items. | -- |

| Schedule | FY04 President's Budget | Change from Baseline |
|---|---|---|
| R & A | | |
| Research Opportunities In Space Science (ROSS) | Yearly in Feb. | -- |
| Data Analysis | | |
| Senior Reviews | Every Two Years | -- |
| Balloon Program | | |
| Research Opportunities In Space Science (ROSS) | Campaigns run all year | -- |

| THEME: | Structure and Evolution of the Universe (SEU) |
|---|---|

## RESEARCH

### ACQUISITION STRATEGY & PERFORMING ORGANIZATIONS

The Research and Analysis (R&A), Data Analysis (DA) and Balloons programs make awards following peer reviewed competitions under NASA Research Announcements (NRAs), Announcements of Opportunity (AOs), and Cooperative Agreement Notices (CANs). The Balloon program has a prime contractor selected via competitive procurement through a Request for Proposals (RFPs). In FY 02, direct procurement represented 100% of budget authority. **Changes since FY 2003 President's. Budget: None.**

| Current Acquisitions | Actual * | Selection Method | Actual * | Performer | Actual * |
|---|---|---|---|---|---|
| Cooperative Agreements | 5% | Full & Open Competition | 98% | Industry | 4% |
| Cost Reimbursable | 32% | Sole Source | 2% | Government | 2% |
| Fixed Price | 1% | | 100% | NASA Intramural | 9% |
| Grants | 49% | | | University | 76% |
| Other | 13% | Sci Peer Review | 100% | Non Profit | 9% |
| * as % of FY02 direct procurement | 100% | * as % of FY02 direct procurement | | * as % of FY02 direct procurement | 100% |

| Future Acquisitions - Major | Selection | Goals |
|---|---|---|
| 1. Annual R&A research announcement | Late 2003 | 100% Science Peer Review |
| 2. Annual Chandra call for proposals | July 2003 | 100% Science Peer Review |

### AGREEMENTS

*Internal:* The program is not dependent on other NASA activities outside of the control of the Associate Administrator for Space Science.

*External:* Two missions in Data Analysis (XMM and INTEGRAL) involve agreements with the European Space Agency.

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

### INDEPENDENT REVIEWS

| Types of Review | Performer | Last Review | Next Review | Purpose |
|---|---|---|---|---|
| MO&DA Senior Review | Sr. Review committee | June 2002 | summer 2004 | To recommend approval and funding level for extending the science investigations of the operating SEU missions. |
| R&A peer review | peer review committee | summer 2002 | summer 2003 | To review SEU proposals to the annual R&A announcement. |

### BUDGET

| Budget Authority ($ in millions) | FY02 | FY03 | FY04 | Comments |
|---|---|---|---|---|
| FY 2004 President's Budget (Research) | 131.7 | 154.0 | 186.6 | |
| R&A | 25.6 | 27.0 | 28.6 | |
| DA | 92.1 | 113.0 | 132.7 | |
| Balloons | 14.0 | 14.0 | 25.3 | |
| Changes since FY 03 Pres. Budget | | | +25.9 | ***Reason for Change:*** |
| R&A | | | +0.7 | Full cost |
| DA | | | +15.0 | Full cost |
| Balloons | | | +10.2 | Full cost; maintain flight rate |

Indicates budget numbers in full cost.

Indicates changes since the FY 2003 Presidents Budget Submit.

FY 2002 and FY 2003 are not in full cost.

| THEME: | Structure and Evolution of the Universe (SEU) |
|---|---|

# TECHNOLOGY AND ADVANCED CONCEPTS

## PURPOSE

| Objectives | Reference 2003 Strategic Plan | Performance Measures |
|---|---|---|
| 5.7, 5.8, 5.9, 6.1, 6.2, 6.3, 6.4, 7.1, 7.2 | | 4SEU4, 4SEU7-9 |

The SEU Technology and Advanced Concepts effort develops advanced technologies needed for specific science missions. This process begins with mission studies - the first phase of the flight program development process. In this phase, scientists work collaboratively with technologists and mission designers to develop the most effective alignment of technology development programs with future mission requirements. This collaboration enables intelligent technology investment decisions through detailed analysis of the trade-offs between design considerations and cost.

## OVERVIEW

SEU's Technology and Advanced Concept efforts are extremely diverse. The program works with and actively seeks input from scientists and engineers in academia, government, and industry. SEU follows an integrated strategy that coordinates technology development for different programs and leverages technology advancement to ensure a maximum return on investment. SEU has identified four technology areas that merit special attention, given their broad applicability across Enterprises. These areas are: Advanced Cryogenic Systems, Formation Flying, High Performance Optics, and Next Generation Detectors.

The **Laser Interferometer Space Antenna (LISA)** will consist of three spacecraft flying 5 million kilometers (km) apart in the shape of an equilateral triangle. The objective of LISA is to observe gravitational waves, including gravitational waves generated in the vicinity of the very massive black holes found in the centers of many galaxies. Some of the project's technology development areas include: inertial sensors, electrical discharge system to remove charges induced by cosmic rays, micro-newton thrusters, interferometry system, pointing accuracy to less than 10 nano-radian, and a high power laser.

**Constellation-X (Con-X)** is another example of how SEU is pushing the frontiers of technological advancement. Con-X will be a set of x-ray telescopes in space that work together to become 100 times more powerful than any previous x-ray telescope. Con-X will utilize two sets of extremely high performance X-ray telescope systems incorporating x-ray micro-calorimeters on each of four satellites; these instruments must be cooled to 50 millikelvins (a fraction of a degree above absolute zero) by cryogenic coolers.

The President's Budget Request for FY 2004 includes increased funding for LISA and Con-X as part of a new initiative called "Beyond Einstein." Beyond Einstein is critical to achieving Objectives 5.7 and 5.8 of the NASA Strategic Plan, to discover what powered the Big Bang and the nature of the mysterious dark energy that is pulling the Universe apart; and to learn what happens to space, time, and matter at the edge of a black hole. LISA and Con-X are the first elements in Beyond Einstein, and are planned for launch early next decade. The initiative will eventually include a series of fully competed, moderate-sized, scientist-led missions to be known as Einstein Probes, to be launched about once every three years.

## PROGRAM MANAGEMENT

The program responsibility is being managed at NASA HQ. The Program Management Council (PMC) has governing responsibility. Each SEU mission will execute the NASA formulation sub-process per NPG 7120.5B to provide high confidence that it will be ready to proceed into implementation. Enterprise official is Dr. Edward Weiler, Associate Administrator for Space Science at NASA HQ. Theme Director and Point of Contact is Dr. Anne Kinney, Director of the SEU Program at NASA HQ.

## TECHNICAL COMMITMENT

Project technical baselines are defined by the individual Formulation Authorization Document (FAD), Program Commitment Agreement (PCA) or equivalent documentation. In anticipation of entering the Formulation phase, a FAD for LISA will be completed during the summer of 2003. A FAD for Con-X will be completed about 3yrs later.

| Technical Specifications | FY04 President's Budget | Change from Baseline |
|---|---|---|
| LISA | TBD - Will be established in the FAD | N/A |
| CON-X | TBD - Will be established in the FAD | N/A |

**THEME:** Structure and Evolution of the Universe (SEU)

# TECHNOLOGY AND ADVANCED CONCEPTS

## TECHNICAL COMMITMENT - CONTINUED

| Schedule | FY04 President's Budget | Change from Baseline |
|---|---|---|
| LISA | | |
| Formulation Start | FY03 | no established baseline until confirmation |
| PDR | TBD | no established baseline until confirmation |
| Implementation Start | TBD | no established baseline until confirmation |
| CDR | TBD | no established baseline until confirmation |
| Launch | TBD | no established baseline until confirmation |
| Con-X | | |
| Formulation Start | TBD | no established baseline until confirmation |
| PDR | TBD | no established baseline until confirmation |
| Implementation Start | TBD | no established baseline until confirmation |
| CDR | TBD | no established baseline until confirmation |
| Launch | TBD | no established baseline until confirmation |

## ACQUISITION STRATEGY & PERFORMING ORGANIZATIONS

The LISA Project Management Office is jointly managed by NASA (GSFC and JPL) and ESA, with NASA having the lead for the day-to-day activity. Responsibility for LISA's mission success is jointly shared between NASA and ESA at all levels. CON-X is being managed solely out of GSFC. In FY02, direct procurement represented 100% of budget authority. **Changes since FY 2003 President's Budget: None.**

| Current Acquisitions | Actual * | Selection Method | Actual * | Performer | Actual * |
|---|---|---|---|---|---|
| Cooperative Agreements | 8% | Full & Open Competition | 61 | Industry | 10% |
| Cost Reimbursable | 24% | Sole Source | 39 | Government | 16% |
| Fixed Price | 10% | | 100% | NASA Intramural | 39% |
| Grants | 0% | | | University | 27% |
| Other | 58% | Sci Peer Review | 100% | Non Profit | 8% |
| * as % of FY02 direct procurement | 100% | * as % of FY02 direct procurement | | * as % of FY02 direct procurement | 100% |

| Future Acquisitions - Major | Selection | Goals |
|---|---|---|
| 1. LISA Phase A Study contracts | FY 04 | 100% Full & Open Competition, 100% Fixed Price |

**THEME:** Structure and Evolution of the Universe (SEU)

# TECHNOLOGY AND ADVANCED CONCEPTS

## AGREEMENTS

*Internal:* The program is not dependent on other NASA activities outside of the control of the Associate Administrator for Space Science.

*External:* LISA currently has a LOA with the European Space Agency (ESA).

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

## INDEPENDENT REVIEWS

| Types of Review | Performer | Last Review | Next Review | Purpose |
|---|---|---|---|---|
| Con-X / LISA Independent Implementation Review | IRT/IPAO | n/a | Mar-03 | To assure compliance with defined technical, cost and schedule thresholds (PCA's, Roadmaps). |

## BUDGET

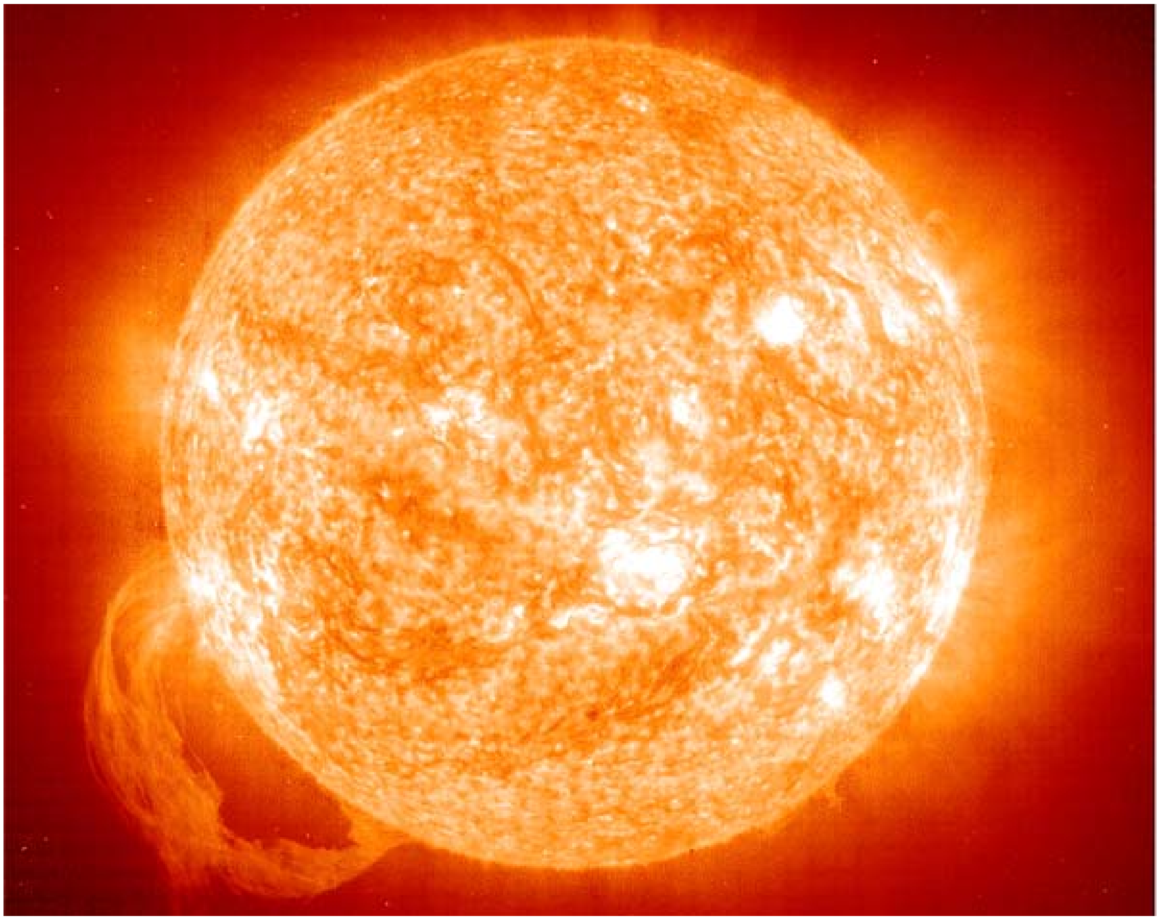
| Budget Authority ($ in millions) | FY02 | FY03 | FY04 | Comments |
|---|---|---|---|---|
| 5.9.1 | 13.0 | 21.5 | 60.9 | |
| CON-X | 6.4 | 12.8 | 23.5 | New Initiative - includes Beyond Einstein funding. |
| LISA | 6.2 | 7.3 | 35.4 | New Initiative - includes Beyond Einstein funding. |
| Einstein Probes | | | | New Initiative - part of Beyond Einstein (funding begins in FY 2007). |
| Other | 0.4 | 1.4 | 2.0 | |
| Changes since FY 03 Pres. Budget | | | | |
| CON-X | | | -2.2 | New Initiative - includes Beyond Einstein funding. |
| LISA | | | +22.2 | New Initiative - includes Beyond Einstein funding. |
| Einstein Probes | | | | New Initiative - part of Beyond Einstein (funding begins in FY 2007). |
| Other | | | | |

Indicates budget numbers in full cost.

Indicates changes since the FY 2003 Presidents Budget Submit.

FY 2002 and FY 2003 are not in full cost.

# THEME: Sun-Earth Connections



On June 9, 2002 a large dynamic eruption of material was observed leaving the Sun by the Solar and Heliospheric Observatory (SOHO) spacecraft. This particular image shows an early phase of the event where a cool, dense cloud of gas, principally composed of Hydrogen and Helium, was seen departing the Sun. Because this event was not directed toward Earth, no geophysical effects were associated with the activity. Eruptive prominences usually take 2-4 days to travel the distance between the Sun and the Earth. Monitoring the Sun can provide early warning for major activity, likely avoiding some of the disruption otherwise experienced. More information can be found at http://sec.gsfc.nasa.gov .

# SUN-EARTH CONNECTIONS

## MAJOR EVENTS IN FY 2004

- STEREO completes integration and test in preparation for launch in 2005. STEREO will use two identically equipped spacecraft to provide revolutionary 3-D imaging of Coronal Mass Ejections.
- Solar Dynamics Observatory enters implementation of development in January 2004. It is a cornerstone mission in the Living With a Star program. It will study the Sun's magnet field and the dynamic processes that influence space weather.

## THEME: Sun-Earth Connection (SEC)

### OVERVIEW

Life and society on Earth can prosper within a relatively stable and safe biosphere because the Sun provides a steady energy source to the Earth, and the Earth's upper atmosphere and magnetic field shield the planet from external influences. The Earth's upper atmosphere and magnetic field form a coupled system with the Sun and geospace (the space inside the protective cavity of the Earth's magnetic field). This is evident in auroral displays at the Earth's poles, and in the belts of high-energy particles encircling the Earth and extending out to distances where communication and weather spacecraft operate. The Sun-Earth Connection (SEC) Programs seek to understand how the Sun, geospace, and the Earth's upper atmosphere are connected in a single system.

| Missions | Goals supported by this theme | Objectives supporting those goals |
|---|---|---|
| Understand and Protect our Home Planet | 1. Understand the Earth system and apply Earth system science to improve prediction of climate, weather, and natural hazards. | 1.3 Understand the origins and societal impacts of variability in the Sun-Earth Connection. |
| Explore the Universe and Search for Life | 5. Explore the solar system and the universe beyond, understand the origin and evolution of life, and search for evidence of life elsewhere. | 5.13 Understand the changing flow of energy and matter throughout the Sun, heliosphere, and planetary environments. |
| | | 5.14 Understand the fundamental physical processes of space plasma systems. |
| Inspire the Next Generation of Explorers | 6. Inspire and motivate students to pursue careers in science, engineering, and mathematics. | 6.1, 6.2, 6.3, 6.4 (Supporting Role) - See Education Programs Theme. |
| | 7. Engage the public in shaping and sharing the experience of exploration and discovery. | 7.1 Improve the capacity of science centers, museums, and other institutions, through the development of partnerships, to translate and deliver engaging NASA content. (Supporting Role) |
| | | 7.2 Improve science literacy by engaging the public in NASA missions and discoveries, and their benefits, through such avenues as public programs, community outreach, mass media, and the Internet. (Supporting Role) |

### RELEVANCE

The system comprised of the Sun, the Earth's upper atmosphere, magnetic field and geospace, is dynamic. The changes to this system, commonly known as space weather, have important implications for life and society. Space weather effects may induce some climate shifts, modify the ozone layer, change the propagation of radio and radar signals in and through the ionosphere, and produce significant effects on any object or person outside the atmosphere. Increasing our understanding of solar variability, its space weather effects, and its implications for technology and life on Earth will lower the risk of failure or degraded performance of new technologies and maintain the U.S. industry's competitiveness in the global marketplace.

| Education and Public Benefits |
|---|
| The Sun-Earth Education Forum and regional Broker/Facilitator institutions work together to develop and support partnerships between SEC scientists and education professionals in formal and informal settings as well as to encourage coordination of activities. The SEC Division also has significant science resources to share with the public. In the modern age, space exploration continues to thrill the public with new discoveries that help build a better understanding of the Sun, near-Earth space, the solar system, and the Universe. They are informed through news releases highlighting solar events, high-production-value films bringing the excitement of SEC science and research to life, documentaries, innovative planetarium shows, exhibits at museums and science centers, and rich website environments. A significant fraction of the U.S. population retains an abiding fascination with space exploration and discovery that can be used to improve science literacy throughout the Nation. |

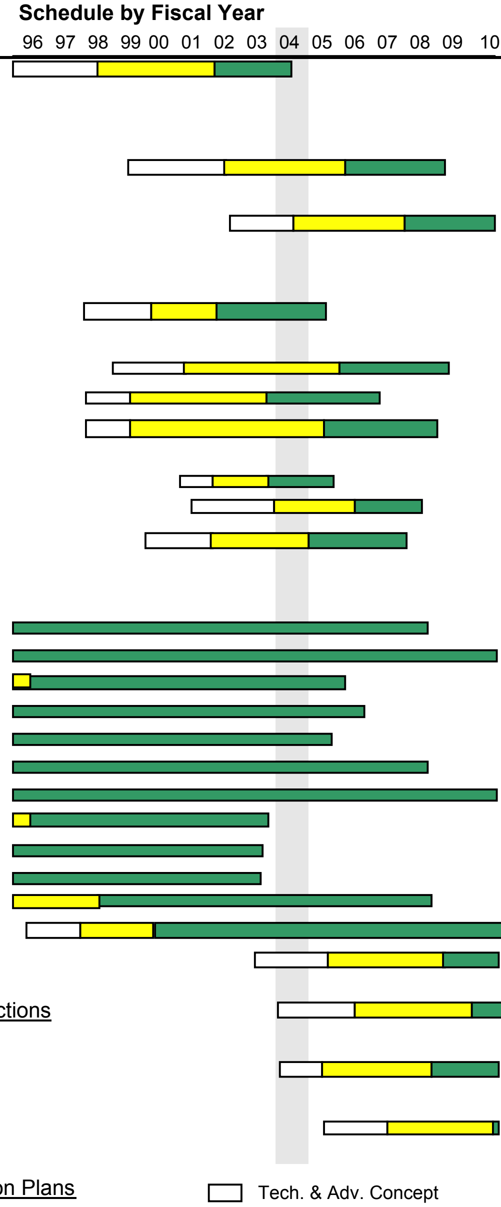
## THEME: Sun-Earth Connection (SEC)

### IMPLEMENTATION

The Sun-Earth Connection theme is composed of many elements that work together to achieve the program's goals and objectives. Repeated management and scientific peer reviews ensure that each mission provides data in a cost-effective manner. In many cases, the data obtained from different missions are complementary, and are combined in cross-disciplinary studies by members of the scientific community.

Theme responsibility resides in the Office of Space Science at NASA Headquarters. Enterprise official is Dr. Edward Weiler, Associate Administrator for Space Science. Theme director and point of contact is Dr. Richard Fisher, Director of the Sun-Earth Connection Division at Headquarters. This theme is in full compliance with NPG 7120.5B.

**Schedule by Fiscal Year**




| Strategy | Purpose |
|---|---|
| TIMED | Study influences of the Sun and humans on the Mesosphere and Lower Thermosphere / Ionosphere. region of Earth's atmosphere. |
| STEREO | View 3D structure of coronal mass ejections, trace the flow and determine why they happen. |
| SDO | Observe Sun's dynamics to help determine the nature and sources of solar variability. |
| Small Projects | |
| RHESSI | Explore basic physics of particle acceleration and explosive energy release in solar flares. |
| Solar B | Reveal the mechanisms of solar variability. |
| TWINS | Establish global connectivities & causal relationships in different regions of magnetosphere. |
| CINDI | Understand the dynamics of Earth's ionosphere. |
| AIM | Study Polar Mesospheric Clouds. |
| ST-5 | Demonstrate and flight-qualify a set of nanosats for application to future space missions. |
| OPERATIONS | |
| SOHO | Extended missions are based on senior review |
| Wind | |
| Polar | |
| Geotail | |
| Ulysses | |
| Voyager | |
| ACE | |
| FAST | |
| IMP-8 | |
| SAMPEX | |
| TRACE | |
| IMAGE | |
| Magnetospheric Multiscale | Understand fundamental processes that connect broad ranges of the magnetosphere. |
| Global Electrodynamic Connections | Systematic multi-point measurements to increase understanding of the ionosphere-thermosphere . |
| ITM Geospace Mission | Study of effects of changes in solar activity on Earth's ionosphere and thermosphere. |
| RBM Geospace Mission | Study of effects of changes in solar actvity on the Earth's radiation belts. |

Link to Program Implementation Plans

| Tailoring |
|---|
| No exceptions to NPG 7120.5B have been taken. |

## THEME: Sun-Earth Connection (SEC)

### STATUS

During 2002, the SEC theme accomplished the following: launched TIMED; began Implementation for STEREO and 2 of 3 ST-6 experiments; started Phase A for SDO; completed CDR for ST-5; shipped Solar B's Focal Plane Package & X-ray telescope mechanical test models to ISAS in Japan; completed environmental testing of the TWINS A instrument; held the Pre-Environmental Review for the CINDI Ion Velocity Meter; successfully launched 27 sounding rockets and 3 meteorological rockets; and completed 25 years of Voyager operations.

Link to SEC homepage for more detailed status information: http://sec.gsfc.nasa.gov/

### PERFORMANCE MEASURES

| Annual Performance Goals | |
|---|---|
| | OUTCOME: A well managed program in accordance with Agency implementing strategies. |
| 4SEC1 | Each Development project will complete its current phase within 10% of total life-cycle cost shown on the table below. |
| 4SEC2 | Each Research project will allocate 75% of its funding competitively during FY04. |
| 4SEC3 | SEC will complete all of its missions within 10% of their baseline schedules. |
| 1.3.1 | OUTCOME: Define the origins and societal impacts of variability in the Sun-Earth Connection. |
| 4SEC4 | Successfully demonstrate progress in developing the capability to predict solar activity and the evolution of solar disturbances as they propagate in the heliosphere and affect the Earth. Progress towards achieving outcomes will be validated by external review. |
| 4SEC5 | Successfully demonstrate progress in specifying and enabling prediction of changes to the Earth's radiation environment, ionosphere, and upper atmosphere. Progress towards achieving outcomes will be validated by external review. |
| 4SEC6 | Successfully demonstrate progress in understanding the role of solar variability in driving space climate and global change in the Earth’s atmosphere. Progress towards achieving outcomes will be validated by external review. |
| 5.13.1 | OUTCOME: Understand the changing flow of energy and matter throughout the Sun, heliosphere, and planetary environments. |
| 4SEC7 | Successfully demonstrate progress in understanding the structure and dynamics of the Sun and solar wind and the origins of magnetic variability. Progress towards achieving outcomes will be validated by external review. |
| 4SEC8 | Successfully demonstrate progress in determining the evolution of the heliosphere and its interaction with the galaxy. Progress towards achieving outcomes will be validated by external review. |
| 4SEC9 | Successfully demonstrate progress in understanding the response of magnetospheres and atmospheres to external and internal drivers. Progress towards achieving outcomes will be validated by external review. |
| 5.14.1 | OUTCOME: Support exploration of the fundamental physical processes of space plasma systems. |
| 4SEC10 | Successfully demonstrate progress in discovering how magnetic fields are created and evolve and how charged particles are accelerated. Progress towards achieving outcomes will be validated by external review. |
| 4SEC11 | Successfully demonstrate progress in understanding coupling across multiple scale lengths and its generality in plasma systems. Progress towards achieving outcomes will be validated by external review. |
| 6.1.1 | OUTCOME: Kindergarten through graduate students will be more proficient in science, technology, engineering, and mathematics (STEM). |
| 4SEC12 | Provide opportunities for students to work directly with NASA space science missions, facilities, and data. |
| 6.2.1 | OUTCOME: More students from diverse communities motivated to pursue careers in STEM. |
| 4SEC13 | Provide new opportunities for participation in the space science program by an increasingly diverse population, including opportunities for minorities and minority universities to compete for and participate in space science missions, research, and education programs. |
| 6.3.1 | OUTCOME: Improve quality of STEM instruction. |
| 4SEC14 | Provide high quality educational materials and teacher training based on Theme content and focused on national curriculum standards. |
| 4SEC15 | Provide exhibits, materials, workshops, and personnel at national and/or regional education and outreach conferences. |
| 6.4.1 | OUTCOME: More students prepared to enter the STEM workforce. |
| 4SEC16 | Provide higher education opportunities offered through OSS research awards and other NASA research and education programs. |

# THEME: Sun-Earth Connection (SEC)

## PERFORMANCE MEASURES - CONTINUED

| Annual Performance Goals - Continued | |
|---|---|
| 7.1.1 | OUTCOME: Improve the capacity of science centers, museums, and other institutions, through the development of partnerships, to translate and deliver engaging NASA content. |
| 4SEC17 | Through partnerships with major science museums or planetariums, put on display or on tour major exhibitions or planetarium shows based on Theme content. |
| 4SEC18 | Provide materials and technical expertise to support the development of exhibits and programs at science museums and planetariums. |
| 7.2.1 | OUTCOME: Engage the public in NASA missions and discoveries through such avenues as public programs, community outreach, mass media, and the Internet. |
| 4SEC19 | Seek out and capitalize on special events and particularly promising opportunities in the Theme science program to bring space science to and involve the public in the process of scientific discovery. |

## INDEPENDENT REVIEWS

| Types of Review | Performer | Last Review | Next Review | Purpose |
|---|---|---|---|---|
| Nat'l Academy of Sciences | Space Stdy Board | 7/02 | N/A | Effectiveness and quality of the program |
| Advisory Council | NAC | 9/02 | 3 times/year | Review sci. strategy, program implementation strategy |
| | SScAC | 8/02 | 3 times/year | Review sci. strategy, program implementation strategy |
| | SEC Subcommittee | 7/02 | 3 times/year | Review sci. strategy, program implementation strategy |

Other independent reviews are conducted at the Program and Project level.

## BUDGET

| Budget Authority ($millions) | FY02 | FY03 | Chng | FY04 | Comments |
|---|---|---|---|---|---|
| **Sun Earth Connection** | **412.9** | **544.2** | **+225.5** | **769.6** | |
| Development | 104.4 | 120.8 | +99.2 | 220.0 | |
| TIMED | 4.3 | | | | |
| STEREO | 58.9 | 74.3 | +25.0 | 99.3 | |
| Solar Dynamics Observatory (SDO) | 8.6 | 26.6 | +39.6 | 66.2 | SDO includes MO&DA - will be moved in next budget |
| Small Projects | 32.6 | 19.9 | +34.6 | 54.5 | process to Operations and Research. |
| Operations | 37.0 | 43.5 | +13.8 | 57.3 | |
| Research | 140.6 | 124.3 | +54.0 | 178.3 | |
| Technology and Advanced Concepts | 130.9 | 255.6 | +58.5 | 314.0 | |

Note: For all formats, the FY 02 column reflects the FY 2002 Congressional Operating Plan dated 9/30/02. The FY 03 column reflects the FY 2003 Presidents Budget Submit (PBS) as Amended. The Change column includes both programmatic and full cost adjustments. FY 2004 column is in full cost.

Indicates budget numbers in full cost.
Indicates changes since the FY 2003 President's Budget Submit.
FY 2002, FY 2003, Prior and BTC are not in full cost.

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| | |
|---|---|
| **THEME:** | Sun-Earth Connection (SEC) |
| **DEVELOPMENT:** | Solar Terrestrial Relations Observatory (STEREO) |

## PURPOSE

| Objectives | | Performance Measures |
|---|---|---|
| 1.3, 5.13, 5.14, 6.1, 6.2, 6.3, 6.4, 7.1, and 7.2 | Reference 2003 Strategic Plan | 4SEC1, 3, 4, 7, 8, 10-19 |

The STEREO project will lead to an understanding of the cause and mechanisms of Coronal Mass Ejection (CME) initiation; characterize the progagation of the CMEs through the heliosphere; discover the mechanisms and sites of the energetic particle acceleration in the Sun's corona and the interplanetary medium; and develop a 3-D time-dependent model of the magnetic topology, temperature, density, and velocity structure of the ambient solar wind.

## OVERVIEW

NASA's STEREO mission will use two identically equipped spacecraft to provide revolutionary 3-D imaging of CMEs. The two spacecraft will be in heliocentric orbits at 1 AU (Astronomical Unit, the mean distance from the Earth to the Sun) with one leading Earth and the other lagging Earth. The STEREO mission will be a multilateral international collaboration involving participants from France, Germany, the United States, and United Kingdom. Investigations for STEREO will include: Sun-Earth Connection Coronal and Heliospheric Investigation (SECCHI) using the remote sensing package which will study the 3-D evolution of CME's from birth at the Sun's surface through the corona and interplanetary medium to their eventual impact at Earth; STEREO/WAVES (SWAVES), an interplanetary radio burst tracker that will trace the generation and evolution of traveling radio disturbances from the Sun to the orbit of Earth; In situ Measurements of Particles and CME Transients (IMPACT) investigation, which will sample the 3-D distribution and provide plasma characteristics of solar energetic particles and the local vector magnetic field, and the PLAsma and SupraThermal Ion and Composition (PLASTIC) experiment,, which will provide plasma characteristics of protons, alpha particles, and heavy ions.

Link to STEREO Homepage for more information.

## PROGRAM MANAGEMENT

STEREO is the third mission within the Solar Terrestrial Probe Program with program and project responsibility delegated to the Goddard Space Flight Center. The Enterprise Program Management Council (PMC) has STEREO governing responsibility. Enterprise official is Dr. Ed Weiler, Associate Administrator for Space Science at HQ. The Theme Director and the Point of Contact is Dr. Richard Fisher, Director of the Sun-Earth Connection Division at HQ. The program is in full compliance with NPG7120.5B.

## TECHNICAL COMMITMENT

The baseline for this commitment is detailed in the 3/2002 STP Program Commitment Agreement (PCA).

| Technical Specifications | FY04 President's Budget | Change from Baseline |
|---|---|---|
| CME Initiation Time: | accuracy of order 10[120] minutes | -- |
| Location of CME Initiation: | $\pm$ 5 [30] degrees of solar latitude and longitude | -- |
| Operational capability: | Prime mission life is 2 years for both spacecraft; assuming a CME rate consistent with minimum of solar magnetic activity cycle, observe at least 60 CMEs with remote sensing instruments and at least 24 interplanetary events in-situ. | -- |
| Science Instruments: | 4 major science instrument suites | -- |

Values not enclosed in brackets indicate the accuracy required when both STEREO spacecraft are required to be operational. Values in square brackets indicate the accuracy of the measurements required to be achieved to meet Minimum Mission Success Criteria.

| Schedule | FY04 President's Budget | Change from Baseline |
|---|---|---|
| Start of Formulation | May-01 | -- |
| Start of Implementation | Mar-02 | -- |
| Mission Critical Design Review | Dec-02 | -- |
| Complete S/C I & T | Jul-04 | -- |
| Launch | Nov-05 | -- |

**THEME:** Sun-Earth Connection (SEC)

# DEVELOPMENT: Solar Terrestrial Relations Observatory (STEREO)

## ACQUISITION STRATEGY & PERFORMING ORGANIZATIONS

The four instrument suites were competitively procured via AO in Dec. 1999. NASA selected these investigations:
(1) SECCHI (Naval Research Laboratory),
(2) STEREO/WAVES (SWAVES) (Centre National de la Recherche Scientifique Observatory of Paris),
(3) In situ Measurements of Particles and CME Transients (IMPACT) (University of California, Berkeley), and
(4) PLAsma and SupraThermal Ion and Composition (PLASTIC), (University of New Hampshire).
The spacecraft, ground support, mission operations, and mission integration function are a sole source procurement to JHU/APL. STEREO will launch on a Delta 2925-10L from Kennedy Space Center. **Changes since FY03 Pres. Budget: None.**

| Current Acquisitions | Actual * | Selection Method | Actual * | Performer | Actual * |
|---|---|---|---|---|---|
| Cooperative Agreements | 0% | Full & Open Competition | 45% | Industry | 7% |
| Cost Reimbursable | 96% | Sole Source | 55% | Government | 21% |
| Fixed Price | 0% | | 100% | NASA Intramural | 3% |
| Grants | 2% | | | University | 68% |
| Other | 2% | Sci Peer Review | 100% | Non Profit | 0% |
| * as % of FY02 direct procurement | 100% | * as % of FY02 direct procurement | | * as % of FY02 direct procurement | 100% |

| Future Acquisitions - Major | Selection | Goals |
|---|---|---|
| 1. ELV Procurement | Fall 2003 | fixed price |

## AGREEMENTS

*Internal:* The program is not dependent on other NASA activities outside of the control of the Associate Administrator for Space Science.
*External:* LOAs are in place with CNES (France), Hungary, Switzerland, PPARC (Particle Physics CNES), the German Aerospace Center and ESA. An MOU with ESA will also be developed. **Changes since FY03 Pres. Budget: None.**

## INDEPENDENT REVIEWS

| Types of Review | Performer | Last Review | Next Review | Purpose |
|---|---|---|---|---|
| Independent Implementation Revi | IRT | NA | Oct-02 | Annual review to look at implementation procuredures |
| Confirmation Review | IRT | Mar-02 | NA | Approval to proceed into Development |

## BUDGET / LIFE CYCLE COST

Total budget authority represents the Life Cycle Cost (LCC). These figures include ELV.

| Budget Authority ($ in millions) | Prior | FY02 | FY03 | FY04 | FY05 | FY06 | FY07 | FY08 | BTC | Total | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|
| FY 2004 President's Budget | 37.4 | 58.9 | 74.3 | 99.3 | 68.3 | 42.6 | 24.7 | 15.0 | 2.5 | 423.0 | |
| Pre-Development | 37.4 | 21.0 | | | | | | | | 58.4 | |
| Development | | 37.9 | 74.3 | 99.3 | 68.3 | 22.2 | | | | 302.1 | |
| Operations | | | | | | 10.8 | 10.2 | 2.1 | | 23.1 | |
| Data Analysis | | | | | | 9.6 | 14.5 | 12.9 | 2.5 | 39.5 | |
| Changes since FY 03 Pres. Budget | | +6.0 | | +9.3 | +7.1 | +6.1 | +1.6 | +15.0 | -14.8 | +30.3 | ***Reason for Change:*** |
| Development | | +6.0 | | +9.3 | +7.1 | +1.5 | | | | +24.0 | full cost adjustment |
| Operations | | | | | | +3.4 | +0.8 | +2.1 | -4.7 | +1.6 | full cost adjustment |
| Data Analysis | | | | | | +1.2 | +0.8 | +12.9 | -10.1 | +4.8 | full cost adjustment |
| FY 2003 President's Budget | 37.4 | 52.9 | 74.3 | 90.0 | 61.2 | 36.5 | 23.1 | | 17.3 | 392.7 | |
| Pre-Development | 37.4 | 21.0 | | | | | | | | 58.4 | |
| Development | | 31.9 | 74.3 | 90.0 | 61.2 | 20.7 | | | | 278.1 | |
| Operations | | | | | | 7.4 | 9.4 | | 4.7 | 21.5 | |
| Data Analysis | | | | | | 8.4 | 13.7 | | 12.6 | 34.7 | |
| Initial Baseline | 37.2 | 52.9 | 74.3 | 90.0 | 61.2 | 36.5 | 23.1 | 17.3 | 2.8 | 395.3 | |
| Pre-Development | 37.2 | 21.0 | | | | | | | | 58.2 | Begin C/D -- March 02 |
| Development | | 31.9 | 74.3 | 90.0 | 61.2 | 20.7 | | | | 278.1 | Launch 11/05 |
| Operations | | | | | | 7.4 | 9.4 | 4.7 | | 21.5 | |
| Data Analysis | | | | | | 8.4 | 13.7 | 12.6 | 2.8 | 37.5 | |

Indicates budget numbers in full cost. (yellow)
Indicates changes since the FY 2003 President's Budget Submit. (blue)
FY 2002, FY 2003, Prior and BTC are not in full cost.

| THEME: | Sun-Earth Connection (SEC) |
|---|---|
| **DEVELOPMENT:** | Sun-Earth Connection Small Development Projects |

## PURPOSE

| Objectives | | Performance Measures |
|---|---|---|
| 1.3, 5.13, 5.14, 6.1, 6.2, 6.3, 6.4, 7.1, and 7.2 | Reference 2003 Strategic Plan | 4SEC1, 3, 4, 5, 6, 7, 9-19 |

The Sun-Earth Connection Small Projects include the Explorer Program and the Solar-B mission (which is the second mission in the Solar Terrestrial Probe Program). The Small Explorer (SMEX) program provides frequent flight opportunities for highly focused, relatively inexpensive missions. Missions are selected through the Announcement of Opportunity (AO) process. SMEX investigations are characterized by a total cost to NASA for definition, development, launch service, and mission operations and data analysis not to exceed $85M (fiscal 2002 dollars). Also included included in this group are Missions of Opportunity (MO). MO are Space Science investigations that are flown as part of a non-NASA space mission.

## OVERVIEW

The missions that are included in the Sun-Earth Connection Small Projects are:

**- SOLAR-B** is an international collaboration building on the highly successful Japan/U.S./UK Yohkoh (Solar-A) experience. Solar-B is a single sun-synchronous low-Earth orbit spacecraft. It will measure the Sun's magnetic field and ultraviolet/x-ray radiation and use the data to increase the understanding of the sources of solar variability. The U.S. responsibility is to manage the U.S. hardware development of three science instruments: Focal Plan Package, X-Ray telescope and the Extreme Ultraviolet Imaging Spectrometer.

**- CINDI (MO) (Coupled Ion Neutral Dynamics Investigation)** will study ion-neutral interactions in Earth's ionosphere to discover their role in the electrodynamic connection between the Sun and the Earth's upper atmosphere. These interactions can interfere with communications and navigation systems.

**- TWINS A/B (MO) (Two Wide-angle Imaging Neutral-atom Spectrometers)** will provide stereoscopic images of the Earth's magnetosphere for the first time. The TWINS project consists of two identical instruments on two spacecraft in Molniya (highly eliptical) orbits around the Earth.

**- AIM (Aeronomy of Ice in the Mesosphere) (SMEX)** will establish the relationship between polar mesospheric clouds and their environment. This will form the basis for the study of long-term changes in the mesosphere.

http://stp.gsfc.nasa.gov/missions/solar-b/solar-b.htm
http://129.110.7.63/heelis/cindi.html
http://nis-www.lanl.gov/nis-projects/twins/
http://www.hamptonu.edu/science/physics/CAS/AIM/aim.html

## PROGRAM MANAGEMENT

CINDI, TWINS, and AIM are projects within the Explorer Program with management responsibility delegated to the Goddard Space Flight Center. CINDI and TWINS are in development. AIM will enter into development in Jan. 2004. The Enterprise Program Management Council (PMC) has governing responsibility. Enterprise official is Dr. Ed Weiler, Associate Administrator for Space Science at HQ. The Theme Director and the Point of Contact is Dr. Richard Fisher, Dir. of the Sun-Earth Connection Division at HQ. The program is in full compliance with NPG7120.

## TECHNICAL COMMITMENT

The baseline for CINDI, TWINS and AIM are detailed in the Explorer Program Commitment Agreement (PCA). The baseline for SOLAR-B was made in 12/00 and is detailed in the Program Level I Reqs. for the Solar-B Project.

| Technical Specifications | FY04 President's Budget | Change from Baseline |
|---|---|---|
| **SOLAR-B** | | |
| Focal Plane Package polarimetric accuracy | within 0.001 | -- |
| X-ray Telescope Angular Resolution | 2.0 arcsec | -- |
| EUV Imaging Spectrometer spatial resolution | 2.0 arcsec | -- |
| **CINDI** | | |
| Measure Total Ion Concentration; Drift Velocity | 200 passes/month | -- |
| and Neutral Wind Velocity | | -- |
| **TWINS** | | |
| Two dimentional views of Earth's | ~10 images per day | -- |
| energetic neutral atoms | | -- |
| **AIM** | TBD/Confirmation Review 12/03 | New |

**THEME:** Sun-Earth Connection (SEC)

# DEVELOPMENT: Sun-Earth Connection Small Development Projects

## TECHNICAL COMMITMENT - CONTINUED

| Schedule | FY04 President's Budget | Change from Baseline |
|---|---|---|
| SOLAR-B Launch | Sep-05 | -- |
| CINDI Launch | Oct-03 | -- |
| TWINS Launch | 4th Qt/2003 & 1st Qt/2005 | -- |

## ACQUISITION STRATEGY & PERFORMING ORGANIZATIONS

The **Solar-B** instrument developers were selected in response to a NASA AO issued in May 1998. Selections made in December 1998 were Lockheed Martin Missiles and Space for the FPP, Smithsonian Astrophysical Observatory for the XRT, and the Naval Research Laboratory for the EIS. **CINDI's** science investigation and both instruments are being developed at the Unversity of Texas at Dallas. Launch on a Pegasus XL by the U.S. Air Force. **TWINS** Principle Investigation is located at the Southwest Research Institute. **AIM** Principle Investigation institution is Hampton University with four major instruments. Spacecraft is being built by Ball Aerospace & Technologies Corp; AIM is being lannch from Vandenber Air Force Base on a Pegasus. **Changes since FY03 Pres. Budget: AIM selected.**

| Current Acquisitions | Actual * | Selection Method | Actual * | Performer | Actual * |
|---|---|---|---|---|---|
| Cooperative Agreements | 100% | Full & Open Competition | 100% | Industry | 52% |
| Cost Reimbursable | 0% | Sole Source | 0% | Government | 12% |
| Fixed Price | 0% | | 100% | NASA Intramural | 0% |
| Grants | 0% | | | University | 22% |
| Other | 0% | Sci Peer Review | 100% | Non Profit | 14% |
| * as % of FY02 direct procurement | 100% | * as % of FY02 direct procurement | | * as % of FY02 direct procurement | 100% |

| Future Acquisitions - Major | Selection | Goals |
|---|---|---|
| 1. none - all major acquisitions are in place | n/a | n/a |

## AGREEMENTS

*Internal:* The programs is not dependent on other NASA activities outside of the control of the Associate Administrator of Space Science.

*External:* CINDI -- MOA with USAF. Solar-B LOA between NASA and ISAS, Febrrary 3, 2001; LOA between NASA and PPARC, March 24, 2000; MOU with ISAS in process. **Changes since FY03 Pres. Budget: None**.

## INDEPENDENT REVIEWS

| Types of Review | Performer | Last Review | Next Review | Purpose |
|---|---|---|---|---|
| SOLAR-B Indep Implement. Review | IPAO | Oct-02 | | Annual implementation review |
| CINDI Confirmation Review | GSFC | Nov-01 | N/A | Approval to proceed into Dev. from the AA for Space Sci. |
| TWINS Confirmation Review | GSFC | Apr-99 | N/A | Approval to proceed into Dev. from the AA for Space Sci. |
| AIM Confirmation Review | GSFC | N/A | Sep-03 | Approval to proceed into Dev. from the AA for Space Sci. |

## BUDGET / LIFE CYCLE COST

Budget authority represents the Development Cost, including launch services for NASA missions. Mission Operations and Data Analysis costs are budgeted elsewhere.

| Budget Authority ($ in millions) | Prior | FY02 | FY03 | FY04 | FY05 | FY06 | FY07 | FY08 | BTC | Total | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|
| FY 2004 President's Budget | 53.4 | 32.6 | 19.9 | 54.5 | 28.3 | 10.8 | | | | 199.3 | |
| SOLAR-B | 39.5 | 25.4 | 16.2 | 12.5 | 10.4 | | | | | 104.0 | |
| CINDI | 1.9 | 4.9 | 3.1 | 0.9 | | | | | | 10.7 | |
| TWINS | 12.0 | 2.1 | 0.6 | 1.1 | 0.4 | | | | | 16.3 | |
| AIM | | 0.2 | | 40.0 | 17.5 | 10.8 | | | | 68.4 | |
| Changes since FY 03 Pres. Budget | | +1.4 | | +43.7 | +20.6 | +10.8 | | | | +76.4 | ***Reason for Change:*** |
| SOLAR-B | | | | +2.7 | +2.7 | | | | | +5.4 | full cost accounting |
| CINDI | | +1.2 | | +0.4 | | | | | | +1.5 | |
| TWINS | | | | +0.6 | +0.4 | | | | | +1.0 | NIAT Added/launch delay |
| AIM | | +0.2 | | +40.0 | +17.5 | +10.8 | | | | +68.4 | new mission |
| FY 2003 President's Budget | 53.4 | 31.2 | 19.9 | 10.8 | 7.7 | | | | | 123.0 | |
| SOLAR-B | 39.5 | 25.4 | 16.2 | 9.8 | 7.7 | | | | | 98.6 | |
| CINDI | 1.9 | 3.7 | 3.1 | 0.5 | | | | | | 9.2 | |
| TWINS | 12.0 | 2.1 | 0.6 | 0.5 | | | | | | 15.2 | |
| Initial Baseline | 39.5 | 25.5 | 16.8 | 9.8 | 7.7 | | | | | 99.3 | |
| SOLAR-B | 39.5 | 25.5 | 16.8 | 9.8 | 7.7 | | | | | 99.3 | CD 12/20/00 Launch Sept 05 |

Indicates budget numbers in full cost.

Indicates changes since the FY 2003 President's Budget Submit.

FY 2002, FY 2003, Prior and BTC are not in full cost.

| THEME: | Sun-Earth Connection (SEC) |
|---|---|
| **DEVELOPMENT:** | **Solar Dynamics Observatory (SDO)** |

## PURPOSE

| Objectives | | Performance Measures |
|---|---|---|
| 1.3, 5.13, 5.14, 6.1, 6.2, 6.3, 6.4, 7.1, and 7.2 | Reference 2003 Strategic Plan | 4SEC1, 3, 4, 5, 6, 7, 10-19 |

SDO will increase our understanding of how the Sun's magnetic field is generated and structured and how this stored magnetic energy is converted and released into the heliosphere and geospace in the form of solar wind, energetic particles, and variations in solar irradiance.

## OVERVIEW

The Solar Dynamics Observatory (SDO) is a cornerstone mission within the Living With a Star (LWS) program. SDO will increase the scientific understanding of how the Sun's magnetic field is generated and structured and how this stored magnetic energy is converted and released into the heliosphere and geospace in the forms of solar wind, energetic particles, and variations in solar irradiance. From geosynchronous Earth orbit, SDO's instrument suites will characterize the Sun's interior (including components of its magnetic activity), its surface, its corona, and the extreme ultraviolet irradiance beyond the corona. These data will be analyzed to improve the capability to predict solar variations (or space weather) and their effects on life on Earth and technological systems. The project includes funding for the spacecraft, launch vehicle, data analysis (6 years), project operations (5 years), education, and outreach. Prime mission operations should end five years and thirty days after launch. Each of the last four years of funding for data analysis is half the value of each of the first two years of funding. Phase A began in 8/2002 when awards for 3 SDO science investigations were announced. Funding guidelines are subject to change as the requirements and design mature and will be capped when SDO is confirmed to start Phase C.

Link to SDO Homepage for more information.

## PROGRAM MANAGEMENT

Goddard Space Flight Center (GSFC) is responsible for mission management, design, integration, test, and operation. The GSFC Program Management Council (PMC) has SDO governing responsibility until March 2003. The Agency PMC subsequently assumes oversight until SDO is confirmed for implementation, at which time the Enterprise assumes governing responsibility. Enterprise official is Dr. Ed Weiler, Associate Administrator for Space Science at HQ. The Theme Director and the Point of Contact is Dr. Richard Fisher, Director of the Sun-Earth Connection Division at HQ. This program is in full compliance with NPG7120.5B.

## TECHNICAL COMMITMENT

No technical commitments will be made until the mission is confirmed to start Implementation in early FY 2004. SDO guidelines are in the mission Formulation Authorization Document (FAD) and may change as the content of the mission requirements and design matures. The LWS Program Commitment Agreement (PCA) and Program Plan will also be signed when SDO is confirmed, because SDO is the first mission in the LWS Program.

| Technical Specifications | FY04 President's Budget | Change from Baseline |
|---|---|---|
| Orbit | Geosynchronous | -- |
| Prime mission life | 5 years | -- |
| Helioseismic and Magnetic Imager (HMI) | Study origin of solar variability through analysis of the Sun's interior and various components of its magnetic activity. | -- |
| Extreme Ultraviolet Variability Experimen (EVE) | Measure extreme ultraviolet irradiance and study it in relationship with the Sun's magnetic features. | -- -- |
| Solar Heliospheric Activity Research and Prediction Program (SHARPP) | Study the Sun's atmosphere and develop space weather predictions by using an Atmospheric Imaging Assember (AIA) and a white light coronograph (WCI). | -- |

| Schedule | FY04 President's Budget | Change from Baseline |
|---|---|---|
| Start of Formulation | Aug-02 | -- |
| Initial Confirmation Review | Jun-03 | -- |
| Start of Implementation | Jan-04 | -- |
| Launch | Aug-07 | -- |
| End of Prime Mission | Sep-12 | -- |

| | |
|---|---|
| **THEME:** | Sun-Earth Connection (SEC) |
| **DEVELOPMENT:** | Solar Dynamics Observatory (SDO) |

## ACQUISITION STRATEGY & PERFORMING ORGANIZATIONS

The selected investigations are: Helioseismic and Magnetic Imager (HMI) at Stanford University (with assistance from a Lockheed Martin team); Extreme Ultraviolet Variability Experiment (EVE) at the University of Colorado, Boulder, Laboratory for Atmospheric and Space Physics; and Solar Heliospheric Activity Research and Prediction Program (SHARPP) at the Naval Research Laboratory. SDO spacecraft and ground system will be built in-house at Goddard Space Flight Center. The launch vehicle will be purchased through Kennedy Space Center. International agreements with Italy, France, Belgium, and the United Kingdom will provide significant components of instruments.
**Changes since FY03 Pres. Budget: None.**

| Current Acquisitions | Actual * | Selection Method | Actual * | Performer | Actual * |
|---|---|---|---|---|---|
| Cooperative Agreements | 12% | Full & Open Competition | 100% | Industry | 0% |
| Cost Reimbursable | 0% | Sole Source | 0% | Government | 12% |
| Fixed Price | 27% | | 100% | NASA Intramural | 88% |
| Grants | 0% | | | University | 0% |
| Other | 61% | Sci Peer Review | 100% | Non Profit | 0% |
| * as % of FY02 direct procurement | 100% | * as % of FY02 direct procurement | | * as % of FY02 direct procurement | 100% |

| Future Acquisitions - Major | Selection | Goals |
|---|---|---|
| 1. Instrument Contracts | Fall 03 | 100% F&O Competition, 100% Cost type contracts. |
| 2. Ground system Contracts | Fall 03 | 100% Sci Peer Review, 20% University, 11% Non Profit. |
| 3. Support Service contract extensions | Fall 03 | |

## AGREEMENTS

*Internal:* Dependence on other NASA activities outside of the control of the Associate Administrator of Space Science will be established when the Living With a Star (LWS) PCA is baselined at SDO's Confirmation Review.
*External:* Letters of Agreement with International Co-Investigators were initiated when instrument investigations were awarded (8/2002).
**Changes since FY03 Pres. Budget: None.**

## INDEPENDENT REVIEWS

| Types of Review | Performer | Last Review | Next Review | Purpose |
|---|---|---|---|---|
| Before Initial Confirm. Review (IRC) | (IRT) Indep. Review Team | N/A | Sep-03 | Confirm to start Phase B; obtain a life cycle cost estimate as directed by Congress (tentative date). |
| Non-Advocate Rev.(NAR) | IRT | | Mar-03 | Seek approval to start Implementation (tentative date). |
| Critical Design Review | IRT | | TBD | |

## BUDGET / LIFE CYCLE COST

Total budget authority represents the Life Cycle Cost (LCC). These figures include…

| Budget Authority ($ in millions) | Prior | FY02 | FY03 | FY04 | FY05 | FY06 | FY07 | FY08 | BTC | Total | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|
| FY 2004 President's Budget (LCC) | 1.7 | 8.6 | 26.6 | 66.2 | 90.0 | 98.9 | 88.5 | 20.0 | | 400.5 | Confirm. Review sched. 12/03 |
| Development | 1.7 | 8.6 | 26.6 | 66.2 | 90.0 | 98.9 | 88.5 | 20.0 | | 400.5 | MO & DA are included in Dev. |
| Operations | | | | | | | | | | | Baseline |
| Data Analysis | | | | | | | | | | | |
| Changes since FY 03 Pres. Budget | +1.7 | +8.6 | +26.6 | +66.2 | +90.0 | +98.9 | +88.5 | +20.0 | | +400.5 | ***Reason for Change:*** |
| Development | +1.7 | +8.6 | +26.6 | +66.2 | +90.0 | +98.9 | +88.5 | +20.0 | | +400.5 | new mission |
| Operations | | | | | | | | | | | |
| Data Analysis | | | | | | | | | | | |

Indicates budget numbers in full cost.
Indicates changes since the FY 2003 President's Budget Submit.
FY 2002, FY 2003, Prior and BTC are not in full cost.

**THEME:** Sun-Earth Connection (SEC)

# OPERATIONS

## PURPOSE

| Objectives | | Performance Measures |
|---|---|---|
| 1.3, 5.13, 5.14 | Reference 2003 Strategic Plan | 4SEC4-11 |

The Sun-Earth Connection Operation's objective is to safely and efficiently operate these scientific satellites. This program element sponsors the maintenance of existing mission operations infrastructure and the development of new control center capabilities at GSFC.

## OVERVIEW

Within the SEC Theme there are currently 14 operational Space Science missions. These include the venerable Voyager spacecraft and SOHO and TRACE. Also included is the TIMED mission which is the first of the STP missions. Many missions involve foreign partners, including ESA and ISAS. In FY06, this program element will include the operations for STEREO and AIM. The program element also supports the multi-mission operations activities at GSFC. These multimission activities support both current and future missions for the SEC, ASO, and SEU themes.

Link to Office of Space Science Missions homepage for more information
http://spacescience.nasa.gov/missions/index.htm

## PROGRAM MANAGEMENT

Enterprise official is Ed Weiler, Associate Administrator for Space Science at HQ. The Theme Director and the Point of Contact is Richard Fisher, Director of the Sun-Earth Connection Division at HQ. TIMED operations are managed by the J. Hopkins University Applied Physics Laboratory. Ulysses and Voyager are managed by the Jet Propulsion Laboratory. All other activities are managed by the Goddard Space Flight Center. The program is in full compliance with NPG7120.5B.

## TECHNICAL COMMITMENT

The baseline for all SEC Theme missions is defined in their respective PCAs or equivalent documentation.

| Technical Specifications | **FY04 President's Budget** | **Change from Baseline** |
|---|---|---|
| All missions will meet Level I specifications as identified in the Program Plan. | | Unchanged |

| **Mission Schedule** | **Launch Date** | **Status** | **Change from Baseline** |
|---|---|---|---|
| SOHO | Dec. 2, 1995 | Mission Extended | -- |
| Wind | Nov. 1, 1994 | Mission Extended | -- |
| Polar | Feb. 24, 1996 | Mission Extended | -- |
| Geotail | July 24, 1992 | Mission Extended | -- |
| TIMED | Dec. 7, 2001 | Prime Mission thru 12/03 | -- |
| Ulysses | Oct. 6, 1990 | Mission Extended | -- |
| Voyager | Aug. 20, 1977 | Mission Extended | -- |
| ACE | Aug. 25, 1997 | Mission Extended | -- |
| FAST | Aug. 21, 1996 | Mission Extended | -- |
| IMP-8 | Oct. 26, 1973 | Terminated Oct 2001 | -- |
| SAMPEX | July 3, 1992 | Mission Extended | -- |
| TRACE | Apr. 1, 1998 | Mission Extended | -- |
| RHESSI | Feb. 5, 2002 | Prime Mission thru 2/05 | -- |
| IMAGE | Mar. 25, 2000 | Mission Extended | -- |

| **THEME:** | Sun-Earth Connection (SEC) |
|---|---|

## OPERATIONS

### ACQUISITION STRATEGY & PERFORMING ORGANIZATIONS

This element contains approximately twenty project tasks ranging from the operation of spacecraft at university sites and NASA Centers, engineering support, and engineering research to improve the technology state to be employed in future mission control centers. Six of the SEC satellite control centers and certain enginnering support services are located at GSFC and are staffed via Consolidated Space Operations Contract (CSOC) under Lockheed Martin. This contract covers 5 years of operations, and will terminate in FY04. **Changes since FY03 Pres. Budget: None.**

| Current Acquisitions | Actual * | Selection Method | Actual * | Performer | Actual * |
|---|---|---|---|---|---|
| Cooperative Agreements | 0% | Full & Open Competition | 89% | Industry | 59% |
| Cost Reimbursable | 75% | Sole Source | 11% | Government | |
| Fixed Price | 1% | | 100% | NASA Intramural | 19% |
| Grants | 0% | | | University | 22% |
| Other | 24% | Sci Peer Review | 100% | Non Profit | 0% |
| * as % of FY02 direct procurement | 100% | * as % of FY02 direct procurement | | * as % of FY02 direct procurement | 100% |

| Future Acquisitions - Major | Selection | Goals |
|---|---|---|
| 1. CSOC recompetition | Late 2003 | 100% Full & Open Competition |

### AGREEMENTS

*Internal:* The program is not dependent on activities outside of the control of the Associate Administrator for Space Science.

*External:* Three of the program elements depend on international agreements with ESA (SOHO and Ulysses) and ISAS (Geotail).

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

### INDEPENDENT REVIEWS

| Types of Review | Performer | Last Review | Next Review | Purpose |
|---|---|---|---|---|
| Senior Review | External panel | 9-Jul-01 | 17-Jun-03 | To consider mission extensions and funding levels for operating SEC spacecraft that have completed their prime mission, based on science productivity and cost. |

### BUDGET

| Budget Authority ($ in millions) | | FY02 | FY03 | FY04 | Comments |
|---|---|---|---|---|---|
| FY 2004 President's Budget | 0.0 | 37.0 | 43.5 | 57.3 | |
| SOHO | | 3.6 | 0.9 | 2.8 | |
| TIMED | | 3.5 | 3.1 | 1.6 | |
| Voyager | | 1.8 | 0.8 | 2.0 | |
| STEREO | | | | | |
| Multi-Miss. Ops | | 20.3 | 37.4 | 44.2 | |
| All Other SEC Operations | | 7.8 | 1.3 | 6.7 | |
| Changes since FY 03 Pres. Budget | | +0.0 | | +14.3 | realignment with DA; Full Cost |
| SOHO | | -0.9 | | +2.4 | |
| TIMED | | | | +1.6 | |
| Voyager | | +0.4 | | | |
| STEREO | | | | | |
| Multi-Miss. Ops | | +1.5 | | +3.9 | |
| All Other SEC Operations | | -1.0 | | +6.4 | |

Indicates budget numbers in full cost.
Indicates changes since the FY 2003 President's Budget Submit.
FY 2002 and FY 2003 are not in full cost.

| THEME: | Sun-Earth Connection (SEC) |
|---|---|

## RESEARCH

### PURPOSE

| Objectives | | Performance Measures |
|---|---|---|
| 1.3, 5.13, 5.14, 6.1, 6.2, 6.3, 6.4, 7.1, and 7.2 | Reference 2003 Strategic Plan | 4SEC2, 4SEC4-19 |

SEC research develops the theoretical tools and laboratory data needed to analyze flight data, makes possible new and better instruments to fly on future missions, and analyzes the data returned by spacecraft so that we can answer specific questions posed and fit them into the overall picture of the Sun, its environment, and solar effects on Earth.

### OVERVIEW

The SEC research element funds a variety of programs including, SEC Research and Analysis (R&A); the analysis of data (DA) from SEC operating missions; the suborbital program for sounding rockets and their payloads; and the science data tools and archives needed to perform the research. DA programs are tied to specific missions, which are focused on the achievement of specific strategic objectives; the scope of R&A programs is generally wider because they provide the new theories and instrumentation that guide future investigations. The alignment of Research programs with SEC strategic goals is ensured through two mechanisms. First, NASA Research Announcements soliciting R&A proposals contain explicit prioritization criteria with respect to Enterprise objectives. Second, the entire R&A program is reviewed triennially to assess scientific quality and productivity of the major components and to adjust plans to best support Enterprise goals. Data Analysis (DA) programs have traditionally been performed by mission instrument teams and interdisciplinary scientists competitively selected for an individual mission for the lifetime of that mission. The DA program includes annual, open and competitive solicitations to all missions that can accommodate "guest investigations."

NASA Research Opportunities http://research.hq.nasa.gov/code_s/code_s.cfm
http://spacescience.nasa.gov/missions/opmsns.htm
Link to Rockets http://www.wff.nasa.gov/pages/soundingrockets.html

### PROGRAM MANAGEMENT

The Sun-Earth Connection Research program responsibility is retained at Headquarters. The NASA Program Management Council (PMC) has SEC governing responsibility. Enterprise official is dr. Ed Weiler, Associate Administrator for Space Science at HQ. The Theme Director and the Point of Contact is Dr. Richard Fisher, Director of the Sun-Earth Connection Division at HQ. The program is in full compliance with NPG7120.5B.

### TECHNICAL COMMITMENT

The baseline for all SEC Theme missions is defined in their respective PCAs or equivalent documentation. Content of R&A is defined in each individual Research Announcement.

| Technical Specifications | FY04 President's Budget | Change from Baseline |
|---|---|---|
| | The NASA Strategic Plan has incorporated results of the OSS Strategic Planning process, which specifies a series of goals, strategic objectives and research focus areas. The OSS Strategic Plan draws from the Solar and Space Physics Decadal Survey (NRC) as well as the road mapping activities by the Sun-Earth Connection Advisory Subcommittee (SECAS). All selections processes and reviews of the elements of the SEC research program use these strategic items as guide posts for selection and/or continuation. Proposals for research must relate to these strategic items. | -- |

| Schedule | FY04 President's Budget | Change from Baseline |
|---|---|---|
| R & A | | |
| Research Opportunities In Space Science (ROSS) | Yearly in Feb. | -- |
| Data Analysis | | |
| Senior Reviews | Every Two Years | -- |
| Sounding Rockets | | |
| Research Opportunities In Space Science (ROSS) | Campaigns run all year | -- |

| THEME: | Sun-Earth Connection (SEC) |
|---|---|

# RESEARCH

## ACQUISITION STRATEGY & PERFORMING ORGANIZATIONS

The Research and Analysis (R&A), Data Analysis (DA), and Sounding Rockets programs make awards following peer-reviewed competitions under NASA Research Announcements (NRAs), Announcements of Opportunity (AOs), and Cooperative Agreement Notices (CANs). The Sounding Rocket program has a prime contractor selected via competitive procurement through a Request for Proposals (RFPs). In FY 02, direct procurement represented 100% of budget authority. **Changes since FY 03 Pres. Budget: None.**

| Current Acquisitions | Actual * | Selection Method | Actual * | Performer | Actual * |
|---|---|---|---|---|---|
| Cooperative Agreements | 1% | Full & Open Competition | 95% | Industry | 33% |
| Cost Reimbursable | 41% | Sole Source | 5% | Government | 7% |
| Fixed Price | 4% | | 100% | NASA Intramural | 7% |
| Grants | 40% | | | University | 42% |
| Other | 14% | Sci Peer Review | 100% | Non Profit | 11% |
| * as % of FY02 direct procurement | 100% | * as % of FY02 direct procurement | | * as % of FY02 direct procurement | 100% |

| Future Acquisitions - Major | Selection | Goals |
|---|---|---|
| 1. Annual R&A research announcement | late 2003 | 100% Science Peer Review |

## AGREEMENTS

*Internal:* The program is not dependent on other NASA activities outside of the control of the Associate Administrator for Space Science.

*External:* Four of the program elements depend on international agreements with ESA (SOHO, Cluster, and Ulysses) and ISAS (Geotail).

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

## INDEPENDENT REVIEWS

| Types of Review | Performer | Last Review | Next Review | Purpose |
|---|---|---|---|---|
| SEC MO&DA Senior Review | Sr. Review committee | July 2001 | June 2003 | To recommend approval and funding level for extending science investigations of the operating SEC missions. |
| R&A peer review | Peer review committee | Summer 2002 | Summer 2003 | To review SEC proposals to the annual R&A announcement. |

## BUDGET

| Budget Authority ($ in millions) | FY02 | FY03 | FY04 | Comments |
|---|---|---|---|---|
| FY 2004 President's Budget | 140.6 | 124.3 | 178.3 | |
| SEC Research and Analysis | 29.0 | 30.6 | 35.2 | |
| Science Data & Computing Tech. | 19.3 | 11.5 | 15.0 | |
| SOHO Data Analysis | 11.0 | 10.4 | 14.1 | |
| SEC Data Analysis | 53.7 | 41.5 | 69.7 | |
| Sounding Rockets | 27.6 | 30.3 | 44.3 | |
| Changes since FY 03 Pres. Budget | | | +46.3 | Programmatic Changes and Full Cost. |
| SEC Research and Analysis | | | +2.2 | |
| Science Data & Computing Tech. | | | +3.8 | |
| SOHO Data Analysis | | | +2.6 | |
| SEC Data Analysis | | | +24.0 | |
| Sounding Rockets | | | +13.7 | |

Indicates budget numbers in full cost.
Indicates changes since the FY 2003 President's Budget Submit.
FY 2002 and FY 2003 are not in full cost.

| **THEME:** | Sun-Earth Connection (SEC) |
|---|---|

## TECHNOLOGY AND ADVANCED CONCEPTS

### PURPOSE

| Objectives | | Performance Measures |
|---|---|---|
| 1.3, 5.13, 5.14 | Reference 2003 Strategic Plan | 4SEC5, 6, 9-11 |

The SEC Technology and Advanced Concepts effort develops advanced technologies needed for specific science missions. This process begins with mission studies -- the first phase of the flight program development process. In this phase, scientists work collaboratively with technologists and mission designers to develop the most effective alignment of technology development programs with future mission requirements. This collaboration enables intelligent technology investment decisions through detailed analysis of the trade-offs between design considerations and cost. In SEC, future missions will seek to understand how changes in solar activity change the Earth's ionosphere, thermosphere, and radiation belts, and how mass and particle ejections from the Sun propagate to the Earth and other planets. Technologies critical to the success of these missions include spacecraft and instrument technologies for microsats and nanosats, solar sails and improved conventional propulsion, and improved power and communications technologies.

### OVERVIEW

Technology and Advanced Concepts are dedicated to mission studies, and the pre-concept and formulation phases of flight projects. Space science programs and projects use an aggressive technology development approach that requires all major technology hurdles to be cleared prior to a science mission's development phase. During pre-concept and formulation phases of missions, scientists work collaboratively with technologists and mission designers to develop the most effective alignment of technology development programs with future missions. This collaboration enables intelligent technology investment decisions through detailed analysis of the trade-offs between design considerations and cost. In order to ensure that the decisions resulting from mission studies are realistic and can be implemented, the studies employ new techniques for integrated design. SEC includes the following pre-development components: the Solar Terrestrial Probe (STP) Program's Magnetospheric Multiscale (MMS) and Global Electrodynamics Connection (GEC) missions, the Living With a Star (LWS) Program's Solar Dynamics Observatory (SDO) and Geospace Ionosphere/Thermosphere Mapper (I/TM) missions; and Future Explorer missions that are not yet selected. Also included is the New Millennium Program (NMP), which provides a path to flight-validate key emerging technologies to enable more capable and more frequent science missions.

### PROGRAM MANAGEMENT

The Office of Space Science is responsible for all SEC programs. The Enterprise Program Management Council is the Governing Program Management Council (GPMC) for the Solar Terrestrial Probes (STP) and Living With a Star Programs (LWS) (until SDO is confirmed for Implementation). After SDO is confirmed to start Implementation, the GPMC for the LWS Program is the Enterprise Program Management Council. GSFC is the GPMC for the Explorers Program, and JPL is the GPMC for the New Millennium Program (NMP). Enterprise official is Dr. Edward Weiler, Associate Administrator for Space Science at HQ. The Theme Director and the Point of Contact is Dr. Richard Fisher, Director of the Sun-Earth Connection Division at HQ. The program is in full compliance with NPG7120.5B.

### TECHNICAL COMMITMENT

Project technical baselines are defined by the individual Formulation Authorization Document (FAD), Program Commitment Agreement (PCA), or equivalent documentation.

| Technical Specifications | **FY04 President's Budget** | Change from Baseline |
|---|---|---|
| New Millennium Program<br>Space Technology-5 (ST-5) | Tests advanced technologies in space flight. Demonstrate and flight qualify a set of nanosats for application to future space missions. | |
| Solar Terrestrial Probes<br>Magnetospheric Multiscale | Understand fundamental processes that connect broad ranges of the magnetosphere. | No established baseline until confirmation. |

**THEME:** Sun-Earth Connection (SEC)

# TECHNOLOGY AND ADVANCED CONCEPTS

## TECHNICAL COMMITMENT - CONTINUED

| Technical Specifications - Continued | FY04 President's Budget | Change from Baseline |
|---|---|---|
| Solar Terrestrial Probes<br>Global Electrodynamic Connections | Study the roles the ionosphere-thermosphere plays in the coupling between the magnetosphere and the upper atmosphere. | No baseline until confirmation. |
| Living With a Star<br>Ionosphere-Thermosphere Mapper (Geospace Mission) | Study effects of changes in solar activity on the Earth's ionosphere & thermosphere. | No baseline until confirmation. |
| Living With a Star<br>Radiation Belt Mapper (Geospace Mission) | Study effects of changes in solar activity on the Earth's radiation belts. | No baseline until confirmation. |

| Schedule | FY04 President's Budget | Change from Baseline |
|---|---|---|
| STP - MMS Launch | Jan-09 | No baseline until confirmation. |
| STP - GEC Launch | Sep-09 | No baseline until confirmation. |
| LWS - SDO Launch | Aug-07 | No baseline until confirmation. |
| LWS - ITM Launch | Aug-08 | No baseline until confirmation. |
| LWS - RBM Launch | Aug-10 | No baseline until confirmation. |
| NMP ST-5 | Oct-04 | 5-month slip;<br>Launch Readiness Date at Confirmation was May-04. |

## ACQUISITION STRATEGY & PERFORMING ORGANIZATIONS

Major acquisitions are: Phase A studies for STP MMS; instrument investigations and spacecraft provider for STP GEC; instrument investigations and spacecraft provider for LWS Geospace Mission - ITM; and LWS SDO spacecraft and instrument hardware.

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

| Current Acquisitions | Actual * | Selection Method | Actual * | Performer | Actual * |
|---|---|---|---|---|---|
| Cooperative Agreements | 1% | Full & Open Competition | 90% | Industry | 8% |
| Cost Reimbursable | 39% | Sole Source | 10% | Government | 20% |
| Fixed Price | 3% | | 100% | NASA Intramural | 18% |
| Grants | 19% | | | University | 52% |
| Other | 38% | Sci Peer Review | 100% | Non Profit | 2% |
| * as % of FY02 direct procurement | 100% | * as % of FY02 direct procurement | | * as % of FY02 direct procurement | 100% |

| Future Acquisitions - Major | Selection | Goals |
|---|---|---|
| 1.Phase A studies MMS | Summer 03 | 85% Full & Open Competition, 15% GSFC mgmt |
| 2.Instrument investigations & Phase A studies - GEC | Mar 03 | 85% Full & Open Competition, 15% GSFC mgmt |
| 3.Instrument investigations & spacecraft-ITM-GM | Winter 03 | 40% Full & Open Comp (Instruments); 60% APL Sole Source |

**THEME:** Sun-Earth Connection (SEC)

# TECHNOLOGY AND ADVANCED CONCEPTS

## AGREEMENTS

*Internal:* The program is not dependent on other NASA activities outside of the control of the Associate Administrator of Space Science.

*External:* None at this time; may be baselined prior to mission confirmation.

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

## INDEPENDENT REVIEWS

| Types of Review | Performer | Last Review | Next Review | Purpose |
|---|---|---|---|---|
| STP & STEREO Independent Review | IRT | Oct-02 | Feb-03 | STP & STEREO CDR |
| STP Program & STP MMS mission | STP IRT | Feb-02 | Feb-03 | MMS ICR to transition from Phase A to Phase B |
| LWS Program & LWS SDO NAR | LWS IRT | | Dec-03 | Confirm SDO for transition to Development |

## BUDGET

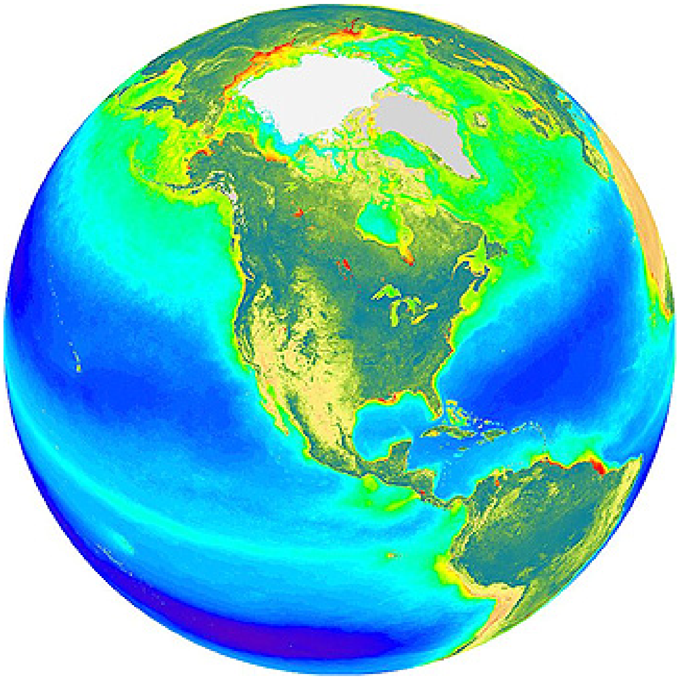
| Budget Authority ($ in millions) | FY02 | FY03 | FY04 | Comments |
|---|---|---|---|---|
| FY 2004 President's Budget (T&AC) | 130.9 | 255.6 | 314.0 | |
| New Millennium Program (NMP) | 48.2 | 62.8 | 86.8 | Includes ST-5 |
| Future Explorers | 13.5 | 96.4 | 118.0 | |
| Solar Terrestrial Probes (STP) | 3.7 | 12.9 | 43.5 | Includes MMS and GEC |
| Living With a Star (LWS) | 38.4 | 78.3 | 49.9 | Includes ITM and RBM (see Development section for SDO) |
| Other Tech and Adv. Concepts | 27.2 | 5.2 | 15.8 | CoF funding |
| Changes since FY 03 Pres. Budget | -33.3 | -26.6 | -63.5 | ***Reason for Change:*** |
| New Millennium Program (NMP) | -12.0 | | +8.0 | |
| Future Explorers | -9.5 | | -45.1 | realign to new missions |
| Solar Terrestrial Probes (STP) | | | +17.9 | |
| Living With a Star (LWS) | -14.8 | -26.6 | -45.1 | transfer SDO to Dev., transition |
| Other Tech and Adv. Concepts | +3.0 | | +0.8 | to full-cost |

Indicates budget numbers in full cost.

Indicates changes since the FY 2003 President's Budget Submit.

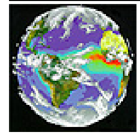
FY 2002 and FY 2003 are not in full cost.

## ENTERPRISE: Earth Science



NASA created the first record of the global biosphere using data from the SeaWiFS instrument, flown in an innovative government/commercial partnership. Data on changes in the global biosphere across seasons and years helps researchers understand how carbon circulates in the Earth system, which is one key piece of the climate change puzzle.

**THEMES**



**Earth System Science**

**Earth Science Applications**

# EARTH SCIENCE

**PURPOSE**

The mission of NASA's Earth Science Enterprise (ESE) is to develop a scientific understanding of the Earth system and its response to natural and human- induced changes. This understanding will allow us to improve prediction of climate, weather, and natural hazards. NASA brings to this endeavor the vantage point of space, allowing global views of Earth system change. NASA is a provider of scientific information, via observation, research, modeling, and applications demonstration, for use by both the public and private sectors. NASA has been studying the Earth from space from its beginnings as an Agency. These efforts have led to our current activity of deploying the first series of Earth Observing System (EOS) satellites that will concurrently observe the major interactions of the land, oceans, atmosphere, ice, and life that comprise the Earth system.

In short, the purpose of the ESE is to provide scientific answers to the fundamental question:

How is the Earth changing, and what are the consequences for life on Earth?

# ENTERPRISE: Earth Science

## FY 2002 ACCOMPLISHMENTS

Understanding iceberg calving, in which huge chunks of ice break off into the sea, may help explain changes in the total mass of Earth's ice as well as interactions among the oceans, ice, and climate. In a NASA-sponsored study, the TERRA MODIS science team observed the disintegration of the Antarctic Larsen Ice Shelf. They found evidence that glaciers melting after ice ages may have dramatically affected global ocean currents and hence, marine and terrestrial productivity. In a finding with more immediate impact, they found that changes in the distribution of icebergs after large calving events radically affect the marine ecosystem food chain.

The Shuttle Radar Topography Mission, a joint effort with the National Imagery and Mapping Agency, completed processing its 30-meter digital elevation models of the Western Hemisphere. This mission used a breakthrough technology, Interferometric Synthetic Aperture Radar, to produce the most detailed, globally consistent topographic data set ever. The data will be used in watershed management, flood remediation, aviation safety, and ecosystem management. Applications were showcased at the 2001 World Summit on Sustainable Development; they included more than 150 DOD applications. The DOD realized a savings of 14 to 1 relative to conventional means of acquiring such data.

For the second year in a row, wildfires coinciding with widespread summer drought challenged the resources of the U.S. Forest Service (USFS) and other agencies responsible for detecting, assessing, and fighting forest fires. In a joint effort, NASA and the USFS successfully validated the MODIS Rapid Fire Response project. By providing near real-time data daily from the MODIS sensors on the Terra and Aqua satellites, this program helped the Forest Service determine how to best mobilize its resources to combat the fires. The MODIS data, coupled with information from other satellites on an area's fuel potential, openness of tree canopy, and topography, are used to create models to predict the likely track of a fire.

## THEME DISTRIBUTION

| Budget Authority ($ in millions) | FY 2002 | FY 2003 President's Budget, As Amended | FY 2004 President's Budget |
|---|---|---|---|
| Earth System Science | 1,241.4 | 1,248.8 | 1,477.4 |
| Earth Science Applications | 94.7 | 61.7 | 74.8 |
| Institutional Support | 256.1 | 317.9 | -- |
| Total | 1,592.2 | 1,628.4 | 1,552.2 |

Note: For all formats, the FY 2002 column reflects the FY 2002 Congressional Operating Plan letter dated 9/30/02. The FY 2003 column reflects the FY 2003 Presidents Budget Submit (PBS) as Amended. The Change column includes both programmatic and full cost adjustments. FY2004 is in full cost.

Indicates budget numbers in Full Cost.

## Earth System Science

Within this theme, we are deploying and operating the first comprehensive constellation of Earth-observing research satellites designed to reveal interactions among Earth's continents, atmosphere, oceans, ice, and life. These interactions produce the conditions that sustain life on Earth. Data and information from our satellites enable researchers to understand the causes and consequences of global change and inform the decisions made by governments, businesses, and citizens to improve our quality of life. Highlights for FY 2004 include:

**Overall budget**
FY 2004 request is $1,477 million, a $52 million or 3.4 percent decrease from FY 2003 President's Request (full cost):

- The decrease in the budget from FY 2003 to FY 2004 is driven primarily by major development programs that are past their peak development spending and are preparing for launches in 2004 including AURA, Cloudsat, and Calipso.

- $96 million for the NPOESS Preparatory Project (NPP) under development in partnership with National Oceanic and Atmospheric Administration and the Department of Defense (DOD). NPP transfers critical research instruments to operational agencies and maintains data continuity for NASA sponsored scientific investigations.

- $60 million for the Landsat data continuity mission, which is an innovative program to seek partnerships with industry to continue receiving critical land remote sensing data.

- $524 million for research and modeling that help answer critical scientific questions on climate change to aid policy and economic decision-makers.

**New Initiative – Climate Change Research Initiative Acceleration**

Request includes $26 million for this new initiative ($72 million over five years)

- Accelerates evaluation of non-carbon dioxide ($CO_2$) impact on climate change. These factors potentially have as much or more influence as $CO_2$, which is the focus of most studies, and can be reduced with far less economic impact and with added benefits to public health and agriculture.

- To greatly enhance our ability to evaluate non-$CO_2$ forcings, an advanced polarimeter instrument will be flown to measure methane, troposheric ozone, aerosols and black carbon. Troposheric ozone, black carbon (soot) and aerosols are also important public health factors.

- Advanced polarimeter will be launched in the 2007 timeframe, which is about four years earlier than originally planned.

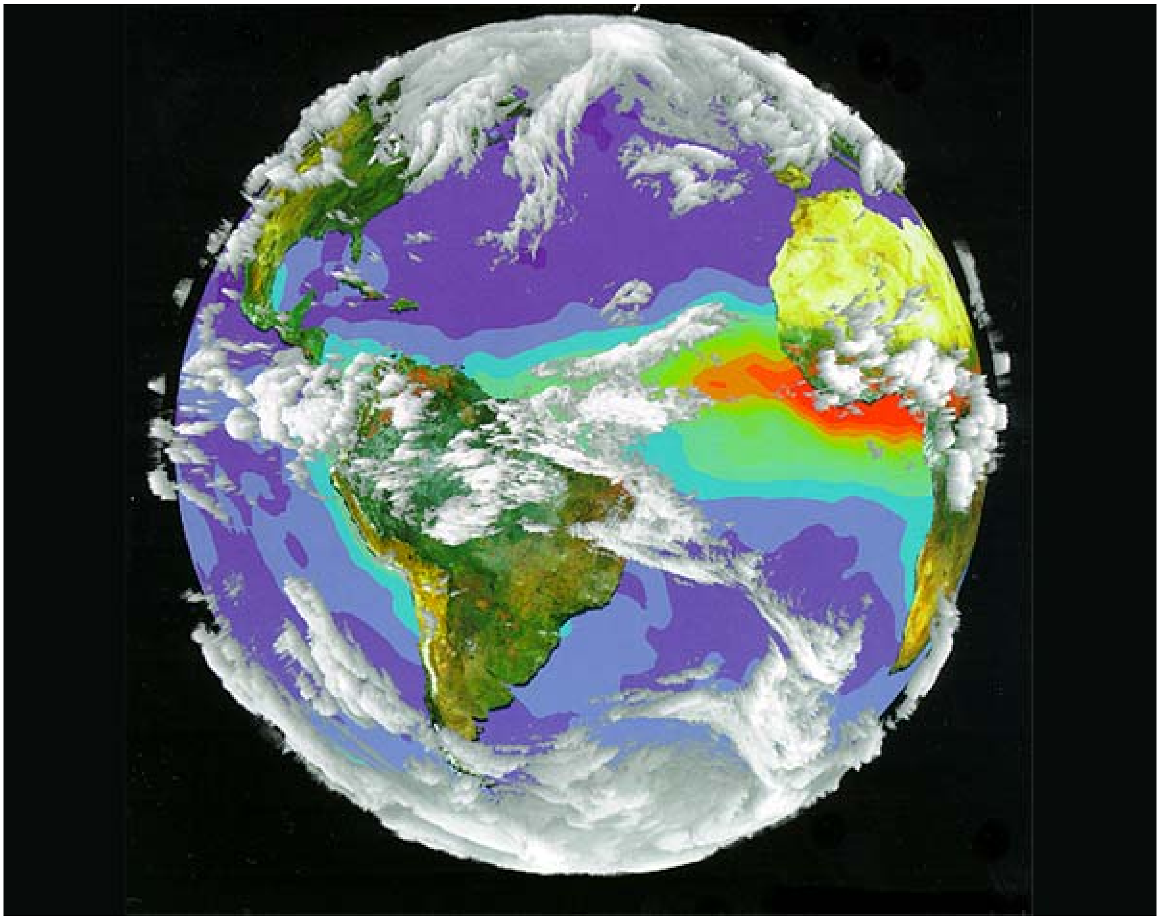
## Earth Science Applications

Within this theme, NASA works with other federal agencies to apply our research results and Earth observation information products to applications of national priority. We have identified applications where our partner agencies have decision support systems, such as weather prediction models and near-airport terrain databases, that are being improved based on NASA research and technological innovations. For each application, joint applications research and demonstrations are under way or being developed. In addition, the theme develops crosscutting solutions that advance the use of NASA information and technology across a range of potential new applications. Highlights for FY 2004 include:

**Overall budget**

FY 2004 request is $75 million, a $6.5 million or 8.0 percent decrease from FY 2003 President's Request (full cost):

- Theme completely revamped to focus on 12 specific applications of national priority where other agencies' decision support systems can be markedly improved based on NASA-provided data and information. Competitive, merit-review will be the hallmark of extramural project selection.



This image combines data sets of sea surface temperature, land vegetation cover, cloud cover, and large-scale fires from the Terra satellite Combining such data sets allows us to see the Earth as a system of interacting atmosphere, oceans, land, ice, and life. NASA introduced the concept of Earth System Science to promote total understanding of how Earth's atmosphere, biosphere, oceans, and continents shape Earth's climate and its variations. This way of looking at the Earth as a system is a powerful means of understanding and predicting changes we see around us, giving us the capability to better protect ourselves and our home planet.

# EARTH SYSTEM SCIENCE

## MAJOR EVENTS IN FY 2004

- Launches of Aura, Cloudsat and Calipso satellites. Aura will study Earth’s ozone, air quality, and climate. Cloudsat will measure the structure of clouds to better quantify their key role in the Earth’s water cycle and climate system. Calipso, with Aura and the advanced polarimeter, will study the role of aerosols in climate, reducing uncertainties in climate models.
- Use satellite observations to provide daily and seasonal global atmospheric water vapor, rainfall, snowfall, sea-ice, and ice-sheet maps; use these observations to improve scientific understanding and models of water cycle through the Earth system.
- Use satellite-derived localized temperature and moisture profiles, with unprecedented accuracy and global coverage, to improve predictive capabilities of regional weather models.
- Assimilate satellite and in situ observations into a variety of ocean, atmosphere, and ice models for purposes of estimating the state of Earth’s seasonal and decadal climate.
- Demonstrate the benefits of formation flying satellites in a constellation (i.e. creating first super-satellite) to enable generation of integrated science products, e.g., aerosol distribution, optical thickness and properties to assess affect on climate aerosols.

## **THEME:** Earth System Science

### OVERVIEW

NASA uses the vantage point of space to observe Earth and understand both how it is changing and the consequences for life. The Earth System Science Theme works with the science community to answer questions on the frontiers of science that have profound societal importance, and for which remote sensing of the Earth can make a defining contribution. The program funds research at the Nation's universities, conducts research at NASA Centers, and collaborates with other research agencies and the U.S. Climate Change Science Program Office/U.S. Global Change Research Program, and the National Research Council to define these questions and lay the scientific foundation for prioritizing and approaching them. The program is answering the scientific community's call for comprehensive observation of the Earth's major components. Research results contribute to the development of sound environmental policy and economic investment decisions. With the FY 2004 budget request, NASA will continue its progress in answering key scientific questions and demonstrating practical applications in response to national priorities.

| Missions | Goals supported by this theme | Objectives supporting those goals — Reference 2003 Strategic Plan |
|---|---|---|
| Understand and Protect our Home Planet | 1. Understand the Earth System and apply Earth system science to improve prediction of climate, weather, and natural hazards. | 1.1 Understand how the Earth is changing, better predict change, and understand the consequences for life on Earth. |
| Inspire the Next Generation of Explorers | 6. Inspire and motivate students to pursue careers in science, technology, engineering, and mathematics. | 6.3 Enhance science, technology, and mathematics instruction with unique teaching tools and experiences that only NASA can provide, that are compelling to teachers and students. (Supporting Role) |
| | 7. Engage the public in shaping and sharing the experience of exploration and discovery. | 7.2 Improve science literacy by engaging the public in NASA missions and discoveries, and their benefits, through such avenues as public programs, community outreach, mass media, and the internet. (Supporting Role) |

### RELEVANCE

The NASA Earth System Science program is driven by the recognition of the societal importance of the natural variability of the Earth system and the realization that humans are no longer passive participants in global change, but are instead causing significant changes in atmospheric composition, land use and land cover, and water resources.

Our satellites are examining the global water cycle, including the roles of precipitation and ice. Understanding how water cycles through the Earth system of oceans, atmosphere, land, and ice is essential for assessing the future of fresh water availability in the U.S. Southwest and other thirsty regions of the globe. NASA is also studying the seasonal rhythm of terrestrial and marine ecosystems on a global scale for the first time. This view of the seasonal uptake and release of carbon provides us with new insights into the role of ecosystems in the carbon cycle. This research helps us assess the impact of global change on food and fiber production.

The FY 2004 budget reflects the alignment of the Earth System Science program with the President's call for action through the U.S. Climate Change Research Initiative (CCRI). In support of this effort, we are accelerating the development and launch of an advanced polarimeter to increase our understanding of black carbon soot and other aerosols as causes of climate change.

| Education and Public Benefits |
|---|
| The Earth Systems Science theme increases public awareness and understanding of how the Earth functions as a system, and enables the use of Earth science information and results in teaching and learning at all levels of education. We also build capacity for productive use of Earth science results, technology, and information in resolving everyday practical problems via the Earth Science Applications theme. |

## THEME: Earth System Science

### IMPLEMENTATION

Earth System Science employs a constellation of more than 15 Earth observing satellites routinely making measurements with over 80 remote sensing instruments to observe the Earth. This information is used to analyze, model, and improve our understanding of the Earth system. Data gathered by these spacecraft will enable improved predictions of climate, weather, and natural hazards.

Earth System Science is a multiple-project program with program responsibility in the Office of Earth Science at NASA HQ. Enterprise official is Dr.Ghassem Asrar, Associate Administrator for Earth Science at HQ. Theme Director is Dr. Jack Kaye at HQ.

| Strategy and Purpose |
|---|
| NASA works with the science community to identify questions on the frontiers of science that have profound societal importance, and to which remote sensing of the Earth can make a defining contribution. These science questions become the foundation of a research strategy, which defines requirements for scientific observations, and a roadmap for combining the technology, observations, modeling efforts, basic research, and partnerships needed to answer the questions over time. The roadmaps listed below can be seen at: http://earth.nasa.gov/roadmaps<br><br>Climate Variability and Change - Develop integrated models of the ocean, air, cryosphere and land surface, and apply to retrospective and future studies of climate variability and change.<br><br>Weather - Develop the technology, observational and modeling capacity needed to improve daily and extreme weather forecasting (e.g. hurricanes, tornadoes).<br><br>Atmospheric Composition - Understand the trace constituent and particulate composition of the Earth's atmosphere and predict its future evolution.<br><br>Carbon Cycle, Ecosystems, and Biogeochemistry - Understand and predict changes in the Earth's terrestrial and marine ecosystems and biogeochemical cycles.<br><br>Water & Energy Cycles - Characterize and predict trends and changes in the global water and energy cycles.<br><br>Earth Surface and Interior Structure - Utilize state-of-the-art measurements and advanced modeling techniques to understand and predict changes in the Earth's surface and interior. |

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

### STATUS

In FY02, this Theme advanced our knowledge of the Earth system in many ways, including:

• Polar Ice Sheets: Knowledge about the ice-covered regions in Greenland and Antarctica provided us with the ability to make a quantitative assessment of changes in ice cover. This knowledge will aide scientists in their ability to test climate models, and will also improve our ability to provide assessments of potentially hazardous changes in sea level and sea ice distributions.

• Atmospheric Aerosols: The most comprehensive evaluation of the global distribution and properties of atmospheric aerosols became available in FY02. The current data provides information not just on aerosol presence, but on the nature of the aerosol particle, including whether or not it can have a net warming or cooling effect on the local climate, and how it interacts with the climate. Combined with ground-based data, this information can help scientists understand aerosol impacts on local weather, agricultural productivity, and air quality.

• Clouds: NASA made great progress in linking satellite and in situ measurements of clouds with their effects on atmospheric radiation. Detailed in situ observations of clouds were made during a NASA-led campaign in which one platform used a suite of more than two dozen instruments to make comprehensive measurement of cloud particle properties. The results should improve information about cloud particle distributions and properties, understanding of satellite remote sensing of clouds, and characterization of cloud formation in climate models.

• Precipitation Studies: Data from several years of operation of the Tropical Rainfall Measuring Mission (TRMM) satellite were available in FY02, and as a result, uncertainty about the global rainfall distribution in the tropics has been reduced by a factor of two, and our knowledge of the variation in precipitation from year to year has been enhanced.

## THEME: Earth System Science

### PERFORMANCE MEASURES

| Annual Performance Goals | |
|---|---|
| | OUTCOME: A well managed program in accordance with Agency implementing strategies. |
| 4ESS1 | Development: Each project will complete its current phase within 10% of total life-cycle cost shown on the table below. |
| 4ESS2 | Research: Each Research project will allocate 80% of its funding competitively during FY04. |
| 4ESS3 | Development: Each project will complete its mission within 10% of its baseline schedules. |
| 4ESS4 | Technology: Successfully develop and infuse technologies that will enable future science measurements. We will do this by: 1) advancing 25% of funded technology developments one Technology Readiness Level (TRL); 2) maturing 2-3 technologies to the point where they can be demonstrated in space or in an operational environment. |
| 4ESS5 | Operations: At least 90 percent of all on-orbit instruments will be operational during their design lifetimes. |
| 4ESS6 | Data information system and services: Disseminate data that are easy to access to science focus area customers. |
| 1.1.1 | OUTCOME: Observe, analyze, and model the Earth system to discover how it is changing and the consequences for life on Earth. |
| 4ESS7 | **Atmospheric Composition -** Integrate high latitude satellite, suborbital, and ground based observations, coupled with laboratory studies and model calculations to assess the potential for future ozone depletion in the arctic, and characterize the properties and distributions of various types of clouds and aerosols as they relate to the extinction of solar radiation in the atmosphere. In the 2010-2014 timeframe, we will aim to improve our ability to predict future ozone change by developing multi-year maps of key tropospheric pollutants and their altitude distribution and variability. Progress toward achieving outcomes will be validated by external review. |
| 4ESS8 | **Weather -** Improve predictive capabilities of regional models using satellite-derived localized temperature and moisture profiles and ensemble modeling. We plan to greatly improve weather and severe storm forecasting by 2014 by creating cloud models with detailed microphysics and spatial resolution of approximately 25 kilometers or less. Progress toward achieving outcomes will be validated by external review. |
| 4ESS9 | **Carbon Cycles, Ecosystems, and Biogeochemistry -** Reduce land cover errors in ecosystem and carbon cycle models, and quantify global terrestrial and marine primary productivity and its interannual variability. One goal we plan to reach by the 2010-2014 timeframe is the identification and quantification of carbon sources and sinks at the sub-regional scales (approximately 100 kilometers) with high confidence, leading to progress in predicting the future of carbon-cycling. Progress toward achieving outcomes will be validated by external review. |
| 4ESS10 | **Water and Energy Cycle** - Enhance land surface modeling efforts, which will lead to improved estimates of soil moisture and run-off. One of our goals for the 2010-2014 timeframe is to have global observation of precipitation over the entire diurnal cycle and important land surface quantities, such as soil moisture and snow quantity at mesoscale resolution (i.e., on the order of kilometers). Progress toward achieving outcomes will be validated by external review. |
| 4ESS11 | **Climate, Variability and Change -** Assimilate satellite and in situ observations into a variety of ocean, atmosphere, and ice models for purposes of state estimation; provide experimental predictions on a variety of climatological timescales; and determine the plausibility of these predictions using validation strategies. One of the goals in the 2010-2014 timeframe is the development of 10-year or longer climate forecasts leading to better informed policy choices on greenhouse gas emissions and carbon management. Progress toward achieving outcomes will be validated by external review. |
| 4ESS12 | **Earth Surface and Interior Structure -** Advance understanding of surface change through improved geodetic reference frame, estimates of mass flux from satellite observations of Earth's gravitational and magnetic fields, and airborne and spaceborne observations of surface height and deformation. One goal toward predicting changes in Earth's surface is to achieve high resolution global topography at meter resolution and decimeter vertical accuracy for the 2010-2014 timeframe. Progress toward achieving outcomes will be validated by external review. |
| 6.3.1 | OUTCOME: Improve quality of STEM instruction. |
| 4ESS13 | Education: Make Earth science information products available to curricula developers. |
| 7.2.2 | OUTCOME: Engage the public in NASA's scientific exploration of Earth from space. |
| 4ESS14 | Post the most exciting imagery and explanations about Earth science on the Earth observations/ESE website. |

# THEME: Earth System Science

## INDEPENDENT REVIEWS

| Types of Review | Performer | Last Review | Next Review | Purpose |
|---|---|---|---|---|
| External Peer Review | Nat Academy of Science | 2000 | 2003 | Review of Science Plan |
| External Peer Review | Earth Science Advisory Committee | Nov 2002 | Nov 2003 | Annual peer review |

## BUDGET

| Budget Authority ($millions) | FY02 | FY03 | Chng | FY04 | Comments |
|---|---|---|---|---|---|
| **Earth System Science** | **1,241.4** | **1,248.8** | **+228.6** | **1,477.4** | |
| Development | 665.5 | 332.7 | -54.2 | 278.5 | |
| Aura | 70.4 | 85.3 | -32.8 | 52.5 | |
| GIFTS (EO-3) | 30.0 | 22.3 | +4.7 | 27.0 | |
| Cloudsat | 25.3 | 27.4 | -10.9 | 16.5 | |
| Calipso | 29.5 | 33.8 | -5.4 | 28.4 | |
| Special:Seawinds | 3.8 | 2.2 | +2.3 | 4.5 | |
| Special: IceSAT | 29.2 | 0.0 | 0.0 | 0.0 | |
| Special: SORCE | 21.0 | 4.0 | -1.9 | 2.1 | |
| EOSDIS | 291.5 | 74.3 | +24.0 | 98.3 | |
| Prior and Small Projects < $100m | 164.8 | 83.4 | -57.3 | 26.1 | |
| CCRI Polarimeter Development | | | +23.2 | 23.2 | New Initiative (See SAE 8-2). |
| Operations | 48.0 | 247.8 | +74.4 | 322.2 | |
| Technology and Advanced Concepts | 189.3 | 311.0 | +42.3 | 353.3 | |
| Technology Infusion | 71.8 | 65.0 | +13.9 | 78.9 | |
| Missions in Formulation | 117.5 | 246.0 | +28.4 | 274.4 | |
| Research | 338.6 | 357.3 | +166.1 | 523.4 | |

Note: For all formats, the FY 02 column reflects the FY 2002 Congressional Operating Plan dated 9/30/02. The FY 03 column reflects the FY 2003 President's Budget Submit (PBS) as Amended. The Change column includes both programmatic and full cost adjustments. FY 2004 column is in full cost.

Indicated budget numbers in Full Cost.

Indicates changes since the FY 2003 Presidents Budget Submit.

FY 2002 and FY 2003 are not in full cost.

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| THEME: | Earth System Science |
|---|---|
| **DEVELOPMENT:** | AURA |

## PURPOSE

| Objectives | Reference 2003 Strategic Plan | Performance Measures |
|---|---|---|
| 1.1 | | 4ESS1, 4ESS3, 4ESS7 |

The Aura mission will study the Earth's ozone, air quality, and climate, providing answers to the following questions: 1) Is the ozone layer, which shields us from the Sun's ultraviolet radiation, recovering? The release of chlorofluorocarbons (CFC's) has caused a dramatic decrease in the ozone layer during the last two decades, especially over Earth's polar regions, but detection of stratospheric ozone depletion led to the regulation and phasing-out of CFC production worldwide. 2) Is global air quality getting worse? The chemistry of Earth's lower atmosphere, the troposphere, is changing. At this level of the atmosphere, ozone pollution, an extremely toxic byproduct of agricultural burning, deforestation, urban activity, and industry, is increasing worldwide. 3) How is Earth's climate changing? Ozone and water vapor in the upper troposphere and lower stratosphere are important "greenhouse gases," playing a significant role in regulating our climate. Understanding how water vapor and ozone vary will reveal how these constituents moderate global temperature increases.

## OVERVIEW

Aura is the third major satellite in the Earth Observing System constellation. The first and second missions, Terra and Aqua, are designed to study the land, oceans, and the Earth's radiation budget. Aura's chemistry measurements will follow up on measurements which NASA pioneered with its Nimbus 7 satellite (1978), continued with NASA's Upper Atmosphere Research Satellite (1991), and the Total Ozone Mapping Spectrometer (TOMS) series of missions. The satellite will be launched in January 2004 and operate for five or more years.

Link to project homepage for more information: http://aura.gsfc.nasa.gov/

## PROGRAM MANAGEMENT

Aura is part of the EOS program with program responsibility delegated to the Goddard Space Flight Center. The GSFC Program Management Council (PMC) has Aura Project governing responsibility. Enterprise official is Dr. Ghassem Asrar, Associate Administrator for Earth Sciences. Theme Director is Dr. Jack Kaye. Aura Program Manager is Doug McCuistion.

## TECHNICAL COMMITMENT

The baseline for this technical commitment was made in 1993. However, the final baseline consistent with these requirements was not reached until 1995. The requirements are detailed in the EOS Program Commitment Agreement.

| Technical Specifications | FY04 President's Budget | Change from Baseline - None |
|---|---|---|

The Aura project will launch four instruments on the EOS Common Spacecraft into a 705km, 98.2-degree inclination, sun-synchronous orbit. The spacecraft will have an equatorial crossing time (ascending node ) of 1:45pm.

The **High Resolution Dynamic Limb Sounder (HIRDLS)** - Infrared limb-scanning radiometer designed to look through the "edge" of Earth's atmosphere to study aerosols and clouds.

The **Microwave Limb Sounder (MLS) -** Passive microwave radiometer/spectrometer which will study ozone depletion and radiation in the Earth's troposphere and stratosphere.

The **Tropospheric Emission Spectrometer (TES) -** Infrared imaging spectrometer to measure global distributions of key atmospheric pollutants.

The **Ozone Measuring Instrument (OMI) -** An imaging spectrometer to map total column densities of aerosols and ozone in the stratosphere and troposphere.

| Schedule | FY04 President's Budget | Baseline | Change from Baseline |
|---|---|---|---|
| Start of Formulation | Aug-93 | Aug-93 | -- |
| Spacecraft Delta PDR | Oct-99 | Mar-98 | +19 Months |
| Spacecraft Delta CDR | Aug-00 | Jun-99 | +17 months |
| Last Instrument Delivery | Nov-02 | Mar-99 | +17 Months |
| Operational Readiness Review | Nov-02 | Oct-02 | +13 Months |
| Launch Readiness Review | Jan-04 | Dec-02 | +13 Months |
| Data Validation Period | 1 yr after receipt by investigators | | -- |
| Observatory Operational Lifetime | 5 years | | -- |

| | |
|---|---|
| **THEME:** | Earth System Science |
| **DEVELOPMENT:** | AURA |

## ACQUISITION STRATEGY & PERFORMING ORGANIZATIONS

Major acquisitions for Aura are: three U.S. instruments, spacecraft development, launch vehicle services through the Kennedy Space Center . Three instruments were selected for development in 1990. MLS and TES are built by JPL. HIRDLS is built by Lockheed Martin and the fourth, OMI, was confirmed for the mission in April 1998 and is being built by the Netherlands. The spacecraft is being built as part of the EOS common spacecraft contract by TRW for GSFC. **Changes since FY03 Pres. Budget: None.**

| Current Acquisitions | Actual * | Selection Method | Actual * | Performer | Actual * |
|---|---|---|---|---|---|
| Cooperative Agreements | 0% | Full & Open Competition | 100% | Industry | 63% |
| Cost Reimbursable | 100% | Sole Source | 0% | Government | 11% |
| Fixed Price | 0% | | #### | NASA Intramural | 0% |
| Grants | 0% | | | University | 26% |
| Other | 0% | Sci Peer Review | 100% | Non Profit | 0% |
| * as % of FY02 direct procurement | 100% | * as % of FY02 direct procurement | | * as % of FY02 direct procurement | 100% |

| Future Acquisitions - Major | Selection | Goals |
|---|---|---|
| No major acquisitions remain, as the program is one year from launch. | N/A | N/A |

## AGREEMENTS

*Internal:* Launch services provided by KSC. The program is not dependent on other NASA activities outside of the control of the Associate Administrator for Earth Science.

*External:* HIRDLS instrument is a joint development with the United Kingdom's Natural Environmental Research Council, and the OMI instrument is provided by the Netherlands' Agency for Aerospace Programs. Both are covered by Memoranda of Agreement between the respective governments. **Changes since FY03 Pres. Budget: None.**

## INDEPENDENT REVIEWS

| Types of Review | Performer | Last Review | Next Review | Purpose |
|---|---|---|---|---|
| Indep. Annual Review | IPAO - LARC | Oct-00 | TBD | Affirmation of Program Commitment Agreement. |
| Pre-Environmental Review | SMO | | Spring 03 | Confirm Observatory is ready for environmental tests. |
| Pre-Ship Review | SMO | | Fall 04 | Confirm Observatory is ready for shipment to launch site. |

## BUDGET/LIFE CYCLE COST

Total budget authority represents the Life Cycle Cost (LCC).

| Budget Authority ($ in millions) | Prior | FY02 | FY03 | FY04 | FY05 | FY06 | FY07 | FY08 | BTC | Total | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|
| FY 2004 President's Budget (LCC) | 551.2 | 70.4 | 85.3 | 52.5 | 4.6 | 3.4 | 0.1 | 0.1 | 0.1 | 767.7 | |
| Development | 537.2 | 63.3 | 55.2 | 45.1 | 4.6 | 3.4 | 0.1 | 0.1 | 0.1 | 709.1 | |
| Launch Vehicle | 14.0 | 7.1 | 30.1 | 7.4 | | | | | | 58.6 | |
| Data Analysis | | | | | | | | | | | |
| (funded through Mission Op and Research activities) | | | | | | | | | | | |
| Changes since FY 03 Pres. Budge | | 0.0 | 0.0 | +52.4 | +4.8 | +3.6 | +0.1 | +0.1 | +0.1 | +61.1 | ***Reason for Change:*** |
| Development | | +21.3 | -14.8 | +42.8 | +4.6 | +3.4 | +0.1 | +0.1 | +0.1 | +57.6 | Launch Delay to January 2004. |
| Launch Vehicle | | -21.3 | +14.8 | +7.0 | | | | | | +0.5 | Rephase to accommodate delay. |
| Data Analysis | | | | | | | | | | | |
| Full Cost | | | | +2.6 | +0.2 | +0.2 | | | | +3.0 | Inclusion of full cost. |
| FY 2003 President's Budget (LCC) | 551.2 | 70.4 | 85.3 | 0.1 | | | | | | 707.0 | |
| Development | 537.2 | 42.0 | 70.0 | 0.1 | | | | | | 649.3 | |
| Launch Vehicle | 14.0 | 28.4 | 15.3 | | | | | | | 57.7 | |
| Data Analysis | | | | | | | | | | | |
| Initial Baseline (LCC) | 765.3 | | | | | | | | | 765.3 | |
| Development (Feb '95) | 707.6 | | | | | | | | | 707.6 | |
| Launch Vehicle | 57.7 | | | | | | | | | 57.7 | |

Indicates budget numbers in Full Cost.

Indicates changes since the FY 2003 Presidents Budget Submit.

FY 2002, FY 2003, Prior and BTC are not in full cost.

| THEME: | Earth System Science |
|---|---|
| **DEVELOPMENT:** | CloudSat |

## PURPOSE

| Objectives | Reference 2003 Strategic Plan | Performance Measures |
|---|---|---|
| 1.1 | | 4ESS1, 4ESS3, 4ESS11 |

CloudSat observations will improve cloud modeling, contributing to better predictions of cloud formation and distribution and to a better understanding of the role of clouds in Earth's climate system. Clouds are the key component of the Earth's hydrological cycle, and they dominate the planet's solar and thermal radiation budgets. Even small changes in their abundance or distribution could significantly alter the climate. These considerations lead scientists to believe that the main uncertainties in climate model simulations are due to the difficulties in adequately representing clouds and their radiative properties.

## OVERVIEW

CloudSat is designed to measure the vertical structure of clouds from space. CloudSat will fly a millimeter-wave (94 GHz) radar that is capable of seeing a large fraction of clouds and precipitation, from very thin cirrus clouds to thunderstorms producing heavy precipitation. CloudSat will furnish data needed to evaluate and improve the way clouds are represented in global models, thereby contributing to better predictions of clouds and a more complete knowledge of their role in climate change.Cloudsat, a collaboration among NASA, the Canadian Space Agency (CSA), and the U.S. Air Force, is co-manifested with CALIPSO. CSA is contributing instrument components and the U.S. Air Force is contributing ground operations.

Cloudsat will answer the following science question: What are the effects of clouds and surface hydrologic processes on Earth's climate?

Link to project homepage for more information: http://cloudsat.atmos.colostate.edu/

## PROGRAM MANAGEMENT

CloudSat is part of the Earth Explorers Program, with program responsibility delegated to the GSFC. The GSFC center Program Management Council (PMC) has CloudSat governing responsibility. Enterprise official is Dr. Ghassem Asrar, Associate Administrator for Earth Science. Theme Director is Dr. Jack Kaye. Program Manager is Doug McCuistion.

## TECHNICAL COMMITMENT

The baseline for this technical commitment was made in December 2001 and is detailed in the Earth Explorers Program Commitment Agreement (PCA).

| Technical Specifications | **FY04 President's Budget** | **Change from Baseline** |
|---|---|---|
| Instrument: | The CloudSat sensor is the Cloud Profiling Radar (CPR). The CPR is a 94-GHz nadir-looking radar which measures the power backscattered by clouds as a function of distance from the radar. | -- |
| Launch and Mission Profile: | The CloudSat satellite will be co-manifested with CALIPSO on a Delta II launch vehicle. CloudSat will fly in near-formation with Aqua. | |
| Science Data Products and Processing: | The CloudSat CPR provides calibrated, range-resolved radar reflectivity measurements. | -- |
| Mission Operations: | The U.S. Air Force Space Test Program will provide ground operations and manage communications. It is expected that the data will be downlinked up to 7 times per day. | -- |
| Data Archiving and Distribution: | The Colorado State University Cooperative Institute for Research in the Atmosphere will be responsible for processing, archiving and distributing the mission science data. | -- |

| Schedule | **FY04 President's Budget** | **Change from 03 Baseline** |
|---|---|---|
| Instrument Del. To I&T | Jul-03 | - 4 months |
| S/C Bus Del. To I&T | Sep-03 | -2 months |
| Launch | Under replan - no earlier than 10/04 | +6 months |
| Mission Design Life | 2 years | -- |

| THEME: | Earth System Science |
|---|---|
| **DEVELOPMENT:** | **CloudSat** |

## ACQUISITION STRATEGY & PERFORMING ORGANIZATIONS

Major acquisitions for CloudSat are: Science investigations; 94GHz Cloud Profiling radar and spacecraft bus; and operations system development. MOU with the Canadian Space Agency (CSA) for radar components, and science operations (2 yrs.). JPL is prime contractor for radar development and overall mission management. Ball Aerospace is building the spacecraft bus under contract with JPL. Data processing provided by Colorado State University under contract with GSFC. **Changes since FY03 Pres. Budget: Implementation Phase of contracts.**

| Current Acquisitions | Actual * | Selection Method | Actual * | Performer | Actual * |
|---|---|---|---|---|---|
| Cooperative Agreements | 0% | Full & Open Competition | 100% | Industry | 3% |
| Cost Reimbursable | 99% | Sole Source | 0% | Government | |
| Fixed Price | 0% | | 100% | NASA Intramural | 94% |
| Grants | 1% | | | University | 3% |
| Other | 0% | Sci Peer Review | 100% | Non Profit | 0% |
| * as % of FY02 dir. proc. | 100% | * as % of FY02 dir. proc. | | * as % of FY02 dir. proc. | 100% |

| Future Acquisitions - Major | Selection | Goals |
|---|---|---|
| No major acquisitions remain. | N/A | |

## AGREEMENTS

*Internal:* GSFC/JPL - CloudSat Mission Formulation/Implementation Subprocess, 12/00.
*External:* GSFC/Colorado State University - CloudSat Mission Implementation Phase, 12/00; GSFC/USAF, MOU Ground Support/Mission Operation of SMC-801 CloudSat, 9/00; NASA/Canadian Space Agency, LOA Development of the CloudSat Cooperative Mission, 11/99; NASA/Canadian Space Agency, Interim Agreement, Development of the CloudSat Cooperative Mission, 10/01; SCU/LPL/DOE Memorandum of Agreement; DOE ground validation data from its Atmospheric Measurements program. **Changes since FY03 Pres. Budget: Implementation Phase of contracts.**

## INDEPENDENT REVIEWS

| Types of Review | Performer | Last Review | Next Review | Purpose |
|---|---|---|---|---|
| Preliminary Design Review | IIRT | Sep.-00 | | Demo prelim. designs meet mission reqs w/ acceptable risk. |
| Mission Confirmation Review | IIRT | Nov.-00 | | Seek OES AA approval to enter Implementation Phase. |
| Critical Design Review | IIRT | Jul.-01 | | Provide tech review of the end-to-end mission system. |
| Pre-environmental Review | IIRT | | TBD | Assess flt. h/w, s/w, & environ. test facilities for acceptance. |
| Pre-ship Review | IIRT | | TBD | Verify sys. elements meet mission reqs & ready for launch. |
| Operational Readiness Review | IIRT | | TBD | Verify sys. elements meet mission reqs & ready for launch. |
| Mission Readiness Review | IIRT | | TBD | Assess readiness of mission to proceed w/ launch & ops. |
| Flight Readiness Review | IIRT | | TBD | Update status; cert. flt. readiness; open MMR issues. |
| Launch Readiness Review | IIRT | | TBD | Final review before launch. |

## BUDGET/LIFE CYCLE COST

Total budget authority represents the Life Cycle Cost (LCC).

| Budget Authority ($ in millions) | Prior | FY02 | FY03 | FY04 | FY05 | FY06 | FY07 | FY08 | BTC | Total | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|
| FY 2004 President's Budget (LCC | 68.3 | 25.3 | 27.4 | 16.5 | 2.7 | 1.7 | 0.0 | 0.0 | 0.0 | 141.8 | |
| Development | 57.4 | 24.6 | 16.3 | 7.5 | | | | | | 105.8 | |
| Operations | | | | 1.9 | 2.7 | 1.7 | | | | 6.3 | |
| Launch Vehicle | 10.9 | 0.7 | 11.1 | 7.0 | | | | | | 29.7 | |
| Data Analysis | | | | | | | | | | 0.0 | |
| Changes since FY 03 PBS | 0.0 | +1.5 | 0.0 | 0.0 | +0.1 | +0.1 | | | | +1.6 | ***Reason for Change:*** |
| Development | +1.0 | +0.8 | +0.4 | -0.9 | | | | | | +1.3 | LV costs less than projected (held in |
| Operations | | | | +0.1 | +0.1 | +0.1 | | | | +0.3 | reserves). |
| Launch Vehicle | -1.0 | +0.7 | -0.4 | +0.7 | | | | | | +0.0 | |
| Data Analysis | | | | | | | | | | +0.0 | |
| FY 2003 President's Budget | 68.3 | 23.8 | 27.4 | 16.5 | 2.6 | 1.6 | 0.0 | 0.0 | 0.0 | 140.2 | Initial baseline set in Formulation; |
| Development | 56.4 | 23.8 | 15.9 | 8.4 | | | | | | 104.5 | subsequently, mission underwent |
| Operations | | | | 1.8 | 2.6 | 1.6 | | | | 6.0 | significant replanning. |
| Launch Vehicle | 11.9 | | 11.5 | 6.3 | | | | | | 29.7 | |
| Data Analysis | | | | | | | | | | 0.0 | |
| Initial Baseline | 71.1 | 29.8 | 10.3 | 3.1 | 1.5 | 0.0 | 0.0 | 0.0 | 0.0 | 115.8 | FY 2001 President's Budget. |
| Development | 58.2 | 18.3 | 3.7 | 0.0 | 0.0 | | | | | 80.2 | |
| Operations | | | 1.2 | 3.1 | 1.5 | | | | | 5.8 | |
| Launch Vehicle | 12.9 | 11.5 | 5.4 | | | | | | | 29.8 | |

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

| | |
|---|---|
| **THEME:** | Earth Systems Science |
| **DEVELOPMENT:** | Cloud-Aerosol Lidar and Infrared Pathfinder Satelllite Observations (CALIPSO) |

## PURPOSE

| Objectives | Reference 2003 Strategic Plan | Performance Measures |
|---|---|---|
| 1.1 | | 4ESS1, 4ESS3, 4ESS7 |

The Cloud-Aerosol Lidar and Infrared Pathfinder Satellite Observations (CALIPSO) mission will address the role of clouds and aerosols in the Earth's radiation budget, providing key measurements to improve climate predictions. Climate models predict a significant global warming in response to the rising concentrations of carbon dioxide and other greenhouse gases in the atmosphere, but uncertainties in the modeled radiative effects of aerosols (small suspended particles) and clouds contribute to the overall uncertainty in the predictions of the climate models. Current predictive capabilities must be improved to enable policy makers to reach balanced decisions on mitigation strategies.

## OVERVIEW

The mission will fly a 3-channel lidar (a laser) in formation with Aqua and CloudSat to obtain coincident observations of radiative fluxes and the atmosphere. This set of measurements is essential for quantification of global aerosol and cloud radiative effects. CALIPSO consists of a partnership between NASA and France's Centre Nationale D'Etudes Spatiale (CNES). CNES is providing a PROTEUS spacecraft, the imaging infrared radiometer (IIR), payload-to-spacecraft I&T, and spacecraft mission operations. This mission will improve our ability to predict the future state of Earth's climate. Together, CALIPSO and Aqua provide: (1) a global measurement suite from which the first observationally-based estimates of aerosol direct radiative forcing of climate can be made, (2) a dramatically improved empirical basis for assessing aerosol indirect radiative forcing of climate, (3) a factor of 2 improvement in the accuracy of satellite estimates of long-wave radiative fluxes at the Earth's surface and in the atmosphere, and (4) a new ability to assess cloud-radiation feedback in the climate system. CALIPSO is co-manifested with CloudSat and is scheduled to launch no earlier than October 2004.

Link to project homepage for more information: http://www-calipso.larc.nasa.gov

## PROGRAM MANAGEMENT

CALIPSO is part of the Earth Probes program with program responsibility delegated to the Goddard Space Flight Center. The GSFC Program Management Council (PMC) has CALIPSO Project governing responsibility. Enterprise official is Dr. Ghassem Asrar, Associate Administrator for Earth Science. Theme Director is Dr. Jack Kaye. Program Manager is Doug McCuistion.

## TECHNICAL COMMITMENT

The baseline for this technical commitment was made in February 2001 and is detailed in the Earth Probes Program Commitment Agreement (PCA).

| Technical Specifications | FY04 President's Budget | Change from Baseline |
|---|---|---|
| Instruments: | 3-channel Lidar, Imaging Infrared Radiometer, and Wide Field Camera | -- |
| Launch and Mission Profile: | Satellite is planned to be launched into a 705km altitude, 98.08 degrees inclined orbit. CALIPSO is planned to be co-manifested with CloudSat on a Delta II launch vehicle and will fly in near formation with Aqua. | -- |
| Science Data Products and Processing: | Science data sets will consist of aerosol and cloud vertical distributions; aerosol extinction and optical depth; cloud extinction, optical depth, emissivity, and effective particle size; and surface and atmospheric radiative fluxes. | -- |
| Mission Operations: | Mission Operations Control Center at LaRC and the CNES-contributed Satellite Operations Control Center in Toulouse, France. | -- |

| Schedule | FY04 President's Budget | Change from 03 Baseline |
|---|---|---|
| Instrument Del. To I&T | Jun-03 | +1 month |
| S/C Bus Del. To I&T | May-03 | -- |
| Launch | Under replan - no earlier than 10/04 | +6 months |
| Mission Design Life | 3 years | |

| | |
|---|---|
| **THEME:** | Earth Systems Science |
| **DEVELOPMENT:** | Cloud-Aerosol Lidar and Infrared Pathfinder Satelllite Observations (CALIPSO) |

## ACQUISITION STRATEGY & PERFORMING ORGANIZATIONS

Major acquisitions for CALIPSO are: payload, science investigations, science data ground system, algorithm implementation, operations center development; and science operations (3 years). Prime contract with Ball Aerospace for payload awarded in August 1999. MOU agreement in place between NASA and CNES to provide the IIR and Spacecraft PROTEUS bus. **Changes since FY03 Pres. Budget: None**.

| Current Acquisitions | Actual * | Selection Method | Actual * | Performer | Actual * |
|---|---|---|---|---|---|
| Cooperative Agreements | 0% | Full & Open Competition | 100% | Industry | 95% |
| Cost Reimbursable | 99% | Sole Source | 0% | Government | 1% |
| Fixed Price | 0% | | 100% | NASA Intramural | 0% |
| Grants | 1% | | | University | 4% |
| Other | 0% | Sci Peer Review | 100% | Non Profit | 0% |
| | 100% | * as % of FY02 direct procurement | | | 100% |

| Future Acquisitions - Major | Selection | Goals |
|---|---|---|
| No major acquisitons remain. | N/A | N/A |

## AGREEMENTS

*Internal:* GSFC/LaRC Memorandum of Understanding, April 1999.

*External:* NASA/CNES Letter of Agreement (June 1999), NASA/CNES MOU (awaiting signature).

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

## INDEPENDENT REVIEWS

| Types of Review | Performer | Last Review | Next Review | Purpose |
|---|---|---|---|---|
| System Requirements Review | IIRT | Jan.-00 | | Review science & tech reqs; demo traceability. |
| Preliminary Design Review | IIRT | Sep.-00 | | Prelim. designs meet reqs w/ acceptable risk. |
| Mission Design Reivew | IIRT | Sep.-00 | | Prelim. designs meet reqs w/ acceptable risk. |
| Mission Confirmation Reivew | IIRT | Nov.-00 | | OES AA approval to enter Implementation Phase. |
| Delta MDR | IIRT | Mar.-01 | | Implement rebaseline w/i cost & schedule. |
| Delta MCR | IIRT | Apr.-01 | | OES AA approval to enter Implementation Phase. |
| Critical Design Reivew | IIRT | Mar.-02 | | Provide expert tech review of mission system. |
| Payload Pre-Ship Readiness Review | IIRT | | TBD | System elements meet reqs/ready for launch. |
| Satelllite Pre-Ship Reivew | IIRT | | TBD | Mission elements meet reqs/ready for launch. |
| Mission Readiness Review * | IIRT | | TBD | Assess readiness of sys. to launch & assess ops. |
| Flight Readiness Review * | IIRT | | TBD | Status; cert. flt. Readines; open MMR issues. |
| Launch Readiness Review * | IIRT | | TBD | Final review before launch. |
| * IIRT co-chairs support but do not chair | | | | |

## BUDGET/LIFE CYCLE COST

Total budget authority represents the Life Cycle Cost (LCC).

| Budget Authority ($ in millions) | Prior | FY02 | FY03 | FY04 | FY05 | FY06 | FY07 | FY08 | Total | Comments |
|---|---|---|---|---|---|---|---|---|---|---|
| FY 2004 President's Budget | 56.5 | 29.5 | 33.8 | 28.4 | 7.6 | 4.5 | 3.0 | 0.0 | 163.3 | |
| Development | 47.3 | 27.1 | 22.8 | 0.2 | | | | | 97.4 | |
| Operations | | | | 21.2 | 7.6 | 4.5 | 3.0 | | 36.3 | |
| Launch Vehicle | 9.2 | 2.4 | 11.0 | 7.0 | | | | | 29.6 | |
| Data Analysis | | | | | | | | | 0.0 | |
| Changes since FY 03 PBS | 0.0 | -1.5 | 0.0 | 9.4 | 1.7 | 1.6 | 1.1 | | 12.4 | ***Reason for Change:*** |
| Development | +3.0 | -3.9 | +0.5 | -11.7 | | | | | -12.1 | LV costs less than proj. |
| Operations | | | | +9.4 | | | | | +9.4 | Reserves transfer from |
| Launch Vehicle | -3.0 | +2.4 | -0.5 | +0.7 | | | | | -0.4 | dev. LV costs less than |
| Date Analysis | | | | | | | | | | 2.4% projected |
| Full Cost | | | | +11.0 | +1.7 | +1.6 | +1.1 | | +15.5 | Inclusion of full cost |
| FY 2003 President's Budget | 56.5 | 31.0 | 33.8 | 19.0 | 5.9 | 2.9 | 1.9 | 0.0 | 151.0 | Initial baseline set in |
| Development | 44.3 | 31.0 | 22.3 | 11.9 | | | | | 109.5 | Formulation; |
| Operations | | | | 0.8 | 5.9 | 2.9 | 1.9 | | 11.5 | subsequently, mission |
| Launch Vehicle | 12.2 | | 11.5 | 6.3 | | | | | 30.0 | underwent significant |
| Data Analysis | | | | | | | | | 0.0 | replanning. |
| Initial Baseline (LCC) | 65.6 | 23.9 | 16.0 | 4.5 | 2.2 | 0.0 | 0.0 | 0.0 | 112.2 | FY 2001 President's |
| Development (Feb) | 52.6 | 12.4 | 3.2 | | | | | | 68.2 | Budget. |
| Operations | | | 7.5 | 4.5 | 2.2 | | | | 14.2 | |
| Launch Vehicle | 13.0 | 11.5 | 5.3 | | | | | | 29.8 | |

Indicates budget numbers in Full Cost.
Indicates changes since the FY 2003 Presidents Budget Submit.
FY 2002, FY 2003, Prior and BTC are not in full cost.

| THEME: | Earth System Science |
|---|---|
| **DEVELOPMENT:** | **SeaWinds** |

## PURPOSE

| Objectives | Reference 2003 Strategic Plan | Performance Measures |
|---|---|---|
| 1.1 | | 4ESS1, 4ESS3, 4ESS11 |

The SeaWinds missions provide long-term, high-resolution, ocean surface wind data (both speed and direction) used for studies of ocean circulation, climate and air-sea interaction. These measurements are crucial to understanding and predicting severe weather patterns and climate changes. SeaWinds data will increase our knowledge of global ocean circulation over inter-annual and decadal time scales; the effects of hydrological processes on climate; and the relationship of variations in weather, precipitation, and water resources to climate variation.

## OVERVIEW

SeaWinds will use a Ku Band microwave radar with a rotating antenna to determine radar scattering globally and to infer wind velocity (speed and direction) over 90% of the ice-free ocean surface every two days with a resolution of 25km. SeaWinds will acquire all-weather, high-resolution measurements of near-surface winds over the global oceans. It will determine atmospheric forcing, ocean response and will characterize air-sea interaction mechanisms on various spatial and temporal scales. SeaWinds will also combine wind data with measurements from scientific instruments in other disciplines to understand mechanisms of global climate change and weather patterns. SeaWinds will improve weather forecasts near coastlines by using wind data in numerical weather and wave prediction models that will also improve storm warning and monitoring.

Link to project homepage for more information: http//winds.jpl.nasa.gov

## PROGRAM MANAGEMENT

SeaWinds is part of the Focused Physical Oceanography and Solid Earth (FPOSE) program with program responsibility delegated to JPL. The JPL Program Management Council (PMC) has SeaWinds governing responsibility. Enterprise official is Dr. Ghassem Asrar, Associate Administrator for Earth Science at HQ. Theme Director is Dr. Jack Kaye. Program Manager is Doug McCuistion.

## TECHNICAL COMMITMENT

The baseline for this technical commitment was made in March 1998, and is detailed in the EOS Program Commitment Agreement (PCA).

| Technical Specifications FY04 President's Budget | Change from Baseline |
|---|---|
| * Employ a Ku-band scatterometer to infer wind velocity over 90% of the ice-free ocean surface every | -- |
| two days with a resolution of 25 km for a duration of three years with a goal of five years. | -- |
| * Produce wind vector measurements over the ice-free oceans from 90% of the obtained data within 5 workin | -- |
| days of data receipt. | -- |
| * Flag measurements for the presence of land and ice in the footprint. Where available, use data from AMSR | -- |
| to provide a rain flag. | -- |
| * Wind speed accuracy will be the greater of 2 m/s rms or 10% rms from 3 to 30 m/s; wind direction | -- |
| accuracy will be 20 degrees rms. | -- |
| * Provide software and data to NOAA to enable their production of near-real-time ocean wind vector | -- |
| information from SeaWinds data. | -- |
| SeaWinds Mission data will be used for weather forecasting, storm detection and tracking, global climate studies, monsoon monitoring, ship routing, and as an aid to offshore oil well platform design and spill cleanup. | |

| Schedule | FY04 President's Budget | Change from Baseline | |
|---|---|---|---|
| Start of Formulation | Dec-92 | -- | |
| Start of Implementation (PDR) | May-95 | -- | |
| Instrument delivery to Japan (1) | Mar-99 | +13 mos | 21% |
| Mission Readiness Review | Oct-02 | +39 mos | 50% |
| Launch (1) | Dec-02 | +40 mos | 50% |
| Spacecraft and Instrument activation | 4 months following launch | -- | |
| Data Calibration/Validation Period | 6 months following Instrument activation | -- | |
| Instrument Operational Lifetime | 3 years (Goal of 5 years) | -- | |
| (1) Launch date slipped from baseline date of August 1999 to December 2002 due to Japanese launch vehicle problems. | | | |

| THEME: | Earth System Science |
|---|---|
| **DEVELOPMENT:** | **Seawinds** |

## ACQUISITION STRATEGY & PERFORMING ORGANIZATIONS

Major acquisitions for SeaWinds were: Traveling Wave Tube Amplifiers from Hughes Electron Dynamics; Scatterometer Electronics Subsystem from Raytheon; SeaWinds Antenna Subsystem from Honeywell Space Systems Operation; Antenna Assembly Structure from Composite Optics; and Platform Waveguide from Continental Microwave. No acquisitions were planned for FY02 and none are planned for FY03 and FY04. Contracts with universities will be conducted through the Ocean Vector Winds Science Team, which will fund all scientific investigations for SeaWinds. **Changes since FY03 Pres. Budget: None.**

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

| Future Acquisitions - Major | Selection | Goals |
|---|---|---|
| N/A<br>Spacecraft was launched December 2002. | N/A | N/A |

## AGREEMENTS

*Internal:* The program is not dependent on other NASA activities outside of the control of the Associate Administrator for Earth Science.

*External:* Memorandum of Understanding between NASDA, NASA and NOAA for Cooperation in the ADEOS-II Program, September 1996. Memorandum of Understanding, between JPL and the Principal Investigator, February 1995. Technical Implementation Agreement between NOAA and NASA Regarding Support by the U.S. Ground System for ADEOS-II, September 1997. **Changes since FY03 Pres. Budget: None.**

## INDEPENDENT REVIEWS

| Types of Review | Performer | Last Review | Next Review | Purpose |
|---|---|---|---|---|
| Preliminary Design Review | JPL | May-95 | | Eval. readiness to proceed with detailed design. |
| Critical Design Review | JPL | Jan-96 | | Eval. readiness to proceed with fabrication, assembly, and I&T. |
| Pre-Environmental Review | JPL | Apr-97 | | Eval. readiness to test, including procedures, equipment & fac. |
| Pre-Ship Review | JPL | Mar-99 | | Eval. readiness to ship Instrument to NASDA. |
| Operational Readiness Review | JPL | Jul-02 | | Eval. ops readiness, including fac., procedures & personnel. |
| Risk Review | JPL | Sep-02 | | Determine if risks are adequately characterized and assessed. |
| Mission Readiness Review | JPL | Sep-02 | | Eval. readiness of systems prior to launch & proceed with ops. |

## BUDGET/LIFE CYCLE COST

Total budget authority represents the Life Cycle Cost (LCC).

| Budget Authority ($ in millions) | Prior | FY02 | FY03 | FY04 | FY05 | FY06 | FY07 | FY08 | BTC | Total | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|
| FY 2004 President's Budget | 139.0 | 3.8 | 2.2 | 4.5 | 3.0 | 2.5 | 2.3 | | | 157.2 | |
| Development | 139.0 | 3.8 | | | | | | | | 142.8 | |
| Operations | | | 2.2 | 4.5 | 3.0 | 2.5 | 2.3 | | | 14.4 | |
| Data Analysis | | | | | | | | | | | |
| (funded through Mission Op and Research activities) | | | | | | | | | | | |
| Changes since FY 03 PBS | | -0.7 | | +3.4 | +2.5 | +2.3 | +2.2 | | | +9.7 | ***Reason for Change:*** |
| Development | | -0.7 | | | | | | | | -0.7 | Reph. due to launch slip to 11/02. |
| Operations | | | | +3.3 | +2.4 | +2.2 | +2.1 | | | +10.0 | Approved O/G for routine ops |
| Data Analysis | | | | | | | | | | | and data processing. |
| Corp G&A | | | | +0.1 | +0.1 | +0.1 | +0.1 | | | +0.4 | |
| FY 2003 President's Budget | 139.0 | 4.5 | 2.2 | 1.0 | 0.5 | 0.2 | 0.1 | | | 147.5 | |
| Development | 139.0 | 4.5 | | | | | | | | 143.5 | |
| Operations | | | 2.2 | 1.0 | 0.5 | 0.2 | 0.1 | | | 4.0 | |
| Data Analysis | | | | | | | | | | | |
| Initial Baseline (LCC) | 135.0 | | | | | | | | | 135.0 | FY 1997 President's Budget. |
| Development | 135.0 | | | | | | | | | 135.0 | Assumed 8/99 launch. |
| Operations | | | | | | | | | | | Embedded in Ground System. |

Indicates budget numbers in Full Cost.

Indicates changes since the FY 2003 Presidents Budget Submit.

| THEME: | Earth System Science |
|---|---|
| **DEVELOPMENT:** | ICE, Cloud and Elevation Satellite (ICESat) |

## PURPOSE

| Objectives | Reference 2003 Strategic Plan | Performance Measures |
|---|---|---|
| 1.1 | | 4ESS1, 4ESS3,4ESS11 |

The Ice, Cloud and Elevation Satellite (ICESat) will measure changes in Earth's ice sheets to support long-term climate variability studies, providing a 3-year data set of ice sheet topography. ICESat will also measure height profiles of clouds and aerosols, land elevations and vegetation cover, and approximate sea ice thickness. The continuous satellite observations will detect interannual changes in the surface mass balance and determine whether they are due to recent or long-term changes in climate.

## OVERVIEW

The GLAS instrument on ICESat will determine the distance from the satellite to the Earth's surface and to intervening clouds and aerosols. It will do this by precisely measuring the time it takes for a short pulse of laser light to travel to the reflecting object and return to the satellite. Although surveyors routinely use laser methods, the challenge for ICESat is to perform the measurement 40 times a second from a platform moving 26,000 km (16,000 mi) per hour. In addition ICESat will be 600 km above the Earth and the precise locations of the satellite in space and the laser beam on the surface below must be determined at the same time.
NASA selected Ball Aerospace to provide its Ball Commercial Platform 2000 (BCP 2000) spacecraft bus for this mission. In cooperation with the University of Colorado/ Laboratory for Atmospheric and Space Physics (LASP), Ball Aerospace will provide the mission operations for ICESat. This includes a Mission Operations Center, a Flight Operations Team, and a Flight Dynamics System, all based on systems currently supporting other similar missions.

Link to project homepage for more information: http://icesat.gsfc.nasa.gov/

## PROGRAM MANAGEMENT

ICESat is part of the EOS program, with program responsibility delegated to Goddard Space Flight Center (GSFC). The GSFC Program Management Council (PMC) has ICESat Project governing responsibility. Enterprise official is Dr. Ghassem Asrar, Associate Administrator for Earth Science. Theme Director is Dr. Jack Kaye. Program Manager is Doug McCuistion.

## TECHNICAL COMMITMENT

The baseline for this technical commitment was made in 4/1998 and is detailed in the EOS Program Commitment Agreement (PCA).

| Technical Specifications FY04 President's Budget | Change from Baseline |
|---|---|
| The objectives of the ICESat mission will be achieved via a laser altimetry instrument, the Geoscience Laser Altimeter System (GLAS), which is an Nd:YAG laser with 1064 and 532 nm output. The instrument was placed into a 600 km, 94° inclination orbit by a Delta II (Model 7320) Expendable Launch Vehicle (ELV) in January 2003. The spacecraft accommodates the GLAS instrument, which has a mass of less than 300kg and power capacity of 330 W. The ICESat and GLAS instrument have a design lifetime of 3 years. Over that period of time ICESat will:<br>- Produce calibrated profiles of ice-sheet surface elevations over Greenland and Antarctica with better than 20 cm accuracy (1s). | -- |

| Schedule | FY04 President's Budget | Baseline | Change from Baseline |
|---|---|---|---|
| Start of Implementation | Apr-98 | Apr-98 | -- |
| Spacecraft Complete | Jun-01 | Oct 01 | -4 Months |
| Instrument Delivery | Jun-02 | Oct 01 | +8 Months |
| Observatory I&T Complete | Oct-02 | May02 | +5 Months |
| Operations Readiness Review | Oct-02 | | -- |
| Launched | Jan-03 | Jan-02 | +12 Months |
| Data Validation Period | 120 days after launch | | -- |
| Observatory Operational Lifetime | 3 years | | -- |

**THEME:** Earth System Science

# DEVELOPMENT: ICE, Cloud and Elevation Satellite (ICESat)

## ACQUISITION STRATEGY & PERFORMING ORGANIZATIONS

Major acquisitions for ICESat are: spacecraft from Ball Aerospace, launch vehicle from Kennedy Space Center, GPS receivers built by the Jet Propulsion Laboratory, and the GLAS instrument built by the Goddard Space Flight Center (including $9M telescope, lasers, laser reference system, star tracker, heat pipes, and detectors). **Changes since FY03 Pres. Budget: None.**

| Current Acquisitions | Actual * | Selection Method | Actual * | Performer | Actual * |
|---|---|---|---|---|---|
| Cooperative Agreements | 0% | Full & Open Competition | 100% | Industry | 60% |
| Cost Reimbursable | 0% | Sole Source | 0% | Government | 0% |
| Fixed Price | 51% | | 100% | NASA Intramural | 0% |
| Grants | 0% | | | University | 0% |
| Other: Cost Plus | 49% | Sci Peer Review | 100% | On-site Contractors | 40% |
| * as % of FY02 direct proc. | 100% | * as % of FY02 direct proc. | | * as % of FY02 direct proc. | 100% |

| Future Acquisitions - Major | Selection | Goals |
|---|---|---|
| N/A<br>Mission launched January 2003. | N/A | N/A |

## AGREEMENTS

*Internal:* Launch vehicle provided by KSC. ICESat is not dependent on other NASA activities outside of the control of the Associate Administrator for Earth Science.

*External:* No external agreements exist for ICESat. **Changes since FY03 Pres. Budget: None.**

## INDEPENDENT REVIEWS

| Types of Review | Performer | Last Review | Next Review | Purpose |
|---|---|---|---|---|
| Confirmation Review | IPAO | 21-Apr-98 | N/A | Confirm readiness for mission implementation. |
| Independent Annual Review | IPAO | 4-Oct-00 | N/A | Eval. Dev.status in terms of cost, schedule, tech. progress. |
| GLAS PER | SSMO/ IRT | Apr-02 | N/A | Evaluate GLAS readiness for environmemntal testing. |
| GLAS Pre-ship Review | SSMO/ IRT | 15-Jun-02 | N/A | Assess environmental results for Instrument shipment. |
| Observatory PER | SSMO/ IRT | 29-Jul-02 | N/A | Evaluate observatory readiness for environmemntal testing. |
| Observatory Pre-Ship Review | SSMO/ IRT | 17-Oct-02 | N/A | Assess environmental results for observatory shipment. |
| Launch Readiness Review | SSMO/ IRT | 12-Dec-02 | N/A | Determine launch readiness. |

## BUDGET/LIFE CYCLE COST

Total budget authority represents the Life Cycle Cost (LCC). These figures include the following.

| Budget Authority ($ in millions) | Prior | FY02 | FY03 | FY04 | FY05 | FY06 | FY07 | FY08 | BTC | Total | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|
| FY 2004 President's Budget (LC( | 192.9 | 29.2 | | | | | | | | 222.1 | |
| Development | 152.2 | 24.8 | | | | | | | | 177.0 | |
| Launch Vehicle | 40.7 | 4.4 | | | | | | | | 45.1 | |
| Data Analysis (funded through Mission Op and Research activities) | | | | | | | | | | | |
| Changes since FY 03 PBSt | | +7.6 | | | | | | | | +7.6 | ***Reason for Change:*** |
| Development | | +10.1 | | | | | | | | +10.1 | Launch Delaly due to late delivery |
| Launch Vehicle | | -2.5 | | | | | | | | -2.5 | of GLAS instrument. |
| Date Analysis | | | | | | | | | | | |
| Corporate G&A | | | | | | | | | | | |
| FY 2003 President's Budget | 192.9 | 21.6 | | | | | | | | 214.5 | Delayed instrument delivery; |
| Development | 152.2 | 14.7 | | | | | | | | 166.9 | incurred penalties for launch delay. |
| Launch Vehicle | 40.7 | 6.9 | | | | | | | | 47.6 | Instrument optical stability rework. |
| Data Analysis | | | | | | | | | | | |
| Initial Baseline (LCC) | 127.5 | 37.6 | | | | | | | | 165.1 | FY 1997 President's Budget. |
| Development | 83.7 | 37.6 | | | | | | | | 121.3 | |
| Launch Vehicle | 43.8 | | | | | | | | | 43.8 | |

Indicates changes since the FY 2003 Presidents Budget Submit.

FY 2002, FY 2003, Prior and BTC are not in full cost.

**THEME:** Earth System Science

# DEVELOPMENT: Geosynchronous Imaging Fourier Transform Spectrometer (GIFTS)

## PURPOSE

| Objectives | Reference 2003 Strategic Plan | Performance Measures |
|---|---|---|
| 1.1 | | 4ESS1, 4ESS3,4ESS8,4ESS10 |

The Geosynchronous Imaging Fourier Transform Spectrometer (GIFTS) mission will validate advanced technologies for lower cost remote sensing systems, and provide a water vapor winds measurement capability to improve operational weather observation and prediction. This will enable significant improvements in the accuracy of short-term weather forecasts. GIFTS will also monitor pollutants and greenhouse gases in both the Earth's troposphere and stratosphere, improving our ability to forecast air quality.

## OVERVIEW

This mission is designed to demonstrate technologies required to measure atmospheric temperature within 1 degree Kelvin and 1 km vertical resolution from geostationary orbit for the first time. Such measurements will enable significant improvements in the accuracy of short-term weather forecasts. In addition, GIFTS will enable advanced technologies and include: an imaging interferometer; large focal-plane array; low power, high efficiency mechanical cooler; and new data readout and signal processing electronics. These technologies will be used for measuring temperature, water vapor, wind, and chemical composition with high resolution in space and time. GIFTS is being planned as a partnership with the Office of Naval Research (ONR) in the Department of the U.S. Navy and NOAA. This partnership will include provisions for funding the spacecraft and launch vehicle (through the U.S. Air Force Space Technology Program office), upgrading the reliability of the instrument to meet a seven-year lifetime, validation of the products by the National Environmental Satellite, Data and Information Service (NESDIS), investing in technology infusion for the next generation of NOAA operational sounders, as well as for transferring

Link to project homepage for more information: http://nmp.jpl.nasa.gov

## PROGRAM MANAGEMENT

GIFTS is part of the New Millennium Program (NMP), managed out of the JPL NMP office. The mission is a collaboration among NASA, NOAA, and the Department of the Navy. The project hardware implementation and first year of mission operations is managed by Langley Research Center. Enterprise official is Dr. Ghassem Asrar. Theme Director is Dr. Jack Kaye. Program Manager is Doug McCuistion.

## TECHNICAL COMMITMENT

The baseline for this technical commitment was made in the NMP Program Commitment Agreement (PCA).

| Technical Specifications FY04 President's Budget | Change from Baseline |
|---|---|
| Design for 7-year lifetime.<br>Includes an initial year to demonstrate breakthrough technologies,<br>and an extended period over the Indian Ocean to provide<br>imaging and selected weather products to the U.S. Navy. | -- |
| During both phases, the instrument will perform the following measurements: | |
| Measure the surface temperature to better than 1/2 Kelvin; | -- |
| Measure temperature profiles of the atmosphere to better than +/- 1 Kelvin for 1 km layers (1s); | -- |
| Measure and spatially resolve the wind velocity to better than 4 m/s for 2 km layers (1s); and | -- |
| Measure the water vapor level to better than 20% accuracy for 2 km layers (1s). | -- |

| Schedule | FY04 President's Budget | Change from Baseline |
|---|---|---|
| Start of Formulation | Nov-99 | -- |
| Start of Implementation | May-02 | -- |
| GIFTS Instrument CDR | Jun-03 | -- |
| GIFTS Instrument delivery to S/C | Aug-04 | -- |
| Observatory Launch Readiness Date | Nov-05 | -- |
| Transfer to Indian Ocean | Mar-06 | -- |
| Delivery of Mission Validation Data | Jun-07 | -- |
| Observatory Operational Lifetime | 7 years with 50% reliability | -- |

| THEME: | Earth System Science |
|---|---|

## DEVELOPMENT: Geosynchronous Imaging Fourier Transform Spectrometer (GIFTS)

### ACQUISITION STRATEGY & PERFORMING ORGANIZATIONS

Major acquisitions for GIFTS-IOMI are: Contract with Space Dynamics Lab for the imaging interferometer instrument, complete with subcontracts for detector assemblies (BAE), high reliability lasers (Test), cryocoolers (Lockheed-Martin), and star tracker assemblies (Texas A&M University).

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

| Current Acquisitions | Actual * | Selection Method | Actual * | Performer | Actual * |
|---|---|---|---|---|---|
| Cooperative Agreements | 0% | Full & Open Competitior | 99% | Industry | 18% |
| Cost Reimbursable | 100% | Sole Source | 1% | Government | 13% |
| Fixed Price | 0% | | 100% | NASA Intramural | 1% |
| Grants | 0% | | | University | 68% |
| Other | 0% | Sci Peer Review | 100% | Non Profit | 0% |
| * as % of FY02 direct procurement | 100% | * as % of FY02 direct procurement | | * as % of FY02 direct procurement | 100% |

| Future Acquisitions - Major | Selection | Goals |
|---|---|---|
| RAD 750 Processors | FY03/04 | N/A |
| Control Module | FY03/04 | |

### AGREEMENTS

*Internal:* The program is not dependent on other NASA activities outside of the control of the Associate Administrator of Earth Science.

*External:* An MOA has been signed with the Department of the Navy and NOAA, with those two agencies responsible for significant portions of the mission hardware and software. Through the Navy, the Air Force is providing the launch vehicle.

**Changes since FY03 Pres. Budget: MOA signed July 22, 2002.**

### INDEPENDENT REVIEWS

| Types of Review | Performer | Last Review | Next Review | Purpose |
|---|---|---|---|---|
| PDR/CDR | SMO | 20-Mar-01 | | Establish design readiness to proceed to implementation. |
| Delta Confirmation Assessment | SMO | 5-Mar-02 | | Establish maturity of developmental technology components. |
| Mission Confirmation Review | SMO | 23-Apr-02 | | Determine readiness to proceed to implementation. |
| Instrument CDR | SMO/IRT | | 21-Feb-03 | Determine instrument readiness to proceed to fabrication and assembly. |
| Mission CDR | SMO/IRT | | 15-Mar-03 | Determine mission readiness to proceed to production. |
| Mission Pre-Ship Review | SMO/IRT | | 15-Aug-05 | Determine completeness of observatory verification and test. |
| Mission Readiness Review | Smo/IRT | | 15-Sep-05 | Establish completeness of mission coordination, ops planning and ground system development. |
| Launch Readiness Review | SMO/IRT | | 15-Oct-05 | Determine overall system readiness to launch. |

### BUDGET/LIFE CYCLE COST

| Budget Authority ($ in millions) | Prior | FY02 | FY03 | FY04 | FY05 | FY06 | FY07 | FY08 | BTC | Total | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|
| FY 2004 President's Budget | 26.8 | 30.0 | 22.3 | 27.0 | 15.5 | 0.0 | 0.0 | | | 121.6 | |
| Development | 26.8 | 30.0 | 22.3 | 27.0 | 15.5 | | | | | 121.6 | |
| (includes ops for tech demo mission) | | | | | | | | | | 0.0 | |
| Changes since FY 03 Pres. Budget | | | | +16.8 | +7.9 | -3.9 | -2.0 | | | +18.8 | ***Reason for Change:*** |
| Development | | | | +5.0 | +2.6 | -3.9 | -2.0 | | | +1.7 | Rephase and restoration of commitment. |
| Full cost | | | | +11.8 | +5.3 | | | | | +17.1 | Inclusion of full cost. |
| FY 2003 President's Budget | 26.8 | 30.0 | 22.3 | 10.2 | 7.6 | 3.9 | 2.0 | | | 102.8 | |
| EO-3/GIFTS | 26.8 | 30.0 | 22.3 | 10.2 | 7.6 | 3.9 | 2.0 | | | 102.8 | |
| Initial Baseline (LCC) | 41.8 | 30.0 | 7.3 | 13.4 | 6.7 | 4.0 | 0.0 | | 2.0 | 105.2 | FY 2002 President's Budget. |

Indicates budget numbers in Full Cost.
Indicates changes since the FY 2003 Presidents Budget Submit.
FY 2002, FY 2003, Prior and BTC are not in full cost.

| THEME: | Earth System Science |
|---|---|
| **DEVELOPMENT:** | Solar Radiation and Climate Experiment (SORCE) |

## PURPOSE

| Objectives | Reference 2003 Strategic Plan | Performance Measures |
|---|---|---|
| 1.1 | | 4ESS1, 4ESS3, 4ESS7, 4ESS11 |

The Solar Radiation and Climate Experiment (SORCE) will provide measurements of the Sun's energy input (including x ray, ultraviolet, visible, near-infared, and total solar radiation) to the Earth's atmosphere. The measurements provided by SORCE specifically address long-term climate change, natural variability and enhanced climate prediction, and atmospheric ozone and UV-B radiation. These measurements are critical to studies of the Sun, its effect on our Earth system, and its influence on humankind.

## OVERVIEW

SORCE measures the Sun's output with the use of radiometers, spectrometers, photodiodes, detectors, and bolometers engineered into instruments mounted on a satellite observatory. The SORCE satellite orbits around the Earth accumulating solar data. Spectral measurements identify the irradiance of the Sun by characterizing the Sun's energy and emissions in the form of color that can then be translated into quantities and elements of matter. Data obtained by the SORCE experiment will be used to model the Sun's output and to explain and predict the effect of the Sun's radiation on the Earth's atmosphere and climate.

The Total Solar Irradiance (TSI) measurement is a continuation of the first space-borne measurements begun by Nimbus 7 in 1978. Currently, three spacecraft are sustaining the TSI database: ACRIMSAT, the Upper Atmosphere Research Satellite (UARS), and the Solar Heliospheric Observer (SOHO) a Space Science mission. Continued and uninterrupted population and monitoring of the TSI data set will provide insight into the role of solar forcing on long-term climate changes. These measurements will continue the spectrally resolved solar irradiance measurements being made from UARS since 1991, as well as earlier missions for TSI measurements, and will add additional capability. They will be used to further understand the effects of solar variability on long-term global climate change and influences on the stratospheric ozone layer. Additionally, the spectral measurements in the 200-300 nm and 1500 nm spectral regions will fulfill the NPOESS operational requirements as part of a tri-agency partnership among NASA, NOAA, and DoD.

Link to homepage for more information: http://lasp.colorado.edu/sorce/

## PROGRAM MANAGEMENT

SORCE is under the EOS program with program responsibility delegated to the Goddard Space Flight Center (GSFC). The GSFC Program Management Council (PMC) has SORCE governing responsibility. Enterprise official is Dr. Ghassem Asrar, Associate Administrator for Earth Science. Theme Director is Dr. Jack Kaye. Program Manager is Doug McCuistion.

## TECHNICAL COMMITMENT

| Technical Specifications | **FY04 President's Budget** | **Change from Baseline** |
|---|---|---|
| Total Irradiance Monitor | Absolute Accuracy 150-250 PPM | -- |
| Solar/Stellar Irradiance Comparison Experiment | Spectral Resolution 0.1-0.2 nm, Absolute Accuracy 1.5 - 5% | -- |
| Spectral Irradiance Monitor | Spectral Resolution 0.2 -30 nm, Absolute Accuracy 1500 | -- |
| XUV Photometer System | Spectral Resolution 5 - 10 nm, Absolute Accuracy 20% | -- |

| Schedule | **FY04 President's Budget** | **Change from Baseline** |
|---|---|---|
| Implementation Start (PDR) | May-99 | -- |
| SC Complete | Feb-02 | +4 months |
| Last Instrument Delivery | Apr-02 | +6 months |
| I&T Complete | Oct-02 | +5 months |
| Deliver S/C to L/V Site | Oct-02 | +4 months |
| Launch | Jan-03 | +6 months |
| Data Validation Period | Apr-03 | +6 months |
| Observatory Operational Lifetime | Jan-07 | +6 months |

**THEME:** Earth System Science

# DEVELOPMENT: Solar Radiation and Climate Experiment (SORCE)

## ACQUISITION STRATEGY & PERFORMING ORGANIZATIONS

Major acquisitions for SORCE are: Instruments, Program Management, Spacecraft and Operations from the University of Colorado's Laboratory for Atmospheric and Space Physics (LASP). The Spacecraft is subcontracted by LASP to Orbital Sciences Corporation. The LASP contract is a Cost Plus, No Fee. Launch Vehicle is provided by Orbital Sciences Corporation through the Kennedy Space Center.

**Changes since FY03 President Budget: NONE**

| Current Acquisitions | Actual * | Selection Method | Actual * | Performer | Actual * |
|---|---|---|---|---|---|
| Cooperative Agreements | 0% | Full & Open Competition | 100% | Industry | 40% |
| Cost Reimbursable | 61% | Sole Source | 0% | Government | 1% |
| Fixed Price | 37% | | 100% | NASA Intramural | 0% |
| Grants | 0% | | | University | 59% |
| Other | 2% | Sci Peer Review | 100% | Non Profit | 0% |
| * as % of FY02 direct procurement | 100% | * as % of FY02 direct procurement | | * as % of FY02 direct procurement | 100% |

| Future Acquisitions - Major | Selection | Goals |
|---|---|---|
| Mission launched Jan. 2003.<br>No acquisitions remaining. | N/A | N/A |

## AGREEMENTS

*Internal:* CSOC/JSC (operations); KSC (launch vehicle). *External:* None

**Changes since FY03 Presidents Budget:** Some Operations support is now provided by CSOC (previous budget assumed LASP was providing all).

## INDEPENDENT REVIEWS

| Types of Review | Performer | Last Review | Next Review | Purpose |
|---|---|---|---|---|
| Mission Design Review | SSMO/IRT | May 1999 | TBD | Demonstrate prelim. designs meet mission reqmts w/ accep. |
| Independent Annual Review | IPAO | Oct. 2000 | TBD | Evaluate dev. status in terms of cost, schedule, tech. progress. |
| Mission Operations Review | SSMO/IRT | April 2001 | TBD | Evaluate mission operations plans, facilities, etc. |
| Instrument Pre-Ship Review | SSMO/IRT | Feb. 2002 | TBD | Verify system elements meet mission reqmts./ready for launch. |
| Pre-Ship Review | SSMO/IRT | Oct. 2002 | TBD | Verify system elements meet mission reqmts./ready for launch. |
| Mission Readiness Review | SSMO/IRT | Oct. 2002 | TBD | Assess readiness of mission system to launch & assess ops. |
| Launch Readiness Review | SSMO/IRT | Nov. 2002 | TBD | Final review before launch. |

## BUDGET/LIFE CYCLE COST

Total budget authority represents the Life Cycle Cost (LCC).

| Budget Authority ($ in millions) | Prior | FY02 | FY03 | FY04 | FY05 | FY06 | FY07 | FY08 | BTC | Total | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|
| FY 2004 President's Budget | 73.5 | 21.0 | 4.0 | 2.1 | 2.2 | 2.2 | 2.4 | 0.8 | 0.0 | 108.3 | |
| Development | 60.1 | 10.4 | 1.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | | 74.5 | |
| Launch Vehicle | 13.1 | 9.1 | | | | | | | | 22.2 | |
| Operations | 0.3 | 1.5 | 2.5 | 1.7 | 1.7 | 1.7 | 1.9 | 0.3 | | 11.6 | |
| Changes since FY 03 PBS | | +2.3 | | +0.1 | +0.2 | +0.2 | +0.6 | +0.8 | | +4.3 | ***Reason for Change:*** |
| Development | | +1.2 | | +0.1 | +0.1 | +0.1 | +0.1 | +0.5 | | +2.1 | Delay and rephase |
| Launch Vehicle | | +0.9 | | | | | | | | +0.9 | Delay |
| Operations | | +0.2 | | +0.1 | +0.1 | +0.1 | +0.5 | +0.3 | | +1.3 | Delay rephase |
| FY 2003 President's Budget | 73.5 | 18.7 | 4.0 | 2.0 | 2.0 | 2.0 | 1.8 | 0.0 | 0.0 | 104.0 | |
| Development | 60.1 | 9.2 | 1.5 | 0.4 | 0.4 | 0.4 | 0.4 | | | 72.4 | |
| Launch Vehicle | 13.1 | 8.2 | | | | | | | | 21.3 | |
| Operations | 0.3 | 1.3 | 2.5 | 1.6 | 1.6 | 1.6 | 1.4 | | | 10.3 | |
| Initial Baseline (LCC) | 75.8 | 16.7 | 4.0 | 2.0 | 2.0 | 2.0 | 1.8 | 0.0 | 0.0 | 104.3 | |
| Development | 59.7 | 6.6 | 1.7 | | | | | | | 68.0 | |
| Launch Vehicle | 16.1 | 8.9 | | | | | | | | 25.0 | |
| Operations | | 1.2 | 2.3 | 2.0 | 2.0 | 2.0 | 1.8 | | | 11.3 | |

Indicates budget numbers in Full Cost.

Indicates changes since the FY 2003 Presidents Budget Submit.

FY 2002, FY 2003, Prior and BTC are not in full cost.

| THEME: | Earth System Science |
|---|---|
| **DEVELOPMENT:** | **Earth Observing System Data and Information System (EOSDIS)** |

## PURPOSE

| Objectives | Reference 2003 Strategic Plan | Performance Measures |
|---|---|---|
| 1.1 | | 4ESS 6, 4ESS 14 |

Earth Observing System Data and Information System Science Development supports development and evolution of new and existing science data processing, archiving, and distribution functions. The work comprises the Strategic Evolution of ESE Data Systems (SEEDS), which will guide the evolution of EOSDIS, and an engineering capability within the Earth Science Data and Information System (ESDIS) Project which can provide enhancements and enable needed evolution.

## OVERVIEW

EOSDIS Development will complete the development of the end-to-end EOSDIS system, including the development of the control centers for the Aura and ICESat missions. In addition, the EOSDIS supports the development of the GLAS Science Investigator-Led Processing System (SIPS) for ICESat and the development of the HIRDLS, MLS, OMI, and TES SIPS for Aura. The Program will complete the development of the EOSDIS Science Data Processing System in FY03.

EOSDIS Development also supports new Earth Science Enterprise missions and the evolution of existing systems to support new missions. Specifically, it will support the Enterprise approach for the next decade, the Strategic Evolution of ESE Data Systems (SEEDS), currently being formulated. EOSDIS Development also supports the evolution of TRMM's processing system to an integrated Precipitation Processing System, capable of handling global precipitation data, as a SEEDS prototype. It will support the science data system development for new missions including the NPOESS Prep Project (NPP).
-The EOSDIS budget was split into development and operations in FY02.

Link to project homepage for more information: http://eosdismain.gsfc.nasa.gov/eosinfo/EOSDIS_Site/

## PROGRAM MANAGEMENT

EOSDIS Development and EOS Operations are managed by the GSFC. The SEEDS project will also be managed by GSFC. The GSFC Program Management Council (PMC) has EOSDIS Project governing responsibility. Enterprise official is Dr. Ghassem Asrar, Associate Administrator for Earth Science. Theme Director is Dr. Jack Kaye. Program Manager is Doug McCuistion.

## TECHNICAL COMMITMENT

The EOSDIS baseline was established in 1986. The requirements are detailed in the EOS PCA.

| Technical Specifications | FY04 President's Budget | Change from Baseline |
|---|---|---|
| EOSDIS | EOSDIS success criteria are to successfully support the ground operations of the EOS missions: Terra, Aqua, Aura, and ICESat, including spacecraft and instrument control, data acquisition, and telemetry processing; to operate the eight Distributed Active Archive Centers, which archive and distribute the data; and to support science investigator-led processing. The success criteria are to add the additional capabilities for new missions in an evolutionary manner, incorporating applicable new technologies that result in cost-effective operations. | -- <br> -- <br> -- |

| Schedule | FY04 President's Budget | Change from Baseline |
|---|---|---|
| Start of Formulation | Nov-88 | -- |
| Start of Implementation | Oct-90 | -- |
| Data Validation Period | 6 months - 1 year after receipt by investigators (depends on maturity of instrument technology). | -- |
| Operational Lifetime | 20 years | -- |

| THEME: | Earth System Science |
|---|---|
| **DEVELOPMENT:** | Earth Observing System Data and Information System (EOSDIS) |

## ACQUISITION STRATEGY & PERFORMING ORGANIZATIONS

Major acquisitions are:
EOSDIS Science Data Processing System, to be completed in FY03. Raytheon is the prime contractor.
EOSDIS Clearinghouse (ECHO), EOSDIS Data Gateway (EDG), and Dynamic Queries,ongoing. Global Sciences and Technology, Inc. is the prime contractor for all of these smaller ongoing efforts. ESDIS is in the process of moving these separate GST procurments from multiple contracts to a consolidated 5-year GSA contract (FY03 - FY07).
**Changes since FY03 Pres. Budget: None.**

| Current Acquisitions | Actual * | Selection Method | Actual * | Performer | Actual * |
|---|---|---|---|---|---|
| Cooperative Agreements | 0% | Full & Open Competition | 100% | Industry | 99% |
| Cost + | 91% | Sole Source | 0% | Government | 0% |
| Fixed Price | 9% | | 100% | NASA Intramural | 0% |
| Grants | 0% | | | University | 1% |
| Other | 0% | Sci Peer Review | 100% | Non Profit | 0% |
| * as % of FY02 direct procurement | 100% | * as % of FY02 direct procurement | | * as % of FY02 direct procurement | 100% |

| Future Acquisitions - Major | Selection | Goals |
|---|---|---|
| 1. Contract transitions from EOSDIS Core System (ECS) to ESDIS Maintenance and Development (EMD). | Fall 02 | 100% Full & Open Competition |

## AGREEMENTS

*Internal:* Several MOAs are in place to satisfy the requirements of the Science Investigator-Led Processing System (SIPS).
*External:* An MOA has been signed with USGS for the coordination of the United Nations Environmental Program.
**Changes since FY03 Pres. Budget: None.**

## INDEPENDENT REVIEWS

| Types of Review | Performer | Last Review | Next Review | Purpose |
|---|---|---|---|---|
| Indep. Annual Review | IPAO | 1-Jan-01 | 3-Mar-03 | Affirmation of Program Commitment Agreement. |
| Annual Review | ESSAAC | Nov 2002 | Nov 2003 | Validation and peer review of program direction. |

## BUDGET/LIFE CYCLE COST

Total budget authority represents the Life Cycle Cost (LCC). These figures include only the estimates for the development of EOSDIS beginning in FY03 and beyond. Prior years are included the cost of operations.

| Budget Authority ($ in millions) | Prior | FY02 | FY03 | FY04 | FY05 | FY06 | FY07 | FY08 | BTC | Total | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|
| FY 2004 President's Budget (LCC) | 2164.8 | 291.5 | 74.3 | 98.3 | 98.6 | 100.6 | 99.4 | 104.7 | | 3032.3 | |
| Development | 2164.8 | 291.5 | 74.3 | 98.3 | 98.6 | 100.6 | 99.4 | 104.7 | | 3032.3 | |
| Changes since FY 03 Pres. Budget | | -1.5 | | +22.3 | +29.3 | +29.3 | +32.8 | +40.7 | | +154.4 | ***Reason for Change:*** |
| Op plan adjustment | | -1.5 | | | | | | | | | |
| Full Cost | | | | +22.3 | +29.3 | +29.3 | +32.8 | +40.7 | | +154.4 | Inclusion of Full Cost. |
| FY 2003 President's Budget (LCC) | 2164.8 | 293.0 | 74.3 | 76.0 | 69.3 | 71.3 | 66.6 | 0.0 | | 2815.3 | Baseline only covers |
| Development | 2164.8 | 293.0 | 74.3 | 76.0 | 69.3 | 71.3 | 66.6 | | | 2815.3 | period through 2001. |
| Operations | | | | | | | | | | 0.0 | |
| Initial Baseline (thru 01) | 2332.6 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | 2332.6 | FY 1997 President's |
| Development (Feb '97) | 2332.6 | | | | | | | | | 2332.6 | Budget. |

Indicates budget numbers in Full Cost.
Indicates changes since the FY 2003 Presidents Budget Submit.
FY 2002, FY 2003, Prior and BTC are not in full cost.

| THEME: | Earth System Science |
|---|---|

## OPERATIONS

### PURPOSE

| Objectives: Reference 2003 Strategic Plan | Performance Measures |
|---|---|
| 1.1 | 4ESS5 |

Earth System Science Operations encompasses spacecraft command and control, mission planning and data acquisition, tracking and data recovery, the processing of satellite instrument data to scientific geophysical-parameter sets, and the subsequent maintenance and distribution of these information products.

### OVERVIEW

The broad objectives of Earth System Science Operations are to establish data sets spanning decades for research into climate and global change, and to acquire science data sets via various NASA facilities. Specific facilities include spacecraft control centers, tracking and data acquisition stations, and data processing, archiving and distribution facilities.

| | |
|---|---|
| Ground Network | http://www.wff.nasa.gov/~code452/ |
| Operating Missions | http://visibleearth.nasa.gov/Sensors/ |
| EOS | http://earth.nasa.gov/ |

### PROGRAM MANAGEMENT

The EOS operations responsibility was delegated to the Goddard Space Flight Center. The Systematic Measurements Program Management Council (SMPMC) has governing responsibility. Enterprise official is Dr. Ghassem Asrar, Associate Administrator for Earth Science. Theme Director is Dr. Jack Kaye. Program Manager is Doug McCuistion.

### TECHNICAL COMMITMENT

The baseline for each mission in operations was established during the project's Non-Advocacy Review (NAR). The requirements are detailed in each mission's Program Commitment Agreement (PCA).

| Technical Specifications | FY04 President's Budget | Change from Baseline |
|---|---|---|
| Operating Missions<br>-TOMS,UARS,TRMM,ERBS, Topex and ASF | Missions in their prime phase are expected to achieve their individual data delivery objectives; extended phases have reduced objectives. | -- |
| EOS<br>(e.g. Terra, Aqua, ICESat) | Provides mission operations and science information end-to-end for various missions, including data processing, data archiving and distribution, and heritage data to fulfill established Earth science goals and objectives. Committed to capturing 95% of science data, to maintain processing and thru-put rates for all instruments, and providing archive and distribution services until 3 years after end of mission lifetime. | -- |
| Ground Network | Tracking stations and related systems acquire data from orbiting automated spacecraft ( 99% availability),balloons, sounding rockets, and Space Shuttle missions (99.5% availability). | -- |

| Schedule | FY04 President's Budget | Change from Baseline |
|---|---|---|
| Operating Missions<br>(includes Alaska SAR Facility) | These operating missions have met prime objectives and are in extended mission phases. | -- |
| Total Ozone Mapping Spectrometer (TOMS) | 1996-2004 | |
| Upper Atmosphere Research Satellite (UARS) | 1991-2003 | |
| Tropical Rainfall Measuring Mission (TRMM) | 1997-2004 | |
| Earth Radiation Budget Satellite (ERBS) | 1986-2003 | |
| Topex | 1992-2003 | |
| EOS<br>-DAACS, ESMO, PI Processing Federation, Networks, etc. | EOS schedules are commensurate with enumerated spacecraft prelaunch, launch and postlaunch milestones for check-out, end-to-end test, and operations throughout spacecraft prime mission lifetime plus 3 years. NASA has agreements with USGS and NOAA for long-term archiving of data. | -- |
| Ground Network | In transition from government assets to commercial services. NASA plans to maintain a capability to support current and future missions. | -- |

| THEME: | Earth System Science |
|---|---|
| **OPERATIONS** | |

## ACQUISITION STRATEGY & PERFORMING ORGANIZATIONS

The prime contractor for the Ground Network,UARS, and TRMM missions is Lockheed Martin under the Consolidated Space Operations Contract (CSOC). This contract covers 5 years of operations, ending in December 2003. The prime contractor on the EOS mission is Raytheon. **Changes since FY03 Pres. Budget:**

| Current Acquisitions | Actual * | Selection Method | Actual * | Performer | Actual * |
|---|---|---|---|---|---|
| Cooperative Agreements | 0% | Full & Open Competition | 96% | Industry | 87% |
| Cost Reimbursable | 84% | Sole Source | 4% | Government | 0% |
| Fixed Price | 4% | | 100% | NASA Intramural | 7% |
| Grants | 5% | | | University | 6% |
| Other | 7% | Sci Peer Review | 3% | Non Profit | 0% |
| * as % of FY02 direct procurement | 100% | * as % of FY02 direct procurement | | * as % of FY02 direct procure | 93% |

| Future Acquisitions - Major | Selection | Goals |
|---|---|---|
| 1. Follow-On Contract to CSOC | Dec 03 | 100% Full & Open Competition |
| 2. Follow-On to ECS: EMD | Mar 03 | 100% Full & Open Competition |

## AGREEMENTS

*Internal:* MOA for Mission Services and Space Communications with NASA Office of Space Flight and Office of Space Sciences.

*External:* National Research Council Review of DAACS.

**Changes since FY03 Pres. Budget: MOA (above), decision not to extend CSOC.**

## INDEPENDENT REVIEWS

| Types of Review | Performer | Last Review | Next Review | Purpose |
|---|---|---|---|---|
| None | N/A | N/A | N/A | N/A |

## BUDGET

| Budget Authority ($ in millions) | FY02 | FY03 | FY04 | Comments |
|---|---|---|---|---|
| FY 2004 President's Budget (Operations) | 48.0 | 247.8 | 322.2 | |
| Operating Missions | 48.0 | 28.8 | 22.2 | |
| UARS, ERBS, TRMM, QuikTOMS, Seastar/Seawifs, TOMS | 36.0 | 20.3 | 12.2 | |
| ASF | 12.0 | 8.5 | 10.1 | |
| Earth Science Ops | | 176.6 | 256.5 | Transferred from Dev to Ops in FY03 Budget. |
| Ground Network | | 42.4 | 43.5 | Transferred from OSF to OES in FY03. |
| Changes since FY 03 Pres. Budget | | | +55.6 | Reason for Change: |
| Ground Network Investments | | | | Network sustaining investments. |
| Transfer EOSDIS dev to Ops | | | | Realign between Develop and ops. |
| Ops reduction of 5% | | | -10.0 | Reduced to accommodate agency priorities. |
| Full Cost | | | +65.6 | Inclusion of full cost. |

Indicates budget numbers in Full Cost.

Indicates changes since the FY 2003 Presidents Budget Submit.

FY 2002 and FY 2003 are not in full cost.

| THEME: | Earth System Science |
|---|---|

## RESEARCH

### PURPOSE

| Objectives | Reference 2003 Strategic Plan | Performance Measures |
|---|---|---|
| 1.1 | | 4ESS2, 4ESS7-12,14 |

The Earth System Science Research program is designed to answer pressing science questions, including: How is the global Earth system changing and what are the consequences for human civilization? How can we predict future changes in the Earth system? In recent years, NASA's Earth System Science Program has begun to provide answers to these questions through an integrated approach using satellites, suborbital platforms, surface based observations, laboratory experiments, and computational modeling.

### OVERVIEW

The Earth Science Research Program at NASA studies the Earth as a whole system, utilizing measurements made by Earth satellites, as well as by Suborbital and Airborne assets. These observations, enhanced by the work of the Mission Science Teams and Algorithm Development activities, enlarge the Earth system knowledge base and are incorporated into models in order to improve our ability to predict climate, weather, and natural hazards. Computing capabilities funded through the Research Program's Information Systems effort further support these improvements. The program also selects and funds over 1,200 U.S. scientific research tasks through the Research and Analysis activity. Scientists from seventeen other nations, funded by their own countries and collaborating with U.S. researchers, are also part of the program. These researchers develop Earth system models from Earth science data, conduct laboratory and field experiments, run aircraft campaigns, develop new instruments, and thus expand our understanding of our planet. In FY04, NASA Earth Science Research Program will continue to provide the technology, observations, and modeling results that contribute towards the provision of answers to the questions society poses about our home planet.

Link to project homepage for more information: http://www.earth.nasa.gov/science/index.html

### PROGRAM MANAGEMENT

The Earth System Science Research program has program responsibility delegated to NASA Headquarters. The Science Division Director is Dr. Jack Kaye. The Headquarters Program Management Council (PMC) has governing responsibility. Enterprise official is Dr. Ghassem Asrar, Associate Administrator for Earth Science.

### TECHNICAL COMMITMENT

| Technical Specifications | FY04 President's Budget | Change from Baseline |
|---|---|---|
| NASA works with the science community to identify questions on the frontiers of science that have profound societal importance, and to which remote sensing of the Earth can make a defining contribution. These science questions become the foundation of a research strategy, which defines requirements for scientific observations, and roadmaps for combining the technology, observations, modeling efforts, basic research, and partnerships needed to answer the questions over time. These can be seen at: http://earth.nasa.gov/roadmaps | | |

| Schedule | FY04 President's Budget | Change from Baseline |
|---|---|---|
| Research Announcements (NRAs, AOs, etc.) | Estimated Selection Date: | |
| NPOESS Preparatory Project | FY03 - 4th Qtr. | -- |
| Earth Observing System | FY03 - 4th Qtr. | -- |
| Interdisciplinary Science | FY03 - 4th Qtr. | -- |
| Modeling/Analysis | FY04 - 3rd Qtr. | -- |
| Terrestrial Hydrology | FY04 - 1st Qtr. | -- |
| Global Water Cycle | FY04 - 4th Qtr. | -- |
| Land Cover Land Use/Applications | FY04 - 3rd Qtr. | -- |
| Physical Oceanography | FY04 - 3rd Qtr. | -- |
| Tropospheric Chemistry and the INTEX Field Mission | FY04 - 3rd Qtr. | -- |
| CAMEX 5 | FY04 - 4th Qtr. | -- |

THEME: Earth System Science

# RESEARCH

## ACQUISITION STRATEGY & PERFORMING ORGANIZATIONS

The NASA Research program is based on full and open competition. Grants are peer reviewed and selected based on NASA Research Announcements (NRAs), Broad Agency Announcements (BAAs), and Announcements of Opportunity (AOs).

**Changes since FY03 President's Budget: None**

| Current Acquisitions | Actual * | Selection Method | Actual * | Performer | Actual * |
|---|---|---|---|---|---|
| Cooperative Agreements | 13% | Full & Open Competition | 81% | Industry | 8% |
| Cost Reimbursable | 0% | Sole Source | 19% | Government | 7% |
| Fixed Price | 16% | | 100% | NASA Intramural | 24% |
| Grants | 51% | | | University | 61% |
| Other: Interagency Agmts | 20% | Sci Peer Review | 100% | Non Profit | 0% |
| * as % of FY02 dir. proc. | 100% | * as % of FY02 dir. proc. | | * as % of FY02 dir. proc. | 100% |

| Future Acquisitions - Major | Selection | Goals |
|---|---|---|
| NPOESS Preparatory Project | FY03 - 4th Qtr. | 95% Sci Peer Review, 100% Grants |
| Earth Observing System | FY03 - 4th Qtr. | 95% Sci Peer Review, 100% Grants |
| Interdisciplinary Science | FY03 - 4th Qtr. | 95% Sci Peer Review, 100% Grants |
| Modeling/Analysis | FY04 - 3rd Qtr. | 95% Sci Peer Review, 100% Grants |
| Terrestrial Hydrology | FY04 - 1st Qtr. | 95% Sci Peer Review, 100% Grants |
| Global Water Cycle | FY04 - 4th Qtr. | 95% Sci Peer Review, 100% Grants |
| Land Cover Land Use/Applications | FY04 - 3rd Qtr. | 95% Sci Peer Review, 100% Grants |
| Physical Oceanography | FY04 - 3rd Qtr. | 95% Sci Peer Review, 100% Grants |
| Tropospheric Chemistry and the INTEX Field Mission | FY04 - 3rd Qtr. | 95% Sci Peer Review, 100% Grants |
| CAMEX 5 | FY04 - 4th Qtr. | 95% Sci Peer Review, 100% Grants |

## AGREEMENTS

*Internal:* The program is not dependent on other NASA activities outside of the control of the Associate Administrator of Earth Science.

*External:* Various Memorandums of Understanding and Agreements with NOAA, NSF, USGS, and other federal and foreign entities. **Changes since FY03 Pres. Budget: None.**

## INDEPENDENT REVIEWS

| Types of Review | Performer | Last Review | Next Review | Purpose |
|---|---|---|---|---|
| External Peer Review | Nat Academy | 2000 | 2003 | External review of Science Plan. |
| External Peer review | ESSAAC | Nov 2002 | Nov 2003 | Overall assessment of progress and priorities. |
| U.S Climate Change | | 2002 | 2003 | Realign agencies, prioritize, coordinate the Program. |

## BUDGET

| Budget Authority ($ in millions) | FY02 | FY03 | FY04 | Comments |
|---|---|---|---|---|
| FY 2004 President's Budget (Research) | 338.6 | 357.3 | 523.4 | |
| EOS Science | 49.3 | 53.6 | 67.0 | |
| Suborbital Science | | 25.0 | 35.4 | |
| Airborne Science | 23.0 | | | |
| UAV Science | 2.0 | | | |
| Information Systems | 13.6 | 10.5 | 14.9 | |
| Algorithm Development | | | 81.2 | |
| Mission Science Teams | 94.6 | 102.6 | 109.4 | |
| Research & Analysis | 156.1 | 162.2 | 215.5 | |
| CofF | | 3.4 | | |
| Changes since FY 03 Pres. Budget | | | +156.6 | Reason for Change: |
| Suborbital Science Program | | | -10.0 | Program restructure. |
| R and A | | | -5.0 | General reduction. |
| NPP science team | | | +3.0 | Transfer from dev. to mission science team. |
| Science teams | | | +3.0 | CCRI research. |
| Full Cost | | | +110.0 | Inclusion of full cost. |
| Algorithm Development | | | +55.6 | Transfer from dev. to mission science team. |

Indicates budget numbers in Full Cost.

Indicates changes since the FY 2003 Presidents Budget Submit.

FY 2002 and FY 2003 are not in full cost.

| THEME: | Earth System Science |
|---|---|
| **TECHNOLOGY AND ADVANCED CONCEPTS:** | Technology Infusion Program |

## PURPOSE

| Objectives | Reference 2003 Strategic Plan | Performance Measures |
|---|---|---|
| 1.1 | | ESS4 |

NASA's Earth Science Enterprise (ESE) is dedicated to understanding the total Earth system and the effects of natural and human-induced changes on the global environment. Advanced technology will play a major role in enabling the ESE science/applications program of the future. The Earth Science Technology Program (ESTP):
- Enables ESE science and application programs by providing new capabilities and reducing the cost of Earth science
measurements planned in the near, mid, and far term; and
- Ensures consistency between the ESE Strategic Plan and the implementing technology strategy, as manifest in the Earth Science Technology Program and New Millennium Program (NMP) and other relevant agency programs

## OVERVIEW

The Earth Science Enterprise formed the Earth Science Technology Office (ESTO) to provide strategic, science-driven technology assessments and requirements development. ESTO will integrate and prioritize these requirements among various implementing programs and projects by maintaining a link between science/applications objectives and technology investments. ESTO aggressively pursues promising scientific and engineering concepts and ensures that the program maintains an effective balance of instrument and information systems investments.

ESTO implements the ESE focused technology program, which includes: the **Instrument Incubator Program (IIP)** to develop new instruments and measurement techniques at the system level; **Advanced Technology Initiatives (ATI)**, which develop technologies required for next generation, space-based missions; **Advanced Information Systems Technology (AIST)**, to develop end-to-end information technologies for future missions; **Computational Technologies (CT)**, to develop and apply high performance computing technologies for Earth and space science; and **Advanced Platform Technology (APT)**. The **New Millennium Program (NMP)** validates innovative measurement concepts, enabling instrument technologies, and space platform technologies required for future missions. The focused technology program also supports **Integrated Product Development Teams**. ESTO will leverage technology investments through internal NASA program synergy and external partnerships. These efforts will include: **Information Systems (IS), Small Business Innovative Research (SBIR), Space Based Technology (SBT), NASA Institute of Advanced Concepts (NIAC), Revolutionary Aero Space Concepts (RASC),** and other agencies' (e.g., DoD) programs.

Link to project homepage for more information: http://esto.nasa.gov

## PROGRAM MANAGEMENT

The program responsibility has been assigned to the Goddard Space Flight Center (GSFC). Enterprise official is Ghassem Asrar, Associate Administrator for the Office of Earth Science at HQ. Point of Contact is George J. Komar, Program Manager, Earth Science Technology Office. This program is in full compliance with NPG7120.5B.

## TECHNICAL COMMITMENT

The baseline for the ESTO and NMP technical commitment is the PCA.

| Technical Specifications | FY04 President's Budget | FY02 | FY03 | FY04 | FY05 | FY06 | FY07 | FY08 | Change from Baseline |
|---|---|---|---|---|---|---|---|---|---|
| 1) Annually advance 25% of funded technology developments one Technology Readiness Level (TRL). | TRL % Change | 25% | 25% | 25% | 25% | 25% | 25% | 25% | -- |
| 2) Mature 2-3 technologies to the point where they can be demonstrated in space or in an operational environment. | Number Matured | 3 | 2 | 2 | 2 | 2 | 2 | 2 | -- |
| 3) Enable one new science measurement capability or significantly improve performance of an existing one. | Number Enabled | 1 | 1 | 1 | 1 | 1 | 1 | 1 | -- |

| THEME: | Earth System Science |
|---|---|

## TECHNOLOGY AND ADVANCED CONCEPTS: Technology Infusion Program

| Schedule | FY04 President's Budget | Change from Baseline |
|---|---|---|
| Integrated Technology Development Plan | 2nd Qtr FY03 | -- |
| Earth Science Technology Conference | 3rd Qtr FY03 | -- |
| Technology Infusion Plan | 3rd Qtr FY03 | -- |
| Advanced Technology Initiatives (ATI) NRA | 2nd Qtr FY04 | -- |
| Instrument Incubator Program (IIP) NRA | 3rd Qtr FY04 | -- |
| Advanced Info Systems Technology (AIST) NRA | 3rd Qtr FY05 | -- |

## ACQUISITION STRATEGY & PERFORMING ORGANIZATIONS

Technology studies and development efforts are procured primarily through the NRA process.
**Changes since FY03 Pres. Budget: None.**

| Current Acquisitions | Actual * | Selection Method | Actual * | Performer | Actual * |
|---|---|---|---|---|---|
| Cooperative Agreements | 0% | Full & Open Competition | 80% | Industry | 15% |
| Cost Reimbursable | 100% | Sole Source | 10% | Government | 8% |
| Fixed Price | 0% | Congressional Initiatives | 10% | NASA Intramural | 32% |
| Grants | 0% | | 100% | University | 25% |
| Other | 0% | Sci Peer Review | 100% | Non Profit | 20% |
| * as % of FY02 direct procurement | 100% | * as % of FY02 direct procurement | | | 100% |

| Future Acquisitions - Major | Selection | Goals |
|---|---|---|
| 1. Advanced Technology Initiatives NRA | 2nd Qtr FY04 | Competitively awarded proposals to support ESS technology needs. |
| 2. Instrument Incubator Program NRA | 3rd Qtr FY04 | Competitively awarded proposals to support ESS technology needs. |
| 3. Advanced Info Systems Technology NRA | 3rd Qtr FY05 | Competitively awarded proposals to support ESS technology needs. |

| THEME: | Earth System Science |
|---|---|

## TECHNOLOGY AND ADVANCED CONCEPTS: Technology Infusion Program

### AGREEMENTS

Internal: The program is not dependent on other NASA activities outside of the control of the Associate Administrator for Earth Science.

External: None.

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

### INDEPENDENT REVIEWS

| Types of Review | Performer | Last Review | Next Review | Purpose |
|---|---|---|---|---|
| External Review Committee | ESSAAC | Nov 02 | Nov 03 | Overall assessment of progress and priorities. |

### BUDGET

| Budget Authority ($ in millions) | FY02 | FY03 | FY04 | Comments |
|---|---|---|---|---|
| Technology Infusion | 71.8 | 65.0 | 78.9 | |
| Instrument Incubator Program | 15.0 | 22.0 | 27.0 | |
| Advanced Info Systems Technology | 9.5 | 9.8 | 11.5 | |
| Advanced Technology Initiatives | 19.7 | 8.5 | 12.3 | |
| Computational Technology | 21.8 | 19.0 | 21.9 | |
| NMP Future Missions | | | | |
| IDPT | 5.8 | 5.7 | 6.1 | |
| Changes since FY 03 Pres. Budget | -30.0 | -22.3 | +1.7 | Reason for Change: |
| Full Cost | | | +17.7 | Inclusion of Full Cost. |
| EO-3 Funding to development | -30.0 | -22.3 | -10.2 | Realign budget structure. |
| NMP future missions | | | -5.8 | Accommodate follow-on rephase. |
| Indicates budget numbers in Full Cost. | | | | |
| Indicates changes since the FY 2003 Presidents Budget Submit. | | | | |
| FY 2002 and FY 2003 are not in full cost. | | | | |

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| THEME: | Earth System Science |
|---|---|
| **TECHNOLOGY AND ADVANCED CONCEPTS:** | Missions in Formulation |

## PURPOSE

| Objectives Reference 2003 Strategic Plan | Performance Measures |
|---|---|
| 1.1 | 4ESS 7-12 |

The next generation of EOS missions will provide new technology and space systems to meet the observing requirements in the Earth System Science Research strategy. NASA has identified a mission architecture over the mid term that will help achieve specific scientific goals using a combination of systematic and exploratory missions.

## OVERVIEW

The new missions selected will capitalize on our investments in advanced technologies to reduce lifecycle time/cost and to better relate to longer-term scientific questions and practical applications. The approach to mission selection and implementation will ensure the maturity of essential technologies during mission definition/formulation for both exploratory and systematic missions (i.e. no missions will go into implementation until key technologies are ready).

## PROGRAM MANAGEMENT

The program responsibility will be delegated to a responsible Center for each mission as it enters implementation. Enterprise official is Dr. Ghassem Asrar, Associate Administrator for Earth Science at HQ.

## TECHNICAL COMMITMENT

The baseline for this technical commitment is the FY02 budget. If, after the Preliminary Design Review, a program is approved to proceed to development, a Program Commitment Agreement (PCA) will rebaseline this commitment.

| Technical Specifications | FY04 President's Budget | Change from Baseline* |
|---|---|---|
| * These missions will not have a baseline until Mission Confirmation review (MCR); technical specifics subject to final approval to proceed to implementation. | | |

NPOESS Preparatory Project (NPP) is being formulated to:

*Fulfill a national commitment to obtain and make available a 15-year data record of fundamental global climate change observations.

*This is a shared-cost precursor mission to the next generation of operational polar weather satellites being developed by the National Polar-Orbiting Operational Environmental Satellite System (NPOESS) Integrated Program Office (IPO). a 5-yr. joint NASA, NOAA, DoD effort.

*Ensures NASA’s long-term science observational needs are met by the operational system, and ensures transfer of key technologies NASA developd as part of the EOS program into the next generation of operational satellites.

Global Precipitation Mission (GPM) is being formulated to:

*Improve climate prediction by quantifying the space-time variability of precipitation and contributing to water budget closure.

*Improve global/regional numerical weather prediction model accuracies through instantaneous rain rate and latent heating measurements.

*Improve global water cycle prediction through frequent sampling and complete Earth coverage of precipitation.

*Sample precipitation globally with reduced diurnal aliasing for precipitation rates from 0.3 to 110 mm/hr.

*Provide immediate data and rain images with data latency less than 3 hours and with 25%-50% precision.

*Provide 3-hour data products and rain images with 15%-40% precision.

*Provide 3-hour precipitation estimates that deliver 90% of the collected science data on average over a 30 day period.

*Provide processed (Level 1, 2 & 3) data with completeness of 98% of the collected science data.

*Provide a minimum 3 years of measurement of global precipitation with a goal of 5 years.

Landsat Data Continuity Mission (LDCM) is being formulated to:

*Continue the basic global land cover change data set, as addressed in the Land Remote Sensing Policy Act of 1992 (P.L. 102-555).

*Enable various management alternatives, with a preference given to a commercial data purchase.

*Provide synoptic, repetitive multispectral, high-resolution, digital imagery of the Earth's land surfaces.

*Characterize and monitor change in land-cover and land-surface processes; improve the assessment of rates of land-cover changes.

*Observe deforestation, ecosystem fragmentation, argicultural productivity, glacier dynamics, and coastal hazards; and monitor volcanoes.

| Technical Specifications | FY04 President's Budget | Change from Baseline * |
|---|---|---|

Ocean Vector Winds Mission (OVWM) is being formulated to:
* Utilize a Ku-band scatterometer to infer wind velocity over 90% of the ice-free ocean surface every two days with a resolution of 25 km or better for a duration of three years with a goal of five years.
* Produce wind vector measurements over the ice-free oceans from 90% of the obtained data within 5 working days of data receipt.
* Flag measurements for the presence of land, ice, and/or significant rain in the footprint.
* Wind speed accuracy will be 2 meters/second rms or better from 3 to 20 m/s; and 10% rms or better for wind speeds from 20 to 30 m/s.
* Wind direction accuracy will be 20 degrees rms or better for wind speeds from 3 to 30 m/s.
* Provide software and data to NOAA to enable the production of near-real-time ocean wind vector information from OVWM data.

Ocean Surface Topography Mission (OSTM) is being formulated to:
* Provide a minimum of 3 years of measurement of ocean surface topography with a goal of 5 years.
* Launch on the same orbit as Jason-1 by flying within +/- 1 km of the same 9.9 day repeating ground track.
* Maintain the accuracy of Jason-1 (e.g. ocean topography to 4.2 cm at 1/sec along-track data rate with a goal of 2.5 cm).
* Maintain the stability of the global sea level measurement with a drift less than 1 mm/year.
* Maintain any relative bias from Jason-1 to less than 5 mm.
* Process more than 80% of all theoretically possible data that can be collected in a five-year period.
* Process more than 95% of all recovered over-ocean data obtained during any 12-month period.

Aquarius is being formulated to:
*Provide the first global measurements of salt concentration on the ocean's surface to explore the response of the ocean to climate and the water cycle.
*Provide a salinity sensor L-band radiometer (1.4 GHz passive), and a surface roughness sensor L-band scatterometer (1.2GHz active) instrument.
*Provide global salinity maps at 0.2 PSU accuracy on a monthly basis at 100km resolution for three years.
*Understand the regional and global processes that couple changes in water cycle and ocean circulation and influence present and future climate.

Orbiting Carbon Observatory (OCO) is being formulated to:
*Provide the first global $CO_2$ measurement with the precision, resolution, and coverage needed to characterize $CO_2$ sources and quantify their variability.
*Utilize three high-resolution grating spectrometers to obatin spectra of reflected sunlight in $CO_2$ and oxygen bands.
*Create time-dependent global maps of $CO_2$ with relative accuracies of 0.3%.
*Enable chemical transport models that will use these data to retrieve $CO_2$ sources and sinks, enabling reliable estimates of future atmospheric concentrations of $CO_2$.

Other activities under this program include:
*Solar Irradiance,
*Total Column Ozone,
*Future Missions/ESSP Support, and
*Other Follow-On Studies.

| Schedule | FY04 President's Budget | Change from Baseline* |
|---|---|---|
| NPOESS Preparatory Project (NPP) | | |
| Start of Formulation | Oct-98 | |
| Start of Implementation | Mid-2003 | |
| Spacecraft Ready for Instrument Integration | Nov-04 | |
| Launch Readiness | First half CY 2006 | |
| Global Precipitation Mission (GPM) | | |
| Start of Formulation | Dec-01 | |
| Non-Advocate Review (Mission Confirmation | TBD | |
| Preliminary Design Review | TBD | |
| Start of Implementation | TBD | |
| Launch | TBD (Core Satellite) | TBD (Constellation Satellite) |
| Observatory Operational Lifetime | 3 years (5 years goal) | |

* These missions will not have a baseline until Mission Confirmation review (MCR); technical specifics subject to final approval to proceed to implementation.

## TECHNICAL COMMITMENT - CONTINUED

| Schedule | FY04 President's Budget | Change from Baseline |
|---|---|---|
| Landsat Data Continuity Mission (LDCM) | | |
| Start of Formulation | Aug. 2000 | -- |
| Non-Advocate Review (Mission Confirmation Review) | N/A | -- |
| Preliminary Design Review | Nov-02 | -- |
| Start of Implementation | Jul-03 | -- |
| Launch | NLT Dec-06 | -- |
| Data Validation Period | NLT Sep-07 | |
| Observatory Operational Lifetime | 5 years+ | -- |
| | | |
| OceanVector Winds Mission (OVWM) | | |
| Start of Formulation | TBD | -- |
| Non-Advocate Review (Mission Confirmation Review) | TBD | -- |
| Preliminary Design Review | TBD | -- |
| Start of Implementation | TBD | -- |
| Launch | TBD | -- |
| Observatory Operational Lifetime | 3 years (5 years goal) | -- |
| | | |
| Ocean Surface Topography Mission (OSTM) | | |
| Start of Formulation | Late 2002 | -- |
| Non-Advocate Review (Mission Confirmation Review) | TBD | -- |
| Preliminary Design Review | Mid 2003 | -- |
| Start of Implementation | Mid 2003 | -- |
| Launch | Late 2006 | -- |
| Observatory Operational Lifetime | 3 years (5 years goal) | -- |
| | | |
| Orbiting Carbon Observatory (OCO) | | |
| Start of Formulation | Late 2003 | -- |
| Non-Advocate Review (Mission Confirmation Review) | TBD | -- |
| Preliminary Design Review | TBD | -- |
| Start of Implementation | TBD | -- |
| Launch | Mid 2007 | -- |
| Observatory Operational Lifetime | 2 years (4 years goal) | -- |
| | | |
| Aquarius | | |
| Start of Formulation | Late 2003 | |
| Non-Advocate Review (Mission Confirmation Review) | TBD | |
| Preliminary Design Review | TBD | |
| Start of Implementation | Mid 2003 | |
| Launch | Late 2008 | |
| Observatory Operational Lifetime | 3 years (5 years goal) | -- |

## ACQUISITION STRATEGY & PERFORMING ORGANIZATIONS

Major acquisitions for NPP are: ATMS Instrument; competitively awarded in December 2002 to Aerojet (subsequently bought by Northrop Grumman). Spacecraft Bus; Delivery Order awarded through the Rapid Spacecraft Acquisition contract in May, 2002. The remainder of these missions are still in early formulation and the acquisition strategy is still being defined.

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

| Current Acquisitions (for NPP only) | Actual * | Selection Method | Actual * | Performer | Actual * |
|---|---|---|---|---|---|
| Cooperative Agreements | 0% | Full & Open Competition | 100% | Industry | 95% |
| Cost Reimbursable | 70% | Sole Source | 0% | Government | 0% |
| Fixed Price | 25% | | 100% | NASA Intramural | 5% |
| Grants | 0% | | | University | 0% |
| Other | 5% | Sci Peer Review | % | Non Profit | 0% |
| * as % of FY02 direct procurement | 100% | * as % of FY02 direct procurement | | | 100% |

| Future Acquisitions - Major | Selection | Goals |
|---|---|---|
| IDCM Implementation Phase Contract Award | Jun-03 | 100% competed |
| Missions are all in formulation. Future acquisitions being defined. | | |

| THEME: | Earth System Science |
|---|---|
| **TECHNOLOGY AND ADVANCED CONCEPTS:** | Missions in Formulation |

## AGREEMENTS

*Internal:* None at this time.

*External:*

NPP: NASA/NOAA/DoD Initial Implementation Agreement, 11/21/99.

LDCM: NASA-USGS Initial Implementation Agreement, 1/11/01.

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

## INDEPENDENT REVIEWS

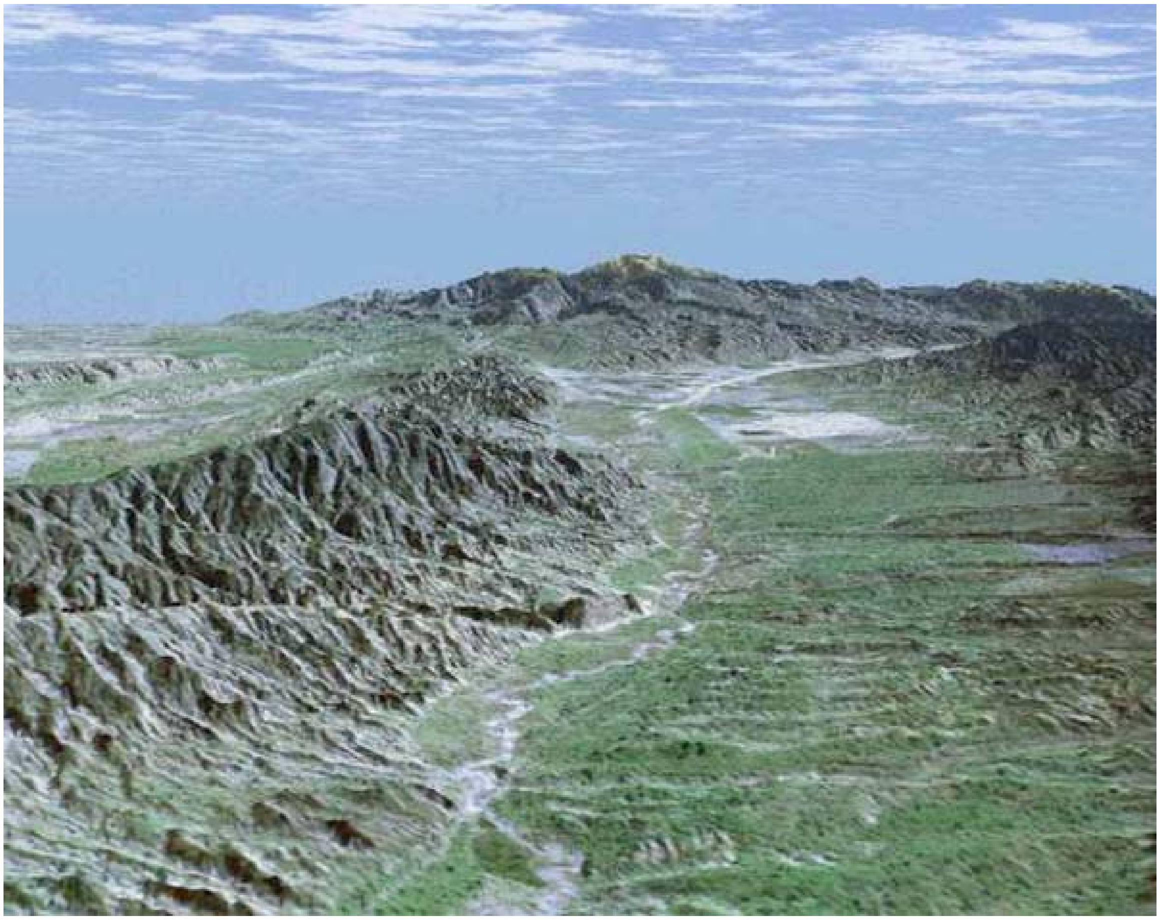
| Types of Review | Performer | Last Review | Next Review | Purpose |
|---|---|---|---|---|
| NPP | | | | |
| Independent Assessment | IPAO | N/A | TBD | |
| Non-Advocate Review | IIRT | N/A | TBD | Evaluation of readiness to enter Implementation. |
| Indep. Implementation Rev | IIRT | N/A | TBD | Independent assessment of the program's progress. |
| GPM | | | | |
| Independent Assessment | IRT/IPAO | N/A | 4Q/FY02-1Q/FY03 | Assess requirements, design concepts, implementation plans, risks, and life cycle cost. |
| Non-Advocate Review | IRT/IPAO | N/A | 1Q/FY04 | |
| Indep. Implementation Rev | IRT/IPAO | N/A | Annually during Implementation | |

## BUDGET

| Budget Authority ($ in millions) | FY02 | FY03 | FY04 | Comments |
|---|---|---|---|---|
| 2004 President's Budget | | | | |
| Advanced Concepts | 117.5 | 246.0 | 274.4 | |
| NPP | 67.2 | 153.1 | 95.6 | |
| GPM | 11.3 | 8.0 | 28.2 | |
| LDCM | 12.0 | 45.0 | 60.0 | |
| Ocean Winds | 5.7 | | 2.7 | |
| Ocean Topography | 9.0 | 32.4 | 40.0 | |
| Solar Irradiance | | | 2.6 | |
| Total Column Ozone | | | 0.3 | |
| Other follow-on studies | 2.9 | | 0.8 | |
| ESSP formulation: | 9.4 | 7.5 | 44.3 | Anticipated direct cost of Aquarius and OCO; full cost to be spread once formulation. |
| Aquarius (ESSP) | 1.2 | 1.0 | 8.2 | |
| Orbiting Carbon Observatory | 2.3 | 2.0 | 17.7 | |
| Future missions/ESSP suppor | 5.9 | 4.5 | 18.4 | |
| Changes since FY 03 PBS | | | -46.3 | ***Reason for Change:*** |
| NPP | | | -55.0 | Rephase |
| NPP | | | +0.2 | Transfer to science team/OMPS instrument |
| NPP | | | +12.5 | Full cost |
| GPM | | | -15.0 | Delay/Rephase |
| GPM | | | +16.2 | Full cost |
| LDCM | | | +6.0 | Rephase and general reduction |
| LDCM | | | +9.0 | Full cost |
| Ocean Winds | | | -28.9 | Delay/Rephase |
| Ocean Winds | | | +0.1 | Full cost |
| Ocean Topography | | | +1.6 | Full cost |
| Solar Irradiance | | | +0.5 | Full cost |
| Total Column Ozone | | | +0.3 | Full cost |
| ESSP | | | +8.2 | Full cost |
| CERES/Other Studies | | | -2.0 | Realign to development |

Indicates budget numbers in Full Cost. (yellow)

Indicates changes since the FY 2003 Presidents Budget Submit. (blue)



This image of the Caliente Range and Cuyama Valley in California was created using radar data from the Shuttle Radar Topography Mission, overlayed by Landsat data of land cover. Such detailed topographic data have a wide variety of civilian and defense uses, including improving aviation safety in challenging terrain and weather. Scientific measurements must be transformed into information products useful to others for the economy and society to fully benefit. Our applications and education programs are designed to provide the translation from science to application through partnerships between NASA and professional information product providers and educators.

# EARTH SCIENCE APPLICATIONS

## MAJOR EVENTS IN FY 2004

- Benchmark improvement to at least two national applications: air quality and agricultural productivity.
- Competitively select projects for the Research, Education, and Applications Solutions Network (REASoN) program to serve national priorities.

## THEME: Earth Science Applications

### OVERVIEW

The Earth Science Applications Program bridges the gap between scientific discoveries and practical applications to benefit society by providing Earth science data and information in forms readily useable by providers of essential services to the Nation. Observations from NASA Earth observing satellites have proven to be valuable in improving the National Oceanographic and Atmospheric Agency's (NOAA) predictions of hurricane landfall, monitoring wildfires to help the U.S. Forest Service allocate resources, and increasing aviation safety through the use of Shuttle Radar Topography Mission (SRTM) data for terrain databases. As we move forward to 2004, the NASA Earth Science Applications Program continues to benchmark contributions to relevant decision support tools that are vital for our nation's safety and security.

| Missions | Goals supported by this theme | Objectives supporting those goals — Reference 2003 Strategic Plan |
|---|---|---|
| Understand and Protect our Home Planet | 1. Understand the Earth system and apply Earth system science to improve prediction of climate, weather, and natural hazards. | 1.2 Expand and accelerate the realization of economic and societal benefits from Earth science, information, and technology. |
| | 3. Create a more secure world and improve the quality of life by investing in technologies and collaborating with other agencies, industry, and academia. | 3.1 Enhance the Nation's security by developing and demonstrating critical access-to-space technologies that benefit NASA, DoD, and other government agencies. (Supporting Role) |
| Inspire the Next Generation of Explorers | 6. Inspire and motivate students to pursue careers in science, technology, engineering, and mathematics. | 6.2 Motivate K-16+ students from diverse communities to pursue science and math courses and ultimately college degrees in science, technology, engineering and mathematics. (Supporting Role) |
| | 7. Engage the public in shaping and sharing the experience of exploration and discovery. | 7.2 Improve science literacy by engaging the public in NASA missions and discoveries, and their benefits, through such avenues as public programs, community outreach, mass media, and the internet. (Supporting Role) |

### RELEVANCE

The Applications Program enhances the availability, interoperability, and utility of Enterprise and private sector data sets, communications, computing, and modeling capabilities to serve national applications. Applications Program outputs include prototypes, assessments, procedures, and verification reports resulting from demonstration projects. The Enterprise works through partnerships with public, academic, and private organizations to develop innovative approaches for using Earth science information and enhances products and services delivered through state, local and tribal organizations to serve citizens. In essence, ESE pursues "government-to-government-to-citizen" relationships to extend the Earth science results to society. Key components of our Nation's economy and homeland security can be improved with the best available knowledge of global conditions. The NASA Earth Science Enterprise is focused on a mission to deliver improved predictions of weather, climate, and natural hazards based on global measurements. The Applications Program is focused on working with federal agencies and national organizations to optimize the use of human capital, technology and the data and knowledge generated by the constellation of over 15 Earth observing satellites. These spacecraft, which routinely make measurements using over 80 remote sensing systems are used by a community of Earth science laboratories, universities, and research institutions throughout the country.

| Education and Public Benefits |
|---|
| In a global economy that depends on access to the best available Earth science information for energy forecasting, aviation safety, agricultural competitiveness, disaster management, and other areas, it is imperative that our Nation have an education system that develops the skills and human capital required to create, maintain, and optimize complex scientific and engineering systems to serve society. The Earth Science Education Program works through partnerships to provide knowledge, data, technology, and people to contribute to the education infrastructure needed to develop "our next generation of explorers." NASA's technology, observations and knowledge of the Earth System can be harnessed to improve predictive capability in fields such as energy usage forecasting, agricultural competitiveness, disaster relief, carbon management, water resource management, invasive species management, and air quality management. |

## THEME: Earth Science Applications

### IMPLEMENTATION

The ESA Theme is composed of national applications cross-cutting technology, and education components. These components harness information gained through Earth System Science research to enhance decision support tools that improve the lives of American citizens.

Earth Science Applications is a multiple-project program with responsibility in the NASA HQ Office of Earth Science. The Agency Program Management Council (PMC) has governing responsibility. Enterprise official is Dr. Ghassem Asrar, Associate Administrator for the Earth Science Enterprise. Theme Director and Point of Contact is Ronald J. Birk, Director for Applications at HQ.

| Strategy | Purpose |
|---|---|
| Benchmarking is the primary method to enable the practical use of earth science data. Benchmarking involves systematically establishing the improvements and standards necessary to assimilate observations from NASA missions and predictions from models into operational agency decision support systems. | |
| Agricultural Competitiveness | Benchmark the process of assimilating NASA enabled predictions of weather, climate and natural hazards to the agricultural community to increase production efficiency, improve environmental stewardship, and increase farm income through partnerships with the U.S. Department of Agriculture. |
| Aviation Safety | Benchmark the process of integrating enhanced weather, climate, and natural hazard predictions and observations into the National Airspace System using active and passive sensor technologies. |
| Energy Forecasting | Work in partnership with DOE and other nat'l organizations, including industry and the public sector to benchmark the use of enhanced weather, climate and natural hazard information to help forecast electrical power use, optimize placement of renewable power facilities, and conduct energy forecasting. |
| Carbon Management | Provide monitoring and modeling capability to serve the USDA, EPA, and DOE in developing a carbon management regime that is planned to include carbon sequestration in soils and biomass to mitigate increases in greenhouse gases in the atmosphere. |
| Homeland Security | Serve the Nation through partnerships with the Department of Homeland Security and other national organizations to benchmark processes of monitoring air and water quality, tracking the spread of dangerous plumes and particulates, and planning for evacuation scenarios, for integration into a Situation Center for decision support. |
| Public Health | Benchmark the process of assimilating NASA enabled predictions of weather, climate and natural hazards through partnerships with CDC, NIH, DOD and other national public health experts with information to more accurately predict conditions associated with global environmental indicators of public health risks. |
| Water Mgmt and Conservation | Benchmark the process of assimilating NASA enabled predictions of weather, climate and natural hazards to contribute to partnerships w/ USGS, EPA, Bureau of Reclamation, & other nat'l organizations developing tools to quantify, monitor and predict water quantity parameters for resource mgmt. |
| Air Quality Management | Benchmark the process of assimilating NASA enabled predictions of weather, climate and natural hazards through partnerships w/ EPA and other nat'l organizations to improve analytical capabilities for emission estimates, as well as tracking and predicting global to regional dispersion of air quality. |
| Disaster Management | Benchmark the process of assimilating NASA enabled predictions of weather, climate and natural hazards through partnerships with FEMA, USGS, NOAA, and other national organizations to provide improved natural hazard detection, response and mitigation through monitoring of earthquakes, hurricanes, floods, and tornados. |
| Coastal Zone Management | Benchmark the process of assimilating NASA enabled predictions of weather, climate and natural hazards through partnerships with NOAA and other nat'l organizations to facilitate the modeling and prediction of harmful algal bloom development and landfall to support decision makers in coastal mgmt. |
| Invasive Species Mgmt | Benchmark the process of assimilating NASA enabled predictions of weather, climate and natural hazards through partnerships with USGS, USDA, and other national organizations to develop tools and methodologies for detecting, monitoring and mitigating invasive species. |
| Community Growth | Benchmark the process of assimilating NASA enabled predictions of weather, climate and natural hazards through partnerships with EPA, state agencies and other nat'l organizations to assist regional and local gov'ts with data and analyses that support municipalities in State Implementat'n Plan reporting. |
| Earth Science Education | Integrate the knowledge, data, technology and human capital resulting from NASA Earth Science Enterprise research and development into the Nation's education system and enable partnerships with the Dep'ts of Education and Labor, the National Science Foundation and others who share this purpose. |
| Crosscutting Solutions | Support the national applications core areas through 1) systems engineering, 2) solutions networks, 3) geospatial interoperability engineering, and 4) human capital capacity development. |

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

## THEME: Earth Science Applications

### STATUS

This Theme accomplished the following this past year:
- Developed the Applications Strategy: 2002-2012; National Academy of Sciences Review delivered 9/30/02.
- Validated the use of QuikScat (wind) and TRMM (precipitation) measurements for operational weather forecasting.
- Successfully validated the MODIS Rapid Fire Response Project with the U.S. Forest Service.
- Validated the use of SRTM, along with airborne Interferometric Synthetic Aperture Radar and lidar data for flood mapping and terrain databases for aviation.

Link to project homepage for more information: http://gaia.hq.nasa.gov/eseapps/

### PERFORMANCE MEASURES

| Annual Performance Goals | |
|---|---|
| 1.2.1 | OUTCOME: Expand and accelerate the realization of economic and societal benefits from Earth science, information, and technology. |
| 4ESA1 | National applications: Benchmark measurable enhancements to at least 2 national decision support systems using NASA results. |
| 4ESA2 | Cross Cutting Solutions: Expand DEVELOP (Digital Earth Virtual Environment and Learning Outreach Project) workforce development program to at least 5 additional states. |
| 4ESA3 | Cross Cutting Solutions: Competitively select at least 5 solutions projects for the Research, Education, Applications solutions Network (REASoN) program to serve national applications. |
| 4ESA4 | Cross Cut Solutions: Verify / validate at least two commercial remote sensing sources/products for Earth science research. |
| 3.1.3 | OUTCOME: Create a more Secure World and improve the quality of life by investing in technologies and collaborating with other agencies, industry, and academia. |
| 4ESA5 | Benchmark improvements to at least two of the target national applications - Air quality and Agricultural competitiveness. |
| 6.2.1 | OUTCOME: More students from diverse communities motivated to pursue careers in STEM. |
| 4ESA6 | Education: Integrate NASA-reviewed Earth science education results through partnerships into "Revolution" blueprint for Earth Science Education. |
| 4ESA7 | Education: Select at least 50 new graduate fellowships to contribute to human capital for Earth science community. |
| 7.2.2 | OUTCOME: Engage the public in NASA's scientific exploration of Earth from space. |
| 4ESA8 | Provide in public venues at least 50 stories on the scientific discoveries, practical benefits, or new technologies sponsored by the Earth Science Enterprise. |
| | OUTCOME: A well managed program in acordance with Agency implementing strategies. |
| 4ESA9 | Research: Each Research project will allocate 80% of its funding competitively during FY 2004. |

### INDEPENDENT REVIEWS

| Types of Review | Performer | Last Review | Next Review | Purpose |
|---|---|---|---|---|
| Indep Annual Review | Earth Sys. Science Advisory Council | 2-Jun-02 | 4-Jun-04 | Alignment of Earth Science Enterprise & Research Strategies. |
| National Acad. Sci. (NAS) | NAS/NRC/SSB | 2-Sep-02 | 4-Sep-04 | Alignment of National Earth Science Priorities and educational blueprint. |

### BUDGET

| Budget Authority ($millions) | FY 02 | FY03 | Chng | FY04 | Comments |
|---|---|---|---|---|---|
| **Earth Science Applications Total** | **94.7** | **61.7** | **+13.1** | **74.8** | |
| **Research - National Applications** | **39.3** | **20.8** | **+3.2** | **24.0** | FY02 level reflects one time |
| Applications Research (old structure) | 39.3 | 20.8 | -20.8 | 0.0 | Congressional interest items. |
| Research: National Applications | 0.0 | 0.0 | +24.0 | 24.0 | New budget structure in FY04. |
| **Research - Education and Outreach** | **17.5** | **18.1** | **+2.7** | **20.8** | |
| Education | 16.5 | 17.1 | +2.7 | 19.8 | |
| Outreach | 1.0 | 1.0 | +0.0 | 1.0 | |
| **Technology and Advanced Concepts** | **37.9** | **22.8** | **+7.2** | **30.0** | |
| Applications Development (old structure) | 37.9 | 22.8 | -22.8 | 0.0 | |
| Adv Concepts: Cross Cutting Solutions | 0.0 | 0.0 | +30.0 | 30.0 | New structure in FY04 |

Note: For all formats, the FY 02 column reflects the FY 2002 Congressional Operating Plan dated 9/30/02. The FY 03 column reflects the FY 2003 President's Budget Submit (PBS) as Amended. The Change column includes both programmatic and full cost adjustments. FY 2004 column is in full cost.

| THEME: | Earth Science Applications |
|---|---|
| **RESEARCH:** | **National Applications Program** |

## PURPOSE

| Objectives | Reference 2003 Strategic Plan | Performance Measures |
|---|---|---|
| 1.2, 3.1 | | 4ESA1, 4ESA5 |

The National Applications Program extends the use of Earth observations beyond the purpose of increasing knowledge of the Earth system into practical applications of the knowledge. The Program makes significant contributions to the President's Management Agenda, the E-Government initiative, and the Climate Change Research Initiative (CCRI) and will contribute to the education and workforce development objectives of the Administration, the Agency, and the Earth Science Enterprise. The program serves the NASA vision "to improve life here" and the NASA mission "to understand and protect our home planet."

## OVERVIEW

Our Nation is challenged to manage resources to support economic security. In priority applications including energy forecasting, aviation safety, and agricultural competitiveness, it is important that we have sound data and analysis to provide decision makers with the best available information. The focus of the National Applications Program is to work with partner agencies, including USDA, FEMA, EPA, NOAA, USGS, CDC, NIH, OHS, DoD, DOE to improve predictions of weather, climate and natural hazards using NASA Earth science research and development in those agencys' operational decision support systems. NASA contributes systems engineering, human capital development, and science expertise, along with Earth science observations and predictions to these efforts. In addition, our applications program supports many other important activities across the government, including homeland security, forestry, land management, disaster relief, and other national priorities. We fund demonstrations with other agencies for fixed periods of time in order to address practical challenges facing many agencies, making a unique contribution. Once demonstrated, we hand those applications over for operational use to the implementing agencies. Project-level and systems-level solutions are solicited through Cooperative Agreement Notices such as the Research, Education and Applications Solutions Network (REASoN) and the GLOBE competitive sourcing solicitation.

Link to Project Homepage for more information: http://gaia.hq.nasa.gov/eseapps/

## PROGRAM MANAGEMENT

The Earth Science Applications program is managed from HQ with performing center activity at Stennis Space Center, Goddard Space Flight Center and Langley Research center. Enterprise official is Dr. Ghassem Asrar, Associate Administrator for Earth Science at HQ. Theme Director and Program Point of Contact is Ronald J. Birk, Director for Applications at HQ. This program is in full compliance with NPG7120.5B.

## TECHNICAL COMMITMENT

This is baselined for the FY 2004 budget. A systems-based implementation plan will baseline this commitment.

| Technical Specifications | FY04 President's Budget | Change from Baseline |
|---|---|---|
| National Applications Program | Benchmark the process of assimilating observations from missions and predictions from models into decision support systems (DSS) as listed below. (Benchmarking involves systematically determining the improvements to decision support processes that are enabled by NASA results.) | |
| **Agency** | **Decision Support System** | |
| Environmental Protection Agency | CMAQ Air Quality DSS - Community Model for Air Quality | -- |
| Fed Emergency Mgmnt Agency | HAZUS Disaster Management DSS | -- |
| Cts for Disease Cont/ Nat Inst. of Health | EHTN Public Health DSS | -- |
| Office of Homeland Security | Homeland Security Situation Center | -- |
| Environmental Protection Agency | State Implementation Plan (SIP) Community Growth DSS | -- |
| Department of Agriculture | Carbon Management DSS | -- |
| Department of Agriculture | Agricultural Competitiveness DSS | -- |
| Geological Survey - USGS | Biological Invasive Species DSS | -- |
| Bureau of Reclamation - USGS/BoR | BoR RiverWare Water Management DSS | -- |

| THEME: | Earth Science Applications |
|---|---|
| **RESEARCH:** | National Applications Program |

## TECHNICAL COMMITMENT (continued)

| Technical Specifications (continued) | FY04 President's Budget | Change from Baseline |
|---|---|---|
| **Agency** | **Decision Support System** | |
| Federal Aviation Administration | National Airspace System DSS | -- |
| Department of Energy | Natural Renewable Energy Laboratory DSS | -- |
| Nat Oceanic and Atmospheric Admin | Harmful Algal Bloom Coastal Management DSS | -- |

| Schedule | | FY04 President's Budget | Change from Baseline |
|---|---|---|---|
| Projects in FY04 include: | | | |
| USDA/Agricultural Competitiveness | Jan-03 | Decision Support System (DSS) Benchmark complete | |
| EPA/Air Quality | Nov-03 | DSS Benchmark complete | -- |
| FAA/National Airspace System | Jun-04 | National Applications Benchmark complete | -- |
| CDC/NIH/ Public Health | Jan-04 | National Applications Benchmark complete | -- |

## ACQUISITION STRATEGY & PERFORMING ORGANIZATIONS

The acquisition strategy is based on two primary components: 1) Competitive sourcing, 2) Space Act Agreements. Performing organizations include NASA field centers (Stennis Space Center, Goddard Space Flight Center, Langley Research center, Marshall Space Flight Center, Ames Research Center, Jet Propulsion Lab) partnering agencies, and competitively selected organizations.

| Current Acquisitions | Actual * | Selection Method | Actual * | Performer | Actual * |
|---|---|---|---|---|---|
| Cooperative Agreements | 11% | Full & Open Competition | 80% | Industry | 15% |
| Cost Reimbursable | 0% | Sole Source | 20% | Government | |
| Fixed Price* | 2% | | 100% | NASA Intramural | 30% |
| Grants | 66% | | | University | 50% |
| Other | 21% | Sci Peer Review | 95% | Non Profit | 5% |
| * as % of FY02 direct procurement | 100% | * as % of FY02 direct procurement | | | 100% |

| Future Acquisitions - Major | Selection | Goals |
|---|---|---|
| REASoN Cooperative Agreement Notice (CAN) | Jan 05 | 100% Full & Open Competition. |

## AGREEMENTS

*Internal:* The program has a component that is dependent on, and benefits, the aviation safety program in the Office of Aerospace Technology.
*External:* MOUs with with USDA, NOAA, USGS, EPA, DoD, USFS, DOE, WGA, FEMA.
*International:* UNESCO, IAA, CCAD, CEOS, CENR. **Changes since FY 2003 Pres. Budget: None.**

## INDEPENDENT REVIEWS

| Types of Review | Performer | Last Review | Next Review | Purpose |
|---|---|---|---|---|
| Indep Annual Review | ESSAAC | 2-Jun-02 | 3-Jun-03 | Alignment with Enterprise Strategy. |
| Nat'l Academy of Sciences | SSB | 2-Sep-02 | 3-Jun-05 | Alignment with Enterprise Strategy. |

## BUDGET

| Budget Authority ($ in millions) | FY02 | FY03 | FY04 | Comments |
|---|---|---|---|---|
| FY 2004 President's Budget | 39.3 | 20.8 | 24.0 | |
| Applications Research | 33.7 | 15.4 | | |
| National Applications | | | 17.5 | |
| Program Planning and | 5.6 | 5.4 | 6.5 | |
| Changes since FY 03 Pres. Budget | +0.0 | +0.0 | +5.2 | ***Reason for Change:*** |
| National Applications | | | +13.3 | New budget structure. |
| Applications Research | | | -13.3 | |
| Full cost | | | +5.2 | Inclusion of full cost. |

Indicates budget numbers in Full Cost.
Indicates changes since the FY 2003 Presidents Budget Submit.
FY 2002 and FY 2003 are not in full cost.

| THEME: | Earth Science Applications |
|---|---|
| **RESEARCH:** | **Earth Science Education** |

## PURPOSE

| Objectives | Reference 2003 Strategic Plan | Performance Measures |
|---|---|---|
| 6.2,7.2 | | 4ESA6, 4ESA7, 4ESA8 |

The Earth Science Education Program enables an accessible, dynamic, and engaging learning environment for all citizens that expands and deepens the Nation's awareness and understanding of Earth system science and inspires pursuit of careers in science and technology development.

## OVERVIEW

The Earth Science Education Program extends NASA's results in the research and development of Earth science, remote sensing, and information technologies to enhance the teaching and learning of Earth and environmental sciences both inside and outside the classroom through partnerships with educational institutions and organizations. The Program makes the discoveries and knowledge generated by Earth science accessible to students and the public via Outreach efforts by focusing on the national education agenda and the needs of the learning communities. The Program focuses on K-16 curriculum and faculty support in science, mathematics, and geography; professional development in informal education venues; as well as continuing training of interdisciplinary scientists to support the study of the Earth as a system through its Fellowship and New Investigators efforts.

Link to Project Homepage for more information: http://earth.nasa.gov/education/catalog/index.html

## PROGRAM MANAGEMENT

The Earth Science Education program is managed from HQ with performing entities at Goddard Space Flight Center, Jet Propulsion Lab, Stennis Space Center, and Langley Research Center, as well as external education organizations (through grants or cooperative agreements). Enterprise official is Dr. Ghassem Asrar, Associate Administrator for Earth Science at HQ. Theme Director is Ronald J. Birk, Director of Earth science Applications Division. Point of Contact is Ming-Ying Wei, Earth Science Education Program Manager.

## TECHNICAL COMMITMENT

The baseline for this technical commitment is the FY 2004 budget. A systems-based implementation plan will baseline this commitment.

| Technical Specifications | **FY04 President's Budget** | **Change from Baseline** |
|---|---|---|
| GLOBE Program | Continue Worldwide implementation and U.S. coordination, in partnership with the National Science Foundation. | -- |
| Virtual Earth | Systems architecture designed to deliver compelling teaching tools for teachers and students of all ages. | -- |
| K-16/Informal Education Program | Integrate and coordinate educational projects selected under the REASoN solicitation. | -- |
| Earth System Science Fellowship Prgm | Support graduate students in pursuit of Master or Ph.D. degrees in Earth System Science applications. | -- |
| Investigator Program | Continue research and educational support for current projects and Earth scientists and/or engineers, and solicit new applications. | -- |

| Schedule | **FY04 President's Budget** | **Change from Baseline** |
|---|---|---|
| GLOBE | | |
| -Worldwide Implementation and U.S. Country Coordinator | -Selection in Mar-03 and Awards placement in Dec-03. | -- |
| Virtual Earth | -Community review of systems design architecture in Sep-3. | -- |
| K-16/Informal Education Program | -Solicitation Nov-02, Selection May -03, Awards in Jun-03. | -- |
| Earth Syst. Science Fellowship Prgm | -Solicitation Dec-02, Selection Jun-03, Awards in Sept-03. | -- |
| Investigator Program | -Solicitation Mar-03, Selection Dec-03, Awards in Jan-04. | -- |

**THEME:** Earth Science Applications

## RESEARCH: Earth Science Education

### ACQUISITION STRATEGY & PERFORMING ORGANIZATIONS

The acquisition strategy is based on two primary components: 1) Competitive sourcing, 2) Space Act Agreements. Performing organizations include NASA field centers (Stennis, Goddard, Langley, Marshall, Ames, JPL), research laboratories, partnering agencies, and competitively selected organizations.

| Current Acquisitions | Actual * | Selection Method | Actual * | Performer | Actual * |
|---|---|---|---|---|---|
| Cooperative Agreements | 3% | Full & Open Competition | 80% | Industry | 4% |
| Cost Reimbursable | 0% | Sole Source | 20% | Government | 0% |
| Fixed Price* | 43% | | 100% | NASA Intramural | 23% |
| Grants | 37% | | | University | 73% |
| Other | 17% | Sci Peer Review | 95% | Non Profit | 0% |
| * as % of FY02 direct procurement | 100% | * as % of FY02 direct procurement | | * as % of FY02 direct procurement | 100% |

| Future Acquisitions - Major | Selection | Goals |
|---|---|---|
| REASoN Cooperative Agreement Notice (CAN) | Jan 05 | 100% Full & Open Competition |
| GLOBE | Mar 03 | 100% Full & Open Competition |
| Fellowships | Jun 03 | 100% Full & Open Competition |

### AGREEMENTS

*Internal:* The program has a component that is dependent on, and benefits, the Agency Education programs in the Office of Education and Office of Space Science.

*External:* Department of Education, Department of Labor, National Science Foundation, Partner Federal Agency Education Programs

*International:* International participation of over 100 countries in the GLOBE Education program.

**Changes since FY 2003 Pres. Budget: None.**

### INDEPENDENT REVIEWS

| Types of Review | Performer | Last Review | Next Review | Purpose |
|---|---|---|---|---|
| Indep Peer review | ESSAAC | Nov 2002 | Nov 2003 | Alignment with NASA and Enterprise Strategy. |
| Nat'l Academy of Sciences | SSB | Sep 2002 | Jun 2005 | Alignment with NASA and Enterprise Strategy. |

### BUDGET

| Budget Authority ($ in millions) | FY02 | FY03 | FY04 | Comments |
|---|---|---|---|---|
| FY 2004 President's Budget | 17.5 | 18.1 | 20.8 | |
| Earth Science Education | 9.1 | 9.1 | 11.4 | |
| Fellowships & New Investigator | 7.4 | 8.0 | 8.4 | |
| Outreach | 1.0 | 1.0 | 1.0 | |
| Changes since FY 03 Pres. Budget | +0.0 | +0.0 | +3.6 | ***Reason for Change:*** |
| Full cost | | | +3.6 | Inclusion of Full Cost. |

Indicates budget numbers in Full Cost.

Indicates changes since the FY 2003 Presidents Budget Submit.

FY 2002 and FY 2003 are not in full cost.

| THEME: | Earth Science Applications |
|---|---|
| **TECHNOLOGY AND ADVANCED CONCEPTS:** | Cross Cutting Solutions |

## PURPOSE

| Objectives | Reference 2003 Strategic Plan | Performance Measures |
|---|---|---|
| 1.2 | | 4ESA2, 4ESA3, 4ESA4 |

The Cross Cutting Solutions effort delivers science and engineering capabilities to partner organizations, enabling them to use NASA's research results and technologies in their decision support systems. A component of this provides human capital development focused on the unique aspects of applying Earth science results in national and international decision support solutions.

## OVERVIEW

The Cross Cutting Solutions program provides four core elements: 1) systems engineering; 2) solutions networks; 3) geospatial interoperability, and; 4) human capital development. The systems engineering capability provides the core competencies in NASA systems and science that are required to assimilate Earth science results into the decision support tools of partnering organizations. Decision support tools used to protect life and property require rigorous validation of new sources of data and information. The systems engineering element verifies, validates, and benchmarks the performance of solutions that are based on NASA Earth science observations and predictions. (The benchmark process involves a rigorous determination of change in performance resulting from change in process). The geospatial interoperability element supports the President's E-government initiative (Geospatial One Stop) in developing and promulgating standards, including interoperability standards, for geospatial data and systems. The human capital development element of the program enables the next generation of decision makers to effectively develop and use advanced tools that assimilate NASA results. The solutions network element enables competitively selected collaborations to deliver results to our nation including data sources, data products, data handling systems, and models and decision support system - moving from research to operations.

Link to Project Homepage for more information: http://www.esa.ssc.nasa.gov

## PROGRAM MANAGEMENT

The Cross-Cutting Solutions Program is managed in the Earth Science Applications Division at HQ with performing activity at the Stennis Space Center and the Goddard Space Flight Center. The Agency Program Management Council (PMC) has governing responsibility. Enterprise official is Dr. Ghassem Asrar, Associate Administrator for Earth Science at HQ. Theme Director and Program Point of Contact is Ron Birk, Director for Earth Science Applications at HQ. This program is in full compliance with NPG7120.5B.

## TECHNICAL COMMITMENT

The baseline for this technical commitment is the FY 2004 budget.

| Technical Specifications | FY04 President's Budget | Change from Baseline |
|---|---|---|
| Systems Engineering | Evaluate, verify, validate and benchmark the assimilation of observations and predictions from science missions and models into decision support systems serving applications of national priority. | -- |
| Solutions Networks | Provide networks of systems solutions in support of the Nat'l Applications and Education programs and their respective objectives. | -- |
| Geospatial Interoperability | Develop and deploy standards for geospatial information and systems in support of the President's e-government initiative, NASA, the Earth Science Enterprise, and science-based solutions in partnership with federal agencies. | -- |
| Human Capital Development | Accelerate human capital development to enable workforce capacity building approaches associated with Earth science and remote sensing solutions for decision support. Provide systems tools to undergraduate-level students to develop prototype solutions for state, local and tribal governments based on Earth Science results. | -- |

## TECHNICAL COMMITMENT - CONTINUED

| Schedule | FY04 President's Budget | Change from Baseline |
|---|---|---|
| Geospatial Interoperability | | |
| Open Geographic Information System (OGIS) Standard | Dec-04 | -- |
| Geospatial One-Stop portal | Apr-05 | -- |
| Systems Engineering | | |
| 2 commercial products verified and validated | Jan-05 | -- |
| 2 decision support systems benchmarked | Jun-05 | -- |
| Earth Science Applications Centers | | |
| 10 solution projects selected through REASoN | Jan-05 | -- |
| Mississippi Space Commerce Initiative | | |
| Engagement | Mar-05 | -- |
| Engagement with 4 national priority projects | Sep-05 | -- |
| Workforce Development E-gov modules | | |
| 5 modules complete | Jan-05 | -- |
| 10 modules complete | Sep-05 | -- |
| DEVELOP students & states | | |
| 2 states added | Mar-05 | -- |
| 3 states added | Sep-05 | -- |

## ACQUISITION STRATEGY & PERFORMING ORGANIZATIONS

The acquisition strategy is based on two primary components: 1) Competitive sourcing; 2) Space Act Agreements. Performing organizations include NASA field centers (Stennis Space Center, Goddard Space Flight Center, Langley Research Center, Marshall Space Fligfht Center, Ames Research Center, Jet Propulsion Lab) partnering agencies, and competitively selected organizations.

**Changes since FY 2003 Pres. Budget: None.**

| Current Acquisitions | Actual * | Selection Method | Actual * | Performer | Actual * |
|---|---|---|---|---|---|
| Cooperative Agreements | 8% | Full & Open Competition | 80% | Industry | 20% |
| Cost Reimbursable | 0% | Sole Source | 20% | Government | 0% |
| Fixed Price* | 28% | | 100% | NASA Intramural | 30% |
| Grants | 20% | | | University | 40% |
| Other | 44% | Sci Peer Review | 95% | Non Profit | 10% |
| * as % of FY02 direct procurement | 100% | * as % of FY02 direct procurement | | * as % of FY02 direct procurement | 100% |

| Future Acquisitions - Major | Selection | Goals |
|---|---|---|
| 1. REASoN Cooperative Agreement Notice | Jan 05 | 100% Full & Open Competition. |

| THEME: | Earth Science Applications |
|---|---|
| **TECHNOLOGY AND ADVANCED CONCEPTS:** | Cross Cutting Solutions |

## AGREEMENTS

*Internal:* Agreements with Stennis Space Center, Langley Research Center, Goddard Space Flight Center, Marshall Space Flight Center, Jet Propulsion Lab, Ames Research Center and Dryden Flight Research Center.
*External:* Agreements with President's e-Government initiative on Geospatial One-Stop, member of Joint Agency Committee for Imagery Evaluation (JACIE) with USGS and NIMA, member of Open GIS Consortium, Federal Geographic Data Committee, partners in the DEVELOP program.
**Changes since FY 2003 Pres. Budget: None.**

## INDEPENDENT REVIEWS

| Types of Review | Performer | Last Review | Next Review | Purpose |
|---|---|---|---|---|
| Independent Peer Review | ESSAAC | Nov 2002 | Nov 2003 | Ensure consistency with ESE mission. |
| National Academy of Sciences | NAS | 2-Jun-02 | 2-Jun-04 | Review commitment to partnerships. |

## BUDGET

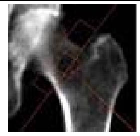
| Budget Authority ($ in millions) | FY02 | FY03 | FY04 | Comments |
|---|---|---|---|---|
| FY 2004 President's Budget | 37.9 | 22.8 | 30.0 | |
| Applications Development | 37.9 | 22.8 | | |
| Cross cutting solutions | 0.0 | 0.0 | 30.0 | |
| Changes since FY 03 Pres. Budget | +0.0 | +0.0 | +4.3 | ***Reason for Change:*** |
| Cross Cutting Solutions reduction | | | -6.0 | Program reorganization. |
| Full cost | | | +10.3 | Inclusion of full cost. |

Indicates budget numbers in Full Cost.
Indicates changes since the FY 2003 Presidents Budget Submit.
FY 2002 and FY 2003 are not in full cost.

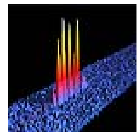
## ENTERPRISE: Biological and Physical Research

Peggy Whitson, the International Space Station's first Science Officer, inspects soybean plants in the Advanced Astroculture plant growth chamber. She dried these plants and beans, and the Space Shuttle Atlantis returned them to Earth. Researchers in NASA, academia, and industry are studying the first-ever soybean crop grown on the Station to understand how microgravity influences its growth and development, and whether such influence may yield unique and desirable traits.

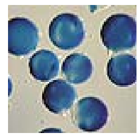
**THEMES**



**Biological Sciences Research**



**Physical Sciences Research**



**Research Partnerships and Flight Support**

# BIOLOGICAL AND PHYSICAL RESEARCH

**PURPOSE**

As humans take the first steps into space, we have a new opportunity to explore profound questions about the laws of nature. At the same time, we enter an environment unique in our evolutionary history that poses serious medical and environmental challenges. NASA's Biological and Physical Research (BPR) Enterprise addresses the opportunities and challenges of space flight through basic and applied research on the ground and in space. The program pursues answers to a broad set of scientific questions that support NASA's goals to explore the fundamental principles of physics, chemistry, and biology through research in space and to extend the duration and boundaries of human space flight to create new opportunities for scientific exploration and discovery. The outcomes of this research include fundamental scientific progress and safer, more efficient space travel. BPR implements its program through three budget themes described below.

In FY 2002, a task force of the NASA Advisory Council performed an independent review and assessment of research productivity and priorities for the entire scientific, technological, and commercial portfolio of BPR. The Council formed a Research Maximization and Prioritization Task Force (ReMaP) that recommended a series of priorities across research disciplines. This review was based upon past performance in these disciplines as presented by BPR and examination of a substantial body of existing reports from the National Research Council. NASA's FY 2004 budget for BPR focuses on research areas identified as high priority by the Research Maximization and Prioritization Task Force. It expands planned biomedical research and countermeasures experiments, including a new Human Research Initiative. It initiates a limited flight program in high priority advanced human support technology and places additional emphasis on physical science research, including applications to human space flight. It also reinstates funding for plant and animal habitats for planned centrifuge research on the International Space Station (ISS). As development of the ISS continues, BPR is expanding research activities and continuing to develop research equipment for the ISS. Development will be completed on facilities for materials science research and fluid physics research and on racks that will eventually house the habitats for plant and animal specimens for biological research.

Implementing ReMaP priorities in the FY 2004 budget is a crucial first step in a longer-term planning and prioritization process including 5-year, 10- year, and strategic planning. BPR has responded to NASA's new Strategic Plan by adopting a 5-year direction consistent with overall agency Vision, Mission, and goals. This direction identifies major research thrusts and the management changes required to support these thrusts. BPR has developed a 10-year research plan that addresses BPR's role within the NASA Strategic Plan by establishing a focused set of organizing questions and supporting top-level roadmaps that will drive BPR research. The 10-year plan has been drafted in consultation with outside advisors and will be subject to additional scientific review. Over the budget development cycle that begins in 2003, BPR will engage its scientific community in developing more detailed interdisciplinary roadmaps, which will be guided by the 10-year plan. These roadmaps will form the basis for a BPR plan that will serve as the guiding document for future research solicitation, selection, and implementation in support of NASA's Vision, Mission, and goals.

## FY 2002 ACCOMPLISHMENTS

FY 2002 saw a major increase in research productivity on the ISS as construction and outfitting of the Station progressed. We added three equipment experiment racks to the orbiting laboratory. Researchers on the Station used this and previously installed racks to conduct 48 science and technology development experiments. Experiments in biological and physical science fields included 11 (26.2 percent) in Human Life Sciences, 24 (57.1 percent) in Physical Sciences, and 7 (16.7 percent) in Space Product Development. Astronauts conducted the first materials science research on the ISS, tested medical procedures for controlling the negative effects of space flight, deepened our understanding of changes to bone and the central nervous system that occur in space, conducted advanced cell culturing research, and broke new ground in the study of dynamic systems made up of tiny particles mixed in a liquid (colloids).

The Physics of Colloids In Space experiment provided new information about the development and dynamics of colloid materials. Colloids are mixtures of very small particles suspended in a liquid; paint and toothpaste are both usually made of colloids. Physicists studying colloids in space are exploring the processes by which particles in colloids arrange themselves into regular patterns, or crystal lattices. These researchers report that they have observed significant phenomena on the ISS never observed on Earth. These findings may improve future telecommunications networks and displays that use optical switches, filters, and lasers to store, transfer, and process information. Other potential uses include improvements in the shelf life of common products made of colloids, including paints, cosmetics, and foods.

NASA and the biotechnology research company, StelSys, LLC, teamed up to test how human liver cells function in the microgravity environment aboard the Station and to compare this to the function of such cells on Earth. The scientists grew cells in a cell culturing apparatus onboard the Station, froze them, and sent them to researchers on Earth. Researchers at StelSys are comparing the micro anatomical, biochemical, and molecular genetic properties of the samples from ISS with those of ground controls. This experiment will provide unprecedented information about how microgravity affects human liver cell function, including insights into how to preserve the health of humans living and working in space.

## THEME DISTRIBUTIONS

| Budget Authority ($ in millions) | FY 2002 | FY2003 President's Budget, As Amended | FY2004 President's Budget |
|---|---|---|---|
| Biological Sciences Research | 218.0 | 245.1 | 358.6 |
| Physical Sciences Research | 227.4 | 247.2 | 353.2 |
| Research Partnerships and Flight Support | 196.9 | 169.5 | 260.9 |
| Institutional (includes Agency Health and EOS) | 181.7 | 180.5 | 0.0 |
| Total | 824.0 | 842.3 | 972.7 |

Note: For all formats, the FY 2002 column reflects the FY 2002 Congressional Operating Plan dated 9/30/02. The FY 2003 column reflects the FY 2003 Presidents Budget Submit (PBS) as Amended. FY2004 column is in full cost.

# ENTERPRISE: Biological and Physical Research

## Biological Sciences Research

Within this theme, we determine ways to support a safe human presence in space. Space flight exposes humans to physiological and psychological health risks from radiation, reduced gravity, and isolation. We are researching how to define and control these risks. This theme also conducts research and development to improve the performance of life support systems. It includes a basic biology research component that seeks both to pursue fundamental biological research questions from cell to tissues to whole organisms, which produce results that can support advanced methods for enabling human exploration of space. Highlights for FY 2004 include:

**Overall budget**

FY 2004 request is $359 million, a $55 million or 18 percent increase over FY 2003 President's Request (full cost):

- $210 million for Bioastronautics Research. In response to ReMAP prioritization, expands planned ground research program in countermeasures development by $27 million, which includes an increase of approximately $20 million in funding for the National Space Biomedical Research Institute from $10 million to $30 million and a $7 million increase through the new Human Research Initiative. The initiative also starts a flight program in high priority areas of advanced human support technology by adding $18 million.

- $149 million for Fundamental Space Biology. In response to ReMAP prioritization, adds $20 million for habitat holding rack development, cell culture unit and ground based research, and animal and plant habitats for research on the Space Station Centrifuge.

- Adds $12 million to ensure adequate levels of reserves for Space Station hardware development and research operations.

**New Initiative – Human Research Initiative**
Request includes $39 million for this new initiative ($347 million over five years). Of the total, $25 million is directed towards Biological Science Research ($283 million over five years) and $14 million towards Physical Sciences Research ($64 million over five years). Goals include:

- Certify crew safety for missions beyond low Earth orbit over 100 days by mitigating the highest risks.

- Enable knowledge and technology to reduce mass to orbit and beyond for life support by a factor of three by 2010.

## Physical Sciences Research

This theme supports research that takes advantage of the unique environment of space to expand our understanding of the fundamental laws of nature. We also support applied physical science research to improve safety and performance for human exploration and research that has applications in terrestrial industry. Highlights for FY 2004 include:

**Overall budget**

FY 2004 request is $353 million, a $2.0 million or 0.6 percent increase over FY 2003 President's Request (full cost):

- Responds to the ReMaP prioritization external study by realigning Physical Sciences Research funds. Provides adequate funding and reserve levels for the major PSR International Space Station Research Capability Development facility class space flight hardware, while reducing funding for lower priority areas such as bimolecular technology, and structural biology future facility class space flight hardware, and level II program management support. Increases funding for research of strategic importance to NASA's long-range goals, including radiation protection and basic research in power and propulsion technologies. Rephased deployment of Low Temperature Microgravity Physics Facility consistent with the availability of the Japanese Experiment Module (JEM) Exposed Facility.

- Reallocates $11 million in FY 04 reserves to ensure adequate levels of reserves for Space Station hardware development (Fluids and Combustion Facility, Low Temperature Microgravity Physics Facility, and Materials Science Research Rack) and research operations.

- Reallocates $28 million for Space Station research equipment initial deployment of the Combustion Integration Rack (CIR) component of the Fluids and Combustion Facility ($22 million) and Materials Science Research Rack (MSRR) ($6 million).

## Research Partnerships and Flight Support

This theme establishes policies and allocates space resources to encourage and develop research partnerships in the pursuit of NASA missions and Enterprise scientific objectives. This research supports product development on Earth and leverages industry resources to accelerate progress in our strategic research areas. Ultimately, research partnerships may support development of an infrastructure that can be applied to human exploration. Highlights for FY 2004 include:

**Overall budget**

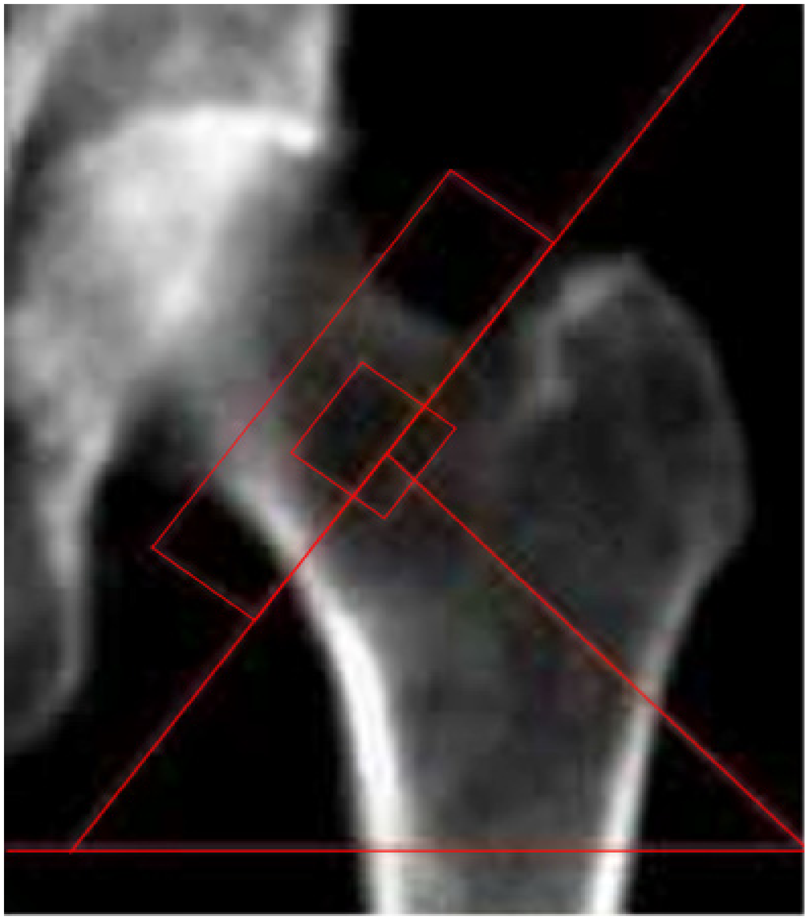
FY 2004 request is $261 million, a $6.8 million or 2.7 percent increase over FY 2003 President's Request (full cost):

- $49 million for Space Product Development. Restructures program by aligning industrial partnerships with NASA mission needs and Enterprise scientific objectives. Will review the existing research partnership centers to determine those centers to be retained. The focus will remain on the flight program.

- As part of FY 2003 Budget Amendment, provides funding for additional research/logistics missions to Space Station beginning in FY 2006. Of the total $113 million over five-years added to budget for these research missions, Space Product Development has $4 million over five years and Multi-User Systems and Support has $93 million. The remaining $16 million is distributed between Biological Sciences Research and Physical Sciences Research.

- $212 million for Multi-User Systems and Support funding.

- Space Product Development budget was augmented by two activities: (1) the transfer of the Anti-Matter Spectrometer program management and budget from Physical Sciences Research; and (2) the consolidation of the Enterprise Support program content and budget, previously diffused across various programmatic components.



People lose bone mass when they spend time in space, but not evenly. Weight bearing bone tends to lose more mass. NASA is studying the specific locations in the skeleton that are most severely affected. Preliminary findings indicate that loss of bone in the hip is three times greater than the average value for the spine. This research helps to identify the risk of bone fractures that astronauts face and may contribute to understanding of mechanisms and potential treatments for bone loss among aging populations on Earth.

# BIOLOGICAL SCIENCES RESEARCH

## MAJOR EVENTS IN FY 2004

- 25 biological sciences flight experiments scheduled to be conducted on the Space Shuttle and Space Station.
- Habitat Holding Rack flight hardware available by September 2004.

## THEME: Biological Sciences Research

### OVERVIEW

Biological Sciences Research includes strategic research that is required to support development of procedures and technologies that ultimately will insure the health, safety and efficient suport of human crews in space; fundamental research that will enable understanding of how animals and plants respond to gravity and its "absence" in space flight; and projects to develop new technologies that will improve space flight life support systems.

Biology research in space gives scientists the capacity to examine the role that gravity and other space environmental factors play in life processes. Just as studying life's interaction with other environmental factors, such as light and oxygen, has given us fundamental insights into life's inner workings, the lack of gravity will also serve as a powerful means of studying the fundamental mechanisms of living processes. To date, we have only limited understanding of how gravity interacts with life processes at the molecular, cellular, systems or behavioral levels. Space provides a unique environment to probe the last frontier of how the physical environment has shaped life on Earth.

| Missions | Goals supported by this theme | Objectives supporting those goals — Reference 2003 Strategic Plan |
|---|---|---|
| Explore the Universe and Search for Life | 4. Explore the fundamental principles of physics, chemistry, and biology through research in the unique natural laboratory of space. | 4.1 Understand how life responds to the space environment and the role of gravity in the processes of life. |
| Inspire the Next Generation of Explorers | 6. Inspire and motivate students to pursue careers in science, technology, engineering, and mathematics. | 6.1 Improve student proficiency in science, technology, engineering, and mathematics by creating a culture of achievement using educational programs, products and services based on NASA's unique missions, discoveries and innovations.<br>6.3 Enhance science, technology, and mathematics instruction with unique teaching tools and experiences that are compelling to educators and students as only NASA can provide. |
| | 7. Engage the public in shaping and sharing the experience of exploration and discovery. | 7.2 Engage the public in NASA missions and discoveries, and their benefits, through such avenues as public programs, community outreach, mass media, and the internet. |
| Space Flight Capabilities | 9. Extend the duration and boundaries of human space flight to create new opportunities for exploration and discovery. | 9.1 Understand and control the human health risks of space flight.<br>9.2 Develop knowledge and technologies to make life support systems self sufficient and improve human performance in space. |

### RELEVANCE

Access to space affords researchers an exciting opportunity for conducting unique biological research at all levels of biological complexity. Studies of the response and adaptation of cells and organisms (e.g., bacteria, insects, plants, and animals) to space will result in new insights into the effects of gravity and other space environment characteristics on biological processes. This knowledge will directly contribute to many aspects of NASA's strategic goal of exploration by providing critical knowledge about the biological mechanisms underlying the human health risks associated with space flight. In addition, novel information about general principles that regulate biological systems in space will provide fundamental knowledge regarding general biological processes with many applications on Earth. Beyond the response and adaptation of individual organisms to space, long duration exposures to space provide the first opportunity to study how organisms respond to this new environment through complete life cycles and over multiple generations. This research will begin to unravel the intriguing question: What is the capacity of life to adapt and thrive as it ventures off the home planet for more extended periods of time?

## THEME: Biological Sciences Research

Human space flight is inherently risky. Crew health drives the ability to maintain the International Space Station and to perform experiments on the ISS and beyond. A key element of our strategic research is specifically established to focus on applied biomedical and human support research to reduce risk and improve safety through developing countermeasures. This includes integrating science and medical research to generate the knowledge required to enable flight crews to leave Earth, and eventually low-Earth orbit, perform their assigned tasks, and return to Earth with their health intact. This also includes sponsoring research to develop therapeutics, procedures, techniques, and equipment needed to address flight medical, safety, and performance issues.

| Education and Public Benefits |
| --- |
| Biological sciences research generates knowledge that promotes understanding of basic biological principles leading to advances in avoiding or eradicating debilitating diseases and physical conditions. Public benefits are gained from development of health-related technologies and processes never before possible.<br>Biological sciences research promotes academic excellence by engaging teachers and students in challenging, relevant space research experiences that provide practice and application of standards-based science, math, and technology concepts. Educational benefits include improvement in science proficiency of educators, availability of unique, space research-related teaching tools and techniques, and increased numbers of students selecting math, science, and technology courses and careers. |

## THEME: Biological Sciences Research

### IMPLEMENTATION

The Enterprise Official for the Biological Sciences Research Theme is Mary Kicza, Associate Administrator for Biological & Physical Research. The HQ Acting Division Director for Fundamental Space Biology is David Liskowsky. The Fundamental Space Biology (FSB) Program is managed and implemented by the Ames Research Center (ARC) under the authority of the ARC Fundamental Biology Program Office. The Center Responsible Officials at ARC are Mel Averner and Gary Jahns. The HQ Acting Division Director for Bioastronautics Research is Guy Fogleman. The Bioastronautics Research (BR) Program coordination responsibility is assigned to the Johnson Space Center (JSC), under the supervision of Dr. John Rummel, Chief, Office of Bioastronautics. The Center Responsible Officials at JSC are Cindy Haven, Bill Paloski, and David Russo.

| Strategy | Schedule by Fiscal Year (96 97 98 99 00 01 02 03 04 05 06 07 08 09 10) | Purpose |
|---|---|---|
| Passive Dosimeter System | | Measures biologically active space radiation at specific experiment locations. |
| Avian Development Facility | | Supports experiments that use non-mammalian amniotic eggs. The facility uses a low-gravity environment to determine the effects on the life-cycle development of organisms. |
| Biomass Production System | | Developed as a precursor for systems capable of supporting plant growth and botanical experimentation in microgravity for extended periods of time on board the ISS. |
| Habitat Holding Rack No. 1/ Qual Rack | | Provides the functional support services required by each subrack payload. Also provides a passive vibration control system to protect the payloads from ISS vibration. |
| Incubator | | A temperature-controlled chamber for conducting life science research with animal, plant and microbial specimens. |
| Insect Habitat | | Designed to support experiments for a variety of insect species. The facility uses a low-gravity environment to determine the effects on the life-cycle development of multi-generational organisms. |
| Life Sciences Glovebox (LSG) | | A sealed work area that provides bioisolation waste control where crew members perform experimental procedures; provided by an ISS Barter Offset Agreement with the National Space Development Agency of Japan. |
| Centrifuge (CR) | | Supports a variety of habitat types and provides a selectable, simulated gravity environment for biological specimens. |
| Fundamental Space Biology Research | | Provides research grants for the study of life-science research in a weightless on-orbit environment. |
| Human Research Facility 1 | | Enables a systematic study of human physiological, behavioral and chemical changes induced by space flight. |
| Human Research Facility 2 | | Similar to the HRF 1, but offers additional rack configurations and other technical options not available on the HRF 1. |
| Bioastronautics Research | | Provides research grants for the systematic study of human physiological, behavioral and chemical changes induced by space flight. |

Research   Development   Operations

## THEME: Biological Sciences Research

### STATUS

During FY 2002, the Fundamental Space Biology (FSB) Program supported 158 investigations; released a solicitation for ground based research resulting in the selection of 22 proposals for funding; proceeded with the initial planning for early ISS utilization; selected and developed for flight a study which will investigate the skeletal system in space and development of countermeasures to bone loss in space flight crews, and a series of experiments which will study genomic changes associated with space flight.

During FY 2002, the Bioastronautics Research (BR) Program conducted protocols for flight testing countermeasures to reduce kidney stone risk; developed an investigation of crew nutritional needs and metabolism status; prepared in-flight validation of cardiovascular countermeasures; evaluated and provided annual report of the progress in reducing medical risk factors; selected 5 ground based experiments and 3 flight based experiments related to the reduction of medical risk factors. The program was part of an independent review by the Research Maximization and Prioritization (ReMaP) Task Force. The efforts offered NASA a stronger understanding of what research portfolios offered the highest potential scientific return.

Go to: http://spaceresearch.nasa.gov/research_projects/FSB.html
http://spaceresearch.nasa.gov/research_projects/biomedical.html
http://spaceresearch.nasa.gov/research_projects/ahst.html

## THEME: Biological Sciences Research

### PERFORMANCE MEASURES

Annual Performance Goals

**Outcome 4.1.1:** Describe and determine the ability of life to adapt and thrive in the space environment.

**4BSR1**: Advance understanding of the role of gravity in biological processes at all levels of biological complexity. FY 04 activities will include soliciting ground-based research in all Fundamental Biology disciplines, planning for increased early ISS utilization for basic biology research in the 2005 and beyond time frame, and maintaining an open, competitive program in fundamental space biology.

**Outcome 6.1.1:** Kindergarten through graduate students will be more proficient in science, technology, engineering and mathematics (STEM).

**4BSR2:** Engage students in inquiry-based learning experiences through development and distribution of classroom activities that simulate biological and physical sciences space research investigations. These activities will align with standards-based curriculum.

**Outcome 6.3.1:** Improve quality of STEM instruction.

**4BSR3:** Develop collaborations with Professional Education Associations directed to enhance of educator proficiency in use of space research content and classroom educational hardware focused on standards-based curriculum.

**4BSR4:** Develop and train facilitators for dissemination of 3 comprehensive Educator Professional Development Seminar packages focused on biological and physical sciences research that coordinates with standards based science, math, and technology concepts.

**Outcome 7.2.4:** Broaden OBPR research information to diverse audiences.

**4BSR5:** In FY04, increase mailing list of Space Research newsletter by 5,000 over FY03 mailing list. Space Research is a significant tool used by OBPR to establish and maintain contact with wide audiences through the quarterly newsletter.

**4BSR6:** Through collaboration with PAO, establish and sustain a series of media presentations of OBPR research highlights. There will be a series of presentations to the media of research results; this campaign of media presentations will be ongoing and will be increased in FY 04 over the initial series that will take place in FY03.

**4BSR7:** OBPR will expand its involvement in reaching minority and under-represented sectors of the public, through participation in conferences and community events that reflect cultural awareness and outreach. There will be at least one new venue associated with a minority and/or under-represented community over outreach efforts taking place in FY 03.

**Outcome 9.1.1:** Identify and test biomedical countermeasures that will make space flight safer for humans.

**4BSR8:** Use ground-based and space-based research to address risk areas related to long duration phenomena such as bone loss, psychological adaptation to isolation and confinement, and the biological effects of radiation as described in the Critical Path Roadmap. Progress toward accomplishing this performance goal will be reviewed by an advisory committee.

**4BSR9:** Publish results of Bioastronautics experiments conducted during early ISS Increments (1 through 8) and preliminary results from Increments 9 and 10. Progress toward accomplishing this performance goal will be reviewed by an advisory committee.

**4BSR10:** Maintain productive peer-reviewed research program in Biomedical Research and Countermeasures including a National Space Biomedical Research Institute that will perform team-based, focused countermeasure-development research. Progress toward accomplishing this performance goal will be reviewed by an advisory committee.

**Outcome 9.1.2:** Acquire physics and biology data base required to predict radiation risk in space with accuracy sufficient to enable astronauts to accomplish three 180-day missions on ISS without exceeding career radiation limits, at a 95% confidence level.

**4BSR11:** Expand the space radiation research science community to involve cutting edge researchers in related disciplines by soliciting, selecting, and funding high quality research.

**4BSR12:** Complete 2 experimental campaigns ("runs") using recently completed Booster Applications Facility (BAF) at Brookhaven National Laboratory (BNL) to measure survival, genetic mutation (mutagenesis), and chromosome aberrations in cells and tissues to improve understanding of the biological effects of the space radiation environment. Progress toward accomplishing this performance goal will be reviewed by an advisory committee.

**4BSR13:** Evaluate radiation risks to astronauts by continued and careful analysis of past radiation exposures, results of medical follow up, and comparison with appropriately chosen control population not exposed to similar levels of radiation. Make experimental data available for operational use on ISS and other space-related activities where appropriate. Progress toward accomplishing this performance goal will be reviewed by an advisory committee.

**Outcome 9.1.3:** Advance understanding of the role of gravity in biological processes to support biomedical research

**4BSR14:** Solicit ground-based research in appropriate Fundamental Biology disciplines to lay the ground work for advanced understanding of the role of gravity in biological processes associated with the human health risks of space flight. Progress toward accomplishing this performance goal will be reviewed by an advisory committee.

**4BSR15:** Plan for increased early utilization for basic biology research in 2005 to take advantage of evolving ISS capabilities. Progress toward accomplishing this performance goal will be reviewed by an advisory committee.

**4BSR16:** Maintain a competitive, productive peer-reviewed research program to advance understanding of the role of gravity in biological processes. Progress toward accomplishing this performance goal will be reviewed by an advisory committee.

**Outcome: 9.2.1:** Identify & test technologies to reduce total mass requirements for Life Support.

**4BSR17:** Demonstrate, through vigorous research and technology development, a 50% reduction in the projected mass of a life support flight system compared to the system baselined for ISS. Progress toward reducing the mass requirements for life support will be evaluated by an advisory committee.

# THEME: Biological Sciences Research

## INDEPENDENT REVIEWS

| Types of Review | Performer | Last Review | Next Review | Purpose |
|---|---|---|---|---|
| Independent Cost Assessment | MSFC CFO | January-02 | None | Assess non-recurring SSBRP hardware |
| COLSA Indep. Assessment | COLSA Corp. | Nov-01 | None | Basis for Habitat Holding Rack cost growth and solutions |
| ReMaP | Indep Committee | September-01 | None | Set priorities for ISS research |
| NASA Advisory Committee | BPRAC | 29-30 Aug 02 | 13-14 Feb 03 | Program Review (three times a year) |
| NASA Advisory Committee | LSAS | 28-Aug-02 | TBD | Program Review (twice a year) |

## BUDGET

| Budget Authority ($millions) | FY02 | FY03 | Chng | FY04 | Comments |
|---|---|---|---|---|---|
| **Total Biological Sciences Research** | **218.0** | **245.1** | **+113.5** | **358.6** | |
| Development | 16.6 | 9.0 | +1.3 | 10.4 | Changes in BSR programs due to full cost, ReMaP decisions, and addition of Human Research Initiative. |
| Habitat Holding Rack (FSB) | 10.0 | 3.5 | +4.7 | 8.3 | |
| Human Research Facility - 2 (BR) | 6.6 | 5.5 | -3.4 | 2.1 | |
| Operations | 66.9 | 67.0 | +62.4 | 129.4 | |
| ISSRC Fundamental Space Biology | 48.9 | 38.6 | +43.1 | 81.7 | |
| ISSRC Bioastronautics Research | 18.0 | 28.4 | +19.3 | 47.7 | |
| Research | 134.5 | 169.1 | +49.7 | 218.8 | |
| Fundamental Space Biology | 33.3 | 56.0 | +2.8 | 58.8 | |
| Bioastronautics Research | 101.2 | 113.1 | +46.9 | 160.0 | |

Note: For all formats, the FY 02 column reflects the FY 2002 Congressional Operating Plan letter dated 9/30/02. The FY 03 column reflects the FY 2003 Presidents Budget Submit (PBS) as Amended. The Change column includes both programmatic and full cost adjustments. FY 2004 column is in full cost.

Indicates budget numbers in Full Cost.
Indicates changes since the FY 2003 Presidents Budget Submit.
FY 2002 and FY 2003 are not in full cost.

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| **THEME:** | Biological Sciences Research (Fundamental Space Biology) |
| **DEVELOPMENT:** | Habitat Holding Rack (HHR) |

## PURPOSE

| Objectives | Reference 2003 Strategic Plan | Performance Measures |
|---|---|---|
| 4.1; 9.1 | | 4BSR1; 15; 16 |

The Habitat Holding Racks (HHR) provides living quarters for various animals to be used in experiments aboard the ISS. The HHR extends the capability to conduct life sciences research in weightlessness with greatly improved on-orbit facilities. In concert with a large diameter variable gravity centrifuge, the suite of research equipment provided by the Space Station Biological Research Project (SSBRP) provides the life sciences research community the capability to perform research using a wide range of specimen types in controlled environments investigating both fundamental biological processes using gravity as a tool and investigating the effects of weightlessness on living specimens and how to control and mitigate those effects.

## OVERVIEW

The Habitat Holding Rack (HHR) is the core element of the Space Station Biological Research Project (SSBRP) which will provide an integrated suite of equipment on the International Space Station (ISS) to perform biological research. The facility will be located in the Centrifuge Accommodation Module (CAM), a module built specifically for the SSBRP facility. The HHR provides a vibration isolated weightless environment for life science experiments. It has common habitat interfaces with the 2.5m Centrifuge and the Life Science Glovebox (LSG). The HHR also provides unique resources necessary for live science research such as cold water cooling, video recording, backup resources for specimens, and crew time saving features. Two Habitat Holding Racks will be located on the International Space Station. The first is planned for January 2005 and will be positioned in the US Lab. Once the Centrifuge Accommodations Module (CAM) is integrated into the Station in mid 2007, both Habitat Holding Racks will be moved to the CAM to be co-located with the LSG and the Centrifuge.

Link to Project Homepage for more information: http://brp.arc.nasa.gov/

## PROGRAM MANAGEMENT

The Enterprise Official for the BSR Theme is Mary Kicza, Associate Administrator for Biological & Physical Research. The HQ Acting Division Director for Fundamental Space Biology is David Liskowsky. The SSBRP, which the HHR is a part, is a project managed and implemented by the Ames Research Center (ARC) under the authority of the ARC Fundamental Biology Program Office. The Center Responsible Officials at ARC are Mel Averner and Gary Jahns. The Habitat Holding Rack is developed by Marshall Space Flight Center (MSFC) under the authority of an intercenter agreement. The HHR is manufactured by Boeing for MSFC as part of a contract developing the HRF, EXPRESS and WORF racks. Full compliance with NPG 7120.5B will be achieved in FY 03 for the relevant portions.

## TECHNICAL COMMITMENT

Baseline Commitment as of OBPR Basis of Estimate (BOE) dated 2/28/02.

| Technical Specifications | FY04 President's Budget | Change from Baseline |
|---|---|---|
| Habitat Holding Rack | Two units on orbit | -- |
| | Accommodates 4 habitats (sub rack payloads designed to accommodate specific science specimens) | -- |
| | Provides Passive vibration isolation for science specimens | -- |
| | Provides cold water cooling to Habitats | -- |
| | International Subrack Interface Standard (ISIS) interfaces to Habitats | -- |
| | Animal well being redundancy | -- |
| | Video recording/compression capability | -- |
| | Compatibility with 2.5m Centrifuge and Life Science glovebox | -- |
| HHR 1 & 2 operational lifetime - 20 years | | |

| Schedule | FY04 President's Budget | Change from Baseline |
|---|---|---|
| Qual Rack testing with Qual Habitat complete | June-03 | -- |
| Flight Rack #1 stand alone testing complete (DD250) | January-04 | -- |
| Flight Rack #2 stand alone testing complete (DD250) | April-04 | -- |
| HHR - 1 integration testing with flight Habitats start | May-04 | -- |
| HHR-1 with Flight Habitats shipped to KSC | July-04 | -- |
| HHR-1 with flight Habitats launched on UF3 | January-05 | -- |

| THEME: | Biological Sciences Research (Fundamental Space Biology) |
|---|---|
| **DEVELOPMENT:** | **Habitat Holding Rack (HHR)** |

## ACQUISITION STRATEGY & PERFORMING ORGANIZATIONS

Data current as of 1/18/03

The HHR development consists of a center agreement between MSFC and ARC and a cost plus contract with Boeing (HHR, combined contract with HRF, EXPRESS, and WORF rack development).

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

| Current Acquisitions | Actual* | Selection Method | Actual* | Performer | Actual* |
|---|---|---|---|---|---|
| Cooperative Agreements | 0% | Full & Open Competition | 100% | Industry | 100% |
| Cost Reimbursable | 100% | Sole Source | 0% | Government | 0% |
| Fixed Price | 0% | | 100% | NASA Intramural | 0% |
| Grants | 0% | | | University | 0% |
| Other | 0% | Sci Peer Review | 0% | Non Profit | 0% |
| | 100% | * % based on FY 02 direct proc. | | | 100% |

| Future Acquisitions - Major | Selection | Goals |
|---|---|---|
| None (HHR complete, Boeing contract ends) | N/A | N/A |

## AGREEMENTS

Internal: None

External: The HHR development supports the National Space Development Agency of Japan (NASDA) development of the 2.5m diameter centrifuge and the Life Science Glovebox (LSG) by providing the design and development of most subsystems and core software used by all three hardware items. The HHR, LSG, and Centrifuge are the three rack level systems which make up the SSBRP, utilizing common spares and interfaces. The LSG and Centrifuge are developed by NASDA for NASA via barter agreement.

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

## INDEPENDENT REVIEWS

Data current as of 1/18/03

| Types of Review | Performer | Last Review | Next Review | Purpose |
|---|---|---|---|---|
| Independent Cost Assessment | MSFC CFO | January-02 | None | Assess non-recurring SSBRP hardware development |
| COLSA Independent Assessment | COLSA Corp. | Nov-01 | None | Determine basis for HHR cost growth & recommend cost reductions. |

## BUDGET LIFE / CYCLE COST

Total budget authority represents a ROM Life Cycle Cost (LCC) for the development of this facility.

| Budget Authority ($ in millions) | Prior | FY02 | FY03 | FY04 | FY05 | FY06 | FY07 | FY08 | BTC | Total | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|
| FY 2004 President's Budget (LCC) | 0.0 | 10.0 | 3.5 | 8.3 | 3.6 | 0.0 | 0.0 | 0.0 | 0.0 | 25.4 | |
| HHR Development | | 10.0 | 3.5 | 8.3 | 3.6 | | | | | 25.4 | |
| Changes since FY 03 Pres. Budget | 0.0 | 0.0 | 0.0 | +6.4 | +2.7 | -0.5 | -0.2 | +0.0 | | +8.5 | **Reason for Change:** |
| HHR Development | | 0.0 | 0.0 | +6.4 | +2.7 | -0.5 | -0.2 | | | +8.5 | Full Cost accounting and design changes |
| FY 2003 President's Budget (LCC) | 0.0 | 10.0 | 3.5 | 1.9 | 0.9 | 0.5 | 0.2 | 0.0 | | 17.0 | |
| HHR Development | | 10.0 | 3.5 | 1.9 | 0.9 | 0.5 | 0.2 | | | 17.0 | |
| Bases of Estimate (BOE) | 0.0 | 16.5 | 10.5 | 5.2 | 2.2 | 0.0 | 0.0 | 0.0 | | 34.4 | |
| HHR Development (Mar 02) | | 16.5 | 10.5 | 5.2 | 2.2 | | | | | 34.4 | Baseline Mar 2002 |

Indicates budget numbers in Full Cost.

Indicates changes since the FY 2003 Presidents Budget Submit.

FY 2002, FY 2003, Prior and BTC are not in full cost.

| THEME: | Biological Sciences Research |
|---|---|
| **DEVELOPMENT:** | **Human Research Facility (HRF) - 2** |

## PURPOSE

| Objectives | Reference 2003 Strategic Plan | Performance Measures |
|---|---|---|
| 9.1; 9.2 | | 4BSR8; 9; 13; 17 |

The Human Research Facility (HRF) enables a systematic study of human physiological, behavioral and chemical changes induced by space flight. The goal is to accumulate long-term data on adaptation to the space environment. HRF allows high resolution imaging for diagnostics and research applications for human organs. Areas of concern to human well being and performance, such as renal stone risk, bone deterioration and the effects of ionizing radiation, will also be studied.

## OVERVIEW

The HRF is a modular International Standard Payload Rack (ISPR) which contains scientific equipment used in Human Research. The HRF rack provides a modular equipment interface for equipment and distributes the utilities of power, data networks, and thermal control. The HRF 2 contains the following subracks: a) the Refrigerated Centrifuge used to separate biological substances of differing densities; b) the Space Linear Acceleration Mass Measuring Device that will provide an accurate means of determining the on-orbit mass of human subjects; c) the Pulmonary Function System that provides the capability to perform pulmonary and cardiovascular measurements; and d) the Rack 2 Workstation which is designed to support human physiological, psychological and cognitive and human factors studies. HRF-1 has been on orbit since March 2001 and has 3 subracks: a) the Ultrasound Imaging System; b) the Gas Analyzer System for Metabolic Analysis Physiology; and c) a computer workstation that allows crew members to command and test the rack's equipment data.

Link to Project Homepage for more information. http://hrf.jsc.nasa.gov

## PROGRAM MANAGEMENT

The Enterprise Official for the Biological Sciences Research Theme is Mary Kicza, Associate Administrator for Biological & Physical Research. The HQ Acting Division Director for Bioastronautics Research is Guy Fogleman. The HRF program responsibility is delegated to the Johnson Space Center. The Center Responsible Official at JSC is Ms. Cindy Haven. Full compliance with NPG 7120.5B will be achieved in FY 03 for the relevant portions.

## TECHNICAL COMMITMENT

Baseline Commitment as of OBPR Basis of Estimates (BOE) dated 2/07/02

| Technical Specifications | FY04 President's Budget | Change from Baseline |
|---|---|---|
| Support Biomedical | 2 Racks | -- |
| Power to Payload | 3 kW per rack | -- |
| Research & Countermeasure | HRF Rack 2 on schedule for launch on ULF-1 (Mar-03) | |
| Validation | Science Verification Testing HRF Rack 1; Aug 2000 | -- |
| | Science Verification Testing HRF Rack 2; June 2002 | -- |
| Science Instruments: | Body Mass Measurement, Pulmonary Function, refrigerated centrifuge, ultrasound imaging | |
| Facility operational lifetime | 10 years | -- |

| Schedule | FY04 President's Budget | Change from Baseline |
|---|---|---|
| HRF-Rack 1 on-orbit | Mar-01 | -- |
| HRF-Rack 2 on dock at KSC | Aug-02 | -- |

| THEME: | Biological Sciences Research |
|---|---|
| **DEVELOPMENT:** | Human Research Facility (HRF) - 2 |

## ACQUISITION STRATEGY & PERFORMING ORGANIZATIONS

Data current as of 1/18/03

HRF development is essentially complete. The balance of the development funds are programmed to cover integration cost of equipment provided by the European Space Agency, including the Muscle Atrophy and Resistive Exercise System (MARES) and the Eye Tracking Device. Integration of these components is under contract to Lockheed-Martin. Also under development is the Urine Monitoring System, being developed by Hamilton-Sundstrand.

| Current Acquisitions | Actual* | Selection Method | Actual* | Performer | Actual* |
|---|---|---|---|---|---|
| Cooperative Agreements | 0% | Full & Open Competition | 100% | Industry | 100% |
| Cost Reimbursable | 100% | Sole Source | 0% | Government | 0% |
| Fixed Price | 0% | | 100% | NASA Intramural | 0% |
| Grants | 0% | | | University | 0% |
| Other | 0% | Sci Peer Review | 0% | Non Profit | 0% |
| | 100% | * % based on FY 02 direct proc. | | | 100% |

| Future Acquisitions - Major | Selection | Goals |
|---|---|---|
| Major acquisitions for HRF were accomplished in prior years. There are no new acquisitions for this development. | N/A | N/A |

## AGREEMENTS

Internal: None.

External: Provision of the Pulmonary Function Module was dependent on the European Space Agency (ESA), according to NASA/ESA Letter of Agreement signed December 1999.

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

## INDEPENDENT REVIEWS

Data current as of 1/18/03

| Types of Review | Performer | Last Review | Next Review | Purpose |
|---|---|---|---|---|
| Independent Annual Review | HQ Code M | 1-Oct-01 | None | No further reviews planned - HRF on-dock at KSC. |

## BUDGET LIFE / CYCLE COST

Total budget authority represents a ROM Life Cycle Cost (LCC) for the development of this facility.

| Budget Authority ($ in millions) | Prior | FY02 | FY03 | FY04 | FY05 | FY06 | FY07 | FY08 | BTC | Total | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|
| FY 2004 President's Budget (LCC) | 0.0 | 6.6 | 5.5 | 2.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 14.2 | |
| Development | | 6.6 | 5.5 | 2.1 | | | | | | 14.2 | |
| Changes since FY 03 Press Budget | 0.0 | 0.0 | +2.0 | +0.1 | +0.0 | +0.0 | +0.0 | +0.0 | | +2.1 | Reason for Change: |
| Development | | 0.0 | +2.0 | +0.1 | | | | | | +2.1 | Full Cost Accounting. |
| FY 2003 President's Budget (LCC) | 0.0 | 6.6 | 3.5 | 2.0 | 0.0 | 0.0 | 0.0 | 0.0 | | 12.1 | |
| Development | | 6.6 | 3.5 | 2.0 | | | | | | 12.1 | |
| Bases of Estimate (BOE) | 0.0 | 6.6 | 3.5 | 2.0 | 0.0 | 0.0 | 0.0 | 0.0 | | 12.1 | |
| Development (Mar 02) | | 6.6 | 3.5 | 2.0 | | | | | | 12.1 | Baseline Mar 2002 |

Indicated budget numbers in Full Cost.

Indicates changes since the FY 2003 Presidents Budget Submit.

FY 2002, FY 2003, Prior and BTC are not in full cost.

| THEME: | Biological Sciences Research |
|---|---|
| **OPERATIONS:** | **Fundamental Space Biology (FSB)** |

## PURPOSE

| Objectives | Reference 2003 Strategic Plan | Performance Measures |
|---|---|---|
| 4.1; 9.1 | | 4BSR1; 15; 16 |

The Fundamental Space Biology (FSB) Space Station Biological Research Project (SSBRP) extends the capability to conduct life sciences research in weightlessness with greatly improved on-orbit facilities. The suite of research equipment provides the life sciences research community the capability to perform research using a wide range of specimen types in controlled environments investigating both fundamental biological processes using gravity as a tool and investigating the effects of weightlessness on living specimens and how to control and mitigate those effects.

## OVERVIEW

The Space Station Biological Research Project (SSBRP) will provide an integrated suite of equipment on the International Space Station (ISS) to perform biological research. The facility will be located in the Centrifuge Accommodation Module (CAM), a module built specifically for the SSBRP facility. The suite of equipment include the 2.5m diameter Centrifuge, the Life Sciences Glovebox (LSG), the Habitat Holding Rack (HHR) [data included under "Development" format], the Passive Dosimeter System (PDS), the Avian Development Facility (ADF), the Incubator, the Insect Habitat, the Cell Culture Unit (CCU), the Advanced Animal Habitat (AAH), the Plant Research Unit (PRU), and the Telecommunications Support Center (TSC) located at the Ames Research Center. The Centrifuge provides an artificial gravitational environment, the LSG provides a contained environment for crew performance of science protocols on science specimens, the PDS monitors the radiation environment, the ADF incubates quail eggs, the Incubator provides controlled temperatures for self contained small experiments, the insect habitat provides multiple generation fly experiments, the CCU provides highly automated cell culture experiments, the AAH provides for long duration rat experiments, and the PRU provides for tall plant experiments. The TSC is the ground control facility that electronically links the experiments on ISS with the researcher in their own labs. The CAM, Centrifuge, and LSG are provided by the National Space Development Agency of Japan (NASDA) as part of a barter offset agreement.

Link to Project Homepage for more information. http://brp.arc.nasa.gov

## PROGRAM MANAGEMENT

The Enterprise Official for the Biological Sciences Research Theme is Mary Kicza, Associate Administrator for Biological & Physical Research. The HQ Acting Division Director for Fundamental Space Biology is David Liskowsky. The Fundamental Space Biology Program is managed and implemented by the Ames Research Center (ARC) under the authority of the ARC Fundamental Biology Program Office. The Center Responsible Officials at ARC are Mel Averner and Gary Jahns. Full compliance with NPG 7120.5B will be achieved in FY 03.

## TECHNICAL COMMITMENT

Baseline is the OBPR Basis of Estimate (BOE) for the Fundamental Space Biology program dated 2/28/02.

| Technical Specifications | FY04 President's Budget | Change from Baseline |
|---|---|---|
| Centrifuge | 2.5 meter diameter, 4 habitats, vibration isolation, 0.01g-2.0g, cold water cooling, International Subrack Standard Interfaces | -- |
| Life Sciences Glovebox | 2 operators, 2 habitats, airlock, lab support equipment capability, bioisolation, cleanability, cold water cooling | -- |
| Passive Dosimeter System (PDS) | Nuclear track detectors | -- |
| Avian Development Facility (ADF) | 24 quail egg incubator, internal centrifuge | -- |
| Incubator (2 units on orbit) | 4°C to 38°C internal temp, data & video capability, 90 day cap | -- |
| Insect Habitat (1 on orbit) | Multiple generation fly experiment capability, 90 day capability | -- |
| Cell Culture Unit (CCU) (2 on orbit) | 18 cell culture chambers, 60 auto fixation/sample containers | -- |
| AAH (8 on orbit) | Six rats, environ control, video, 90 day capability | Not included in FY03 PBS |
| PRU (8 on orbit) | 38cm high plants, environ control, video, 90 day capability | Not included in FY03 PBS |

| Schedule | FY04 President's Budget | | Change from Baseline |
|---|---|---|---|
| Phase 2 Incubator, Insect Habitat flight | January-05 | UF3 | -- |
| Phase 2 Insect Habitat science/validation flight | April-05 | UF4 | -- |
| Phase 3 LSG flight | January-06 | UF6 | -- |
| Phase 2 CCU flight | June-06 | TBD | -- |
| Phase 3 Centrifuge/CAM flight | April-07 | UF7 | -- |
| Phase 3 AAH flight (REMAP augmentation, preliminary schedule) | September-07 | TBD | -- |
| Phase 3 PRU flight (REMAP augmentation, preliminary schedule) | March-08 | TBD | -- |

| THEME: | Biological Sciences Research |
|---|---|
| **OPERATIONS:** | Fundamental Space Biology (FSB) |

## ACQUISITION STRATEGY & PERFORMING ORGANIZATIONS

Data current as of 1/18/03

FSB Operations is composed of two primary components: Biological Research Projects (BRP) and Utilization. BRP consists of numerous contracts with the following organizations to build equipment: Lockheed Martin (Facility Integration and Incubator), SHOT (ADF), ORBITEC (BPS/PRU), PSI (CCU), STAR (AAH); an international cooperative agreement with the Canadian Space Agency (Insect Habitat) and other international barter agreements for equipment with other partners. Utilization covers all of the expenses associated with integrating the experiments into the flight platform, performing the experiments on-orbit (and related ground control experiments), and post-flight processing of the specimens and data including development of experiment unique hardware, ground operations, flight operations, safety, and quality control.

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

| Current Acquisitions | Actual* | Selection Method | Actual* | Performer | Actual* |
|---|---|---|---|---|---|
| Cooperative Agreements | 0% | Full & Open Competition | 76% | Industry | 79% |
| Cost Reimbursable | 70% | Sole Source | 24% | Government | 21% |
| Fixed Price | 7% | | 100% | NASA Intramural | 0% |
| Grants | 0% | | | University | 0% |
| Other | 23% | Sci Peer Review | 0% | Non Profit | 0% |
| | 100% | * % based on FY 02 direct proc. | | | 100% |

| Future Acquisitions - Major | Selection | Goals |
|---|---|---|
| Advanced Animal Habitat | Winter 03 | 100% SBIR Modification, 100% Cost Reimbursable |
| Plant Research Unit | Winter 03 | 100% SBIR Modification, 100% Cost Reimbursable |

## AGREEMENTS

Internal: None

External: An international cooperative agreement with the Hungarian Space Agency (PDS); an international cooperative agreement with the Canadian Space Agency (Insect Habitat); and an ISS barter offset agreement with the National Space Development Agency of Japan (NASDA) for the CAM, Centrifuge, and the LSG.

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

## INDEPENDENT REVIEWS

Data current as of 1/18/03

| Types of Review | Performer | Last Review | Next Review | Purpose |
|---|---|---|---|---|
| Independent Cost Assessment | MSFC CFO | January-02 | None | Assess non-recurring SSBRP hardware development costs & perform parametric estimates. |
| ReMaP | Indep Committee | 1-Sep-02 | None | Set priorities for ISS research. |

## BUDGET

| Budget Authority ($ in millions) | FY02 | FY03 | FY04 | Comments |
|---|---|---|---|---|
| FY 2004 President's Budget | 48.9 | 38.6 | 81.7 | |
| ISSRC Fundamental Space Biology (Operations) | 48.9 | 38.6 | 81.7 | |
| Changes since FY 03 President's Budget | +0.9 | +0.0 | +45.0 | ***Reason for Change:*** |
| | +0.9 | +0.0 | +45.0 | Full cost accounting; addition of Animal & Plant habitats; OBPR shuttle mission to ISS; fund project liens, and ReMaP recommendations. |

Indicates budget numbers in Full Cost.
Indicates changes since the FY 2003 Presidents Budget Submit.
FY 2002 and FY 2003 are not in full cost.

| | |
|---|---|
| **THEME:** | Biological Sciences Research |
| **OPERATIONS:** | Bioastronautics Research (BR) |

## PURPOSE

| Objectives | Reference 2003 Strategic Plan | Performance Measures |
|---|---|---|
| 9.1; 9.2 | | 4BSR8; 9; 13; 17 |

Bioastronautics Research performs systematic study of human physiological, behavioral and chemical changes induced by space flight. NASA is accumulating long-term data on adaptation to the space environment. The Human Research Facility (HRF) provides the major on-orbit capability to perform this research. HRF allows high resolution imaging for diagnostics and research applications for body organs. Areas of concern to human well being and performance, such as renal stone risk, bone deterioration and the effects of ionizing radiation, are also being studied.

## OVERVIEW

Bioastronautics Research operations include activities required for HRF science development and operations, such as developing experiments and associated flight products: (e.g., operations concepts, flight resource and integration requirements, data management plans, crew procedures and displays, training products for training the crew and ground support personnel). HRF operations include Principal Investigators (PI) hardware development including unique equipment, experiment kits and cables, and integration activities at HRF ground based integration facilities and KSC. HRF operations include sustaining engineering for HRF on-orbit hardware and software. It also includes HRF upgrades and improvements. This task also includes the execution of science performed during research increments, and the operation of the JSC Telescience Support Center and associated hardware and software. Starting in FY 2004 OBPR will begin the Human Reserach Inititative. This will accelerate the acquisition of knowledge and technology needed for decisions on human exploration beyond low-Earth-orbit.

Link to Project Homepage for more information: http://hrf.jsc.nasa.gov

## PROGRAM MANAGEMENT

The Enterprise Official for the Biological Sciences Research Theme is Mary Kicza, Associate Administrator for Biological & Physical Research. The HQ Acting Division Director for Bioastronautics Research is Guy Fogleman. The Bioastronautics Research Program coordination responsibility is assigned to the Johnson Space Center (JSC), under the supervision of Dr. John Rummel, Chief, Office of Bioastronautics. The Center Responsible Official at JSC is Ms. Cindy Haven. Full compliance with NPG 7120.5B will be achieved in FY 03 for the relevant portions.

## TECHNICAL COMMITMENT

Baseline commitment is as of the OBPR Basis of Estimates (BOE) dated 2/7/2002.

| Technical Specifications | FY04 President's Budget | Change from Baseline |
|---|---|---|
| Support Biomedical | 2 Racks | -- |
| Power to Payload | 3 kW per rack | -- |
| Research & Countermeasure | HRF Rack 2 on schedule for launch on ULF-1 | |
| Validation | Science Verification Testing HRF Rack 1 Aug 2000 | Not included |
| | Science Verification Testing HRF Rack 2 June, 2002 | Not included |
| Science Instruments: | Body Mass Measurement, Pulmonary Function, refrigerated centrifuge, ultrasound imaging | |

| Schedule | FY04 President's Budget |
|---|---|

Individual experiments are scheduled for Increments 9 (Sep 2003) & 10 (Feb 2004), currently set for FY 2004. Descriptions of those experiments are available at http://hrf.jsc.nasa.gov/science_summ.html. The following 9 experiments will be conducted using the Human Research Facility on ISS Increments 9 and 10:

1. E039/Badhwar/ Organ Dose Measurement Using Phantom Torso,
2. E057L/Whitson/ Renal Stone Risk During Spaceflight: Assessment and Countermeasure Validation,
3. E096/Kanas/ Crewmember and Crew-Ground Interactions During ISS Missions,
4. E120/Bloomberg/Mobility Promoting Sensorimotor Response Generalizability: A Countermeasure to Mitigate Locomotor Dysfunction after Long-Duration Space Flight,
5. E129/Barrett/ Space Flight-Induced Reactivation of Latent Epstein-Barr Virus,
6. E318/Cavanagh/ Foot/Ground Reaction Forces During Space Flight,
7. E400/Fitts/ Effect of Prolonged Spaceflight on Human Skeletal Muscle,
8. SMO-006/Meck/ Test of Midodrine as a Countermeasure Against Postflight Orthostatic Hypotension, and
9. SMO-008/Meck/ Monitoring of Heart Rate and Blood Pressure During Entry Landing and Egress.

| THEME: | Biological Sciences Research |
|---|---|
| **OPERATIONS:** | **Bioastronautics Research (BR)** |

## ACQUISITION STRATEGY & PERFORMING ORGANIZATIONS

Data current as of 1/18/03

The prime contractor for the HRF Operations mission is Lockheed Martin under the Science Engineering Analysis and Test (SEAT) contract. The contract covers 5 years of operations, renewable in December 2003. In FY 2002, direct procurement represented about 50% of budget authority. **Changes since FY 2003 President's Budget: none**.

| Current Acquisitions | Actual* | Selection Method | Actual* | Performer | Actual* |
|---|---|---|---|---|---|
| Cooperative Agreements | 0% | Full & Open Competition | 100 | Industry | 100 |
| Cost Reimbursable | 100 | Sole Source | 0% | Government | 0% |
| Fixed Price | 0% | | 100% | NASA Intramural | 0% |
| Grants | 0% | | | University | 0% |
| Other | 0% | Sci Peer Review | 100% | Non Profit | 0% |
| | 100% | * % based on FY 02 direct proc. | | | 100% |

| Future Acquisitions - Major | Selection | Goals |
|---|---|---|
| None | N/A | N/A |

## AGREEMENTS

Internal: None

External: None

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

## INDEPENDENT REVIEWS

Data current as of 1/18/03

| Types of Review | Performer | Last Review | Next Review | Purpose |
|---|---|---|---|---|
| ReMaP | Indep Committee | 1-Sep-02 | None | Set priorities for ISS research. |

## BUDGET

| Budget Authority ($ in millions) | FY02 | FY03 | FY04 | Comments |
|---|---|---|---|---|
| FY 2004 President's Budget | 18.0 | 28.4 | 47.7 | |
| ISSRC Bioastronautics Research (Operations) | 18.0 | 28.4 | 47.7 | |
| Changes since FY 03 President's Budget | -5.6 | -2.0 | +21.1 | ***Reason for Change:*** |
| | -5.6 | -2.0 | +21.1 | Changes reflect shift to full cost budgeting, recommendations made by the ReMaP committee, and the addition of the Human Research Initiative. |

Indicates budget numbers in Full Cost.

Indicates changes since the FY 2003 Presidents Budget Submit.

FY 2002 and FY 2003 are not in full cost.

| | |
|---|---|
| **THEME:** | Biological Sciences Research |
| **RESEARCH:** | Fundamental Space Biology (FSB) |

## PURPOSE

| Objectives | Reference 2003 Strategic Plan | Performance Measures |
|---|---|---|
| 4.1; 6.1; 6.3; 7.6; 9.1 | | 4BSR1; 2-7; 14-16 |

The Fundamental Space Biology (FSB) Program uses the environment of space to enhance our understanding of biology by providing a continuum of research that investigates the role of gravity and other space flight factors at all levels of biological processes. The understanding, development, and implementation of this research will provide the underpinnings necessary to support long-term human space flight. Additionally, information derived from this research will provide new knowledge about biological processes and their applications on earth.

## OVERVIEW

The Fundamental Space Biology Program will: (1) Develop the foundation of fundamental biological knowledge required to enable a long-duration human presence in space; (2) Effectively use microgravity and the other characteristics of the space environment to enhance our understanding of fundamental biological processes; (3) Develop the biological understanding to support other biologically related NASA activities; and (4) Apply this knowledge and technology to improve our nation's competitiveness, education, and the quality of life on Earth. Ground-based and flight research grants are solicited and reviewed via a competitive peer review process.

Link to Project Homepage for more information: http://spaceresearch.nasa.gov/research_projects/FSB.html

## PROGRAM MANAGEMENT

The Enterprise Official for the Biological Sciences Research Theme is Mary Kicza, Associate Administrator for Biological & Physical Research. The HQ Acting Division Director for Fundamental Space Biology is David Liskowsky. The Fundamental Space Biology Program is managed and implemented by the Ames Research Center (ARC) under the authority of the ARC Fundamental Biology Program Office. The Center Responsible Officials at ARC are Mel Averner and Gary Jahns. Full compliance with NPG 7120.5B will be achieved in FY 03.

## TECHNICAL COMMITMENT

Baseline commitment as of OBPR Basis of Estimate (BOE) dated 2/28/02.

| Technical Specifications | FY04 President's Budget | Change from Baseline |
|---|---|---|
| | The Fundamental Space Biology Program will focus on research in Cell and Molecular Biology, Developmental Biology, and Organismal and Comparative Biology. It includes flight and ground based research designed to understand the effects of the space environment on organisms and their interactions when exposed to space for varying periods of time. | Evolutionary Biology and parts of Gravitational Ecology were given a lower priority by ReMaP, which followed with adjustments to funding levels. |

| Schedule | FY04 President's Budget | Change from Baseline |
|---|---|---|
| Research Announcements | Mar-03 NRA; Jan-04 NRA; Jan-05 NRA; 3YR PERIOD | +3 months |
| Research Awards | Dec-03 Award; Oct-04 Award; Oct-05 Award; 3YR PERIOD | +3 months |

| THEME: | Biological Sciences Research |
|---|---|
| **RESEARCH:** | **Fundamental Space Biology (FSB)** |

## ACQUISITION STRATEGY & PERFORMING ORGANIZATIONS

Data current as of 1/18/03

Fundamental Space Biology research is performed by Principal Investigators (PI). Most are affiliated with universities. Some are civil servants assigned to NASA Centers and other Federal Agencies such as the National Institutes of Health. Research is solicited and selected for funding through a competitive scientific peer review process. The research program is implemented by the Ames Research Center (ARC) under the authority of the ARC Fundamental Biology Program Office.

| Current Acquisitions | Actual* | Selection Method | Actual* | Performer | Actual* |
|---|---|---|---|---|---|
| Cooperative Agreements | 19% | Full & Open Competition | 87% | Industry | 41% |
| Cost Reimbursable | 36% | Sole Source | 13% | Government | 0% |
| Fixed Price | 5% | | 100% | NASA Intramural | 2% |
| Grants | 40% | | | University | 44% |
| Other | 0% | Sci Peer Review | 39% | Non Profit | 13% |
| | 100% | * % based on FY 02 direct proc. | | | 100% |

| Future Acquisitions - Major | Selection | Goals |
|---|---|---|
| Support Services Contract (Lockheed/Martin) | Spring '03 | 100% Full and Open, Cost Reimbursable |
| Cooperative Agreements | Spring '03 | 100% Cooperative Agreements- 100% Sole Source |

## AGREEMENTS

Internal: None

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

## INDEPENDENT REVIEWS

Data current as of 1/18/03

| Types of Review | Performer | Last Review | Next Review | Purpose |
|---|---|---|---|---|
| Independent committee | ReMaP | 1-Sep-02 | None | Establish research priorities for OBPR. |
| NASA Advisory Committee | BPRAC | 29-30 Aug 02 | 13-14 Feb 03 | Program Review (three times a year). |
| NASA Advisory Committee | LSAS | 28-Aug-02 | TBD | Program Review (twice a year). |

## BUDGET

| Budget Authority ($ in millions) | FY02 | FY03 | FY04 | Comments |
|---|---|---|---|---|
| FY 2004 President's Budget | 33.3 | 56.0 | 58.8 | |
| Fundamental Space Biology (Research) | 33.3 | 56.0 | 58.8 | |
| Changes since FY 03 President's Budget | -2.0 | 0.0 | -18.9 | ***Reason for Change:*** |
| FSB R&T Budget | -2.0 | 0.0 | -18.9 | Full cost accounting; Reprioritization of OBPR research and program restructuring |

Indicates budget numbers in Full Cost.
Indicates changes since the FY 2003 Presidents Budget Submit.
FY 2002 and FY 2003 are not in full cost.

| THEME: | Biological Sciences Research |
|---|---|
| **RESEARCH:** | **Bioastronautics Research (BR)** |

## PURPOSE

| Objectives | Reference 2003 Strategic Plan | Performance Measures |
|---|---|---|
| 6.1; 6.3; 7.6; 9.1; 9.2 | | 4BSR2; 3-8; 10-13; 17 |

The Bioastronautics Research theme seeks to understand physical and psychological adaptation to space flight and return to Earth to develop countermeasures and technologies that reduce risks to the crew. The theme also develops technologies that improve spacecraft habitability, environmental controls, planetary habitability, and space systems. The primary goal of this research is to improve the health and safety of space travelers; however, this research also has the potential to make significant contributions to medical care on Earth.

## OVERVIEW

Bioastronautics Research performs research and develops technology for systems that will enable humans to live and work safely and effectively in space. Special emphasis is placed on those technologies that will have a dramatic impact on the reduction of required mass, power, volume, and crew time, and on those that will increase safety and reliability. The program funds technologies that address both the near-, mid-, and long-term needs of space travel, and places a high priority on making NASA technologies available to the private sector for Earth applications. It also performs the scientific research that develops the knowledge base and technologies required to preserve health, morale, performance, and safety in astronaut crews. Program research results are directed to providing a better understanding of physiological, psychological, and behavioral adaptations to space flight that will enable improvements in: predictions of astronaut health and safety risks; diagnostics of health status; management of medical and behavioral problems; establishment of human physiological norms for space flight; protection of humans from the negative physiological and behavioral effects of space flight; and tools available for rehabilitation of crewmembers after space flight.

Link to Project Homepage for more information: http://spaceresearch.nasa.gov/research_projects/biomedical.html

## PROGRAM MANAGEMENT

The Enterprise Official for the Biological Sciences Research Theme is Mary Kicza, Associate Administrator for Biological & Physical Research. The Bioastronautics Research Program coordination responsibility is assigned to the Johnson Space Center (JSC), under the supervision of Dr. John Rummel, Chief, Office of Bioastronautics. The Center Responsible Officials at JSC are Bill Paloski for Biomedical Research and Countermeasures, and Dave Russo for Advanced Human Support Technology. Full compliance with NPG 7120.5B will be achieved in FY 2003.

## TECHNICAL COMMITMENT

Baseline commitment is as of the OBPR Basis of Estimates (BOE) dated 2/7/2002.

| Technical Specifications | FY04 President's Budget | Change from Baseline |
|---|---|---|
| Bioastronautics and Countermeasures (BR&C) and Advanced Human Support Technology (AHS<br>BR&C is further divided into the following research sub disciplines:<br>Radiation Health, Integrated Physiology, Organ System<br>Physiology, Clinical and Operational Medicine, and Behavior and Performance.<br>Sub disciplines of AHST include Environmental Monitoring and Control, Human Factors Eng.,<br>Advanced Life Support and Advanced Extravehicular Activity. | | Environmental Health and Advanced<br>Extra-Vehicular Activity were given<br>a lower priority by ReMaP, which<br>followed with adjustments to funding |

| Schedule | FY04 President's Budget | Change from Baseline |
|---|---|---|
| Research Announcements | Mar 03; Jan 04; Jan 05 | -- |
| Grant Awards | Dec 03; Oct 04; Oct 05 | -- |

| THEME: | Biological Sciences Research |
|---|---|
| **RESEARCH:** | **Bioastronautics Research (BR)** |

## ACQUISITION STRATEGY & PERFORMING ORGANIZATIONS

Data current as of 1/18/2003

Bioastronautics research is performed by Principal Investigators (PI). Most are affiliated with universities. Some are civil servants assigned to NASA Centers and other Federal agencies such as the National Institutes of Health. A substantial portion of BR's program is executed by the National Space Biomedical Research Institute (NSBRI), a consortium of 12 universities which uses funding provided by NASA and other sources to conduct open competition leading to award of peer-reviewed research grants. NSBRI coordinates its research goals with NASA to minimize duplication and ensure balanced research portfolios.

| Current Acquisitions | Actual* | Selection Method | Actual* | Performer | Actual* |
|---|---|---|---|---|---|
| Cooperative Agreements | 31% | Full & Open Competition | 100% | Industry | 41% |
| Cost Reimbursable | 33% | Sole Source | 0% | Government | 7% |
| Fixed Price | 0% | | 100% | NASA Intramural | 2% |
| Grants | 36% | | | University | 50% |
| Other | 0% | Sci Peer Review | 54% | Non Profit | 0% |
| | 100% | * % based on FY 02 direct proc. | | | 100% |

| Future Acquisitions - Major | Selection | Goals |
|---|---|---|
| Annual Research Announcement | N/A | Issue announcement each January; awards in September. |
| Renew or recompete NSBRI agreement | N/A | Next renewal option due in October 2007. |

## AGREEMENTS

Internal: None

External: NASA manages an extensive portfolio of interagency agreements with other Federal agencies such as DOD, DOE and NIH to leverage NASA resources and improve the quality of research results.

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

## INDEPENDENT REVIEWS

Data current as of 1/18/03

| Types of Review | Performer | Last Review | Next Review | Purpose |
|---|---|---|---|---|
| Independent committee | ReMaP | 1-Sep-02 | None | Establish research priorities for OBPR. |
| NASA Advisory Committee | BPRAC | 29-30 Aug 02 | 13-14 Feb 03 | Program Review (three times a year). |
| NASA Advisory Committee | LSAS | 28-Aug-02 | TBD | Program Review (twice a year). |

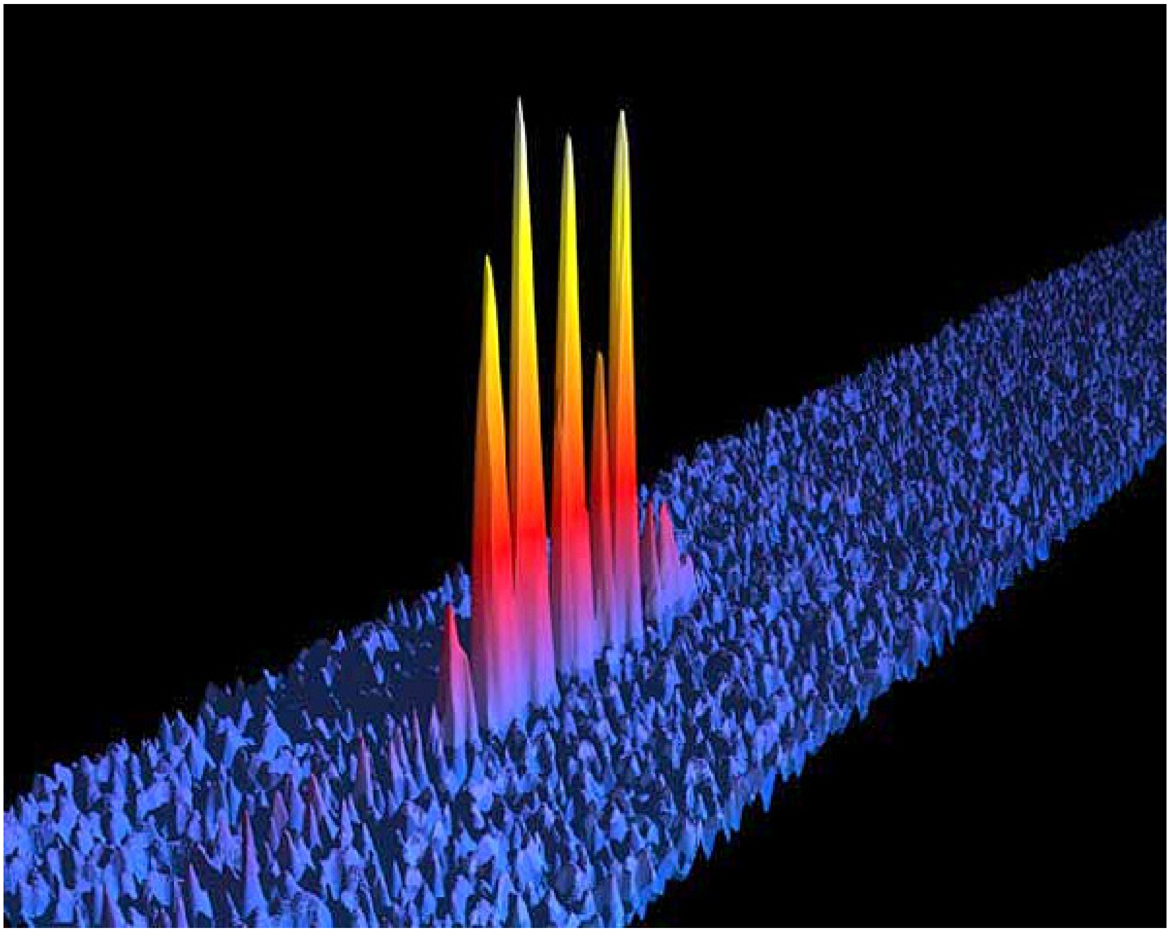
## BUDGET

| Budget Authority ($ in millions) | FY02 | FY03 | FY04 | Comments |
|---|---|---|---|---|
| FY 2004 President's Budget (Research) | 101.2 | 113.1 | 160.0 | |
| Bioastronautics Research (Research) | 95.1 | 113.1 | 160.0 | |
| Health Research | 6.1 | | | In FY 2003 OBPRs portion of Health Research was moved to BR. |
| Changes since FY 03 President's Budget | -0.6 | +0.0 | +43.4 | ***Reason for Change:*** |
| | -0.6 | +0.0 | +43.4 | Full cost accounting and ReMaP. |

Indicates budget numbers in Full Cost.

Indicates changes since the FY 2003 Presidents Budget Submit.

FY 2002 and FY 2003 are not in full cost.



NASA-funded physicists at Rice University discovered ultra cold atoms forming bright solitons, localized bundles of waves that maintain a constant shape as they propagate. The researchers observed atomic soliton trains, groups of as many as 15 solitons. These solitons propagated without spreading for several seconds—an eternity for a localized wave bundle. This fundamental research may lead to technical innovations such as atom lasers that could eventually be used to predict volcanic eruptions on Earth and map a probable subsurface ocean on Jupiter's moon, Europa.

# PHYSICAL SCIENCES RESEARCH

## MAJOR EVENTS IN FY 2004

- 6 physical sciences flight experiments scheduled to be conducted on the Space Shuttle and Space Station.
- Delivery of the first major PSR research facility rack to the International Space Station, the Combustion Integrated Rack (CIR) on ULF-2. Beginning of prime research facility operations on the ISS, a new phase of Space Station utilization.
- Fluids Integrated Rack (FIR) flight hardware available by August 2004.

## THEME: Physical Sciences Research (PSR)

### OVERVIEW

The Office of Biological and Physical Research (OBPR) Physical Sciences Research (PSR) theme carries out basic and applied scientific investigations to lay the foundation for understanding the details of physical and chemical processes involved in developing the capabilities to deploy spacecraft, to generate resources, and to maintain life support sub-systems for in-space and planetary applications. By using the unique environment afforded by space platforms, the program also tackles fundamental unsolved scientific problems and pursues a better understanding of processes sensitive to the effects of gravity and relevant to industrial and technological applications on Earth. This theme relies on a talented and diverse academic research community to carry out many of its research activities, and strives to involve the next generation of scientists and engineers in space-based, as well as Earth-based, theoretical and experimental research, and to communicate the excitement and share the rewards of new discoveries.

| Missions | Goals supported by this theme | Objectives supporting those goals — Reference 2003 Strategic Plan |
|---|---|---|
| Understand and Protect our Home Planet | 3. Create a more secure world and improve the quality of life by investing in technologies and collaborating with other agencies, industry, and academia. | 3.5 Use the unique low-gravity environment of space to resolve scientific issues impacting Earth-based technological and industrial applications |
| Explore the Universe and Search for Life | 4. Explore the fundamental principles of physics, chemistry, and biology through research in the unique natural laboratory of space. | 4.2 Using the unique low-gravity environment in space, explore the fundamental organizing principles of nature and understand how they give rise to structure and complexity in matter. |
| Inspire the Next Generation of Explorers | 6. Inspire and motivate students to pursue careers in science, technology, engineering and mathematics. | 6.1 Improve student proficiency in science, technology, engineering and mathematics by creating a culture of achievement using educational programs, products and services based on NASA's unique missions, discoveries and innovations.<br>6.3 Enhance science, technology, and mathematics instruction with unique teaching tools and experiences that are compelling to educators and students only NASA can provide. |
| | 7. Engage the public in shaping and sharing the experience of exploration and discovery | 7.2 Engage the public in NASA missions and discoveries, and their benefits, through such avenues as public programs, community outreach, mass media, and the internet. |
| Space Flight Capabilities | 9. Extend the duration and boundaries of human space flight to create new opportunities for exploration and discovery | 9.3 Create a research database that resolve fundamental low-gravity issues affecting technologies for human space travel beyond low-Earth orbit (LEO). |

### RELEVANCE

The PSR theme addresses high priority research as identified by the science community. This research will improve Earth-based technologies and industrial applications by: 1) Improving the understanding of processes for combustion-based energy production and pollutant emission, focusing on issues in materials manufacturing such as the synthesis and processing of complex composite materials, and exploring natural self-assembly processes for advanced materials development; 2) Integrating physical sciences tools to understand complex biological systems impacting health research such as the functional basis of human physiology in space through the application of biological fluid modeling, the use of space to contribute to major problems in structural biology through advances in protein crystallography, mammalian tissue engineering using low gravity to control mechanical stresses, and use of laser tweezers for DNA characterization; 3) Developing quantum technologies, such as the atom laser and quantum data storage and computing, by using the ability to better manipulate atoms and molecules as Bose-Einstein condensates in a low-gravity environment.

## THEME: Physical Sciences Research (PSR)

Space exploration offers a unique opportunity to advance our understanding of the fundamental nature of matter and of the some of the key phenomena that give rise to order, structure, and complexity throughout the physical universe. The PSR program will enhance fundamental knowledge of the universe by: 1) Conducting pioneering experiments to advance understanding of model systems of complexity, focusing on a field of condensed matter physics known as "soft matter:" colloids, foams, liquid crystals, and granular systems, and biological system engineering; 2) Sharpening the experimental resolution of studies in condensed matter physics, leading to ultra-precise clocks to probe Einstein's General Relativity theory at an unrivaled level; and 3) Using the space environment to conduct unique experiments in materials science, challenging basic tenets of existing theories of how matter undergoes transformation from one form to another.

The PSR theme will improve the design and operation of space-based infrastructure such as spacecraft power and propulsion sub-systems, life support and resource creation and management systems, and innovative fabrication methods for space exploration purposes either in-space or on extra-terrestrial locations. Data from PSR projects will enable new technologies or improve existing designs in: 1) Efficient technologies for thermal management relying on boiling (an apparently simple technology not now available to designers because boiling in low gravity is not well-understood) two-phase flows in low-gravity in order to improve heat rejection capacity and reliability while decreasing mass and volume requirements; 2) Materials flammability assessment, combustion detection sensors, and fire extinguishment methodologies development in low and partial gravity; 3). Novel approaches for in-space fabrication methods using limited resources, under varying gravity levels, pressures and temperatures; and 4) Assessment and analysis of the effects of radiation on structural, electronic, and life support materials, and the development of radiation protection structure technology.

| Education and Public Benefits |
| --- |
| Public benefits are derived from the accumulation of new knowledge on a variety of physical and chemical phenomena that cannot be understood, or even observed, by earth-based experiments because of the effects of gravity. A better understanding of how combustion, free convection and other phenomena will lead to better manufacturing processes and improved products. With consistent improvements and a continued understanding of theses effects, there positive impacts to our quality of life is evident.<br><br>The broadly-based nurturing of academic peer-reviewed research through undergraduate, graduate, and post-doctoral students support in a wide variety of scientific and engineering disciplines will contribute to sustain the supply of the skilled technical workforce of tomorrow. New observations and understanding of nature revealed by unfamiliar phenomena by scientific research in space will enhance the appeal of a technical education. They will provide the renewed excitement and motivation to acquire understanding and to make new discoveries through actual hands-on involvement in flight-based research and space exploration. |

### IMPLEMENTATION

This theme is composed of a set of integrated elements working together to achieve the aforementioned goals and objectives. Those elements support five scientific and engineering disciplines contributing their expertise to the accomplishment of the specified goals and objectives. These disciplines are: Cellular and Macromolecular Biotechnology, Combustion Science, Fluid Physics and Transport Phenomena, Materials Science, and Fundamental Physics. Each of these disciplines involve the related scientific communities in academia, government, and the private sector who compete for peer-reviewed research grants to carry out earth and space-based research. The flight-based research is carried out through the development, on-orbit deployment, and operations of a set of cross-disciplinary and/or specialized facilities. The output of the earth and space-based research takes the form of peer-reviewed archival publications, patents, students master and doctoral theses, co-operative agreements with the private sector for collaborative research or for product development, and transferred technology through a technical database.

## THEME: Physical Sciences Research (PSR)

### IMPLEMENTATION (continued)

The elements of the program include a Research component that selects and administers peer reviewed research grants and contracts, and a flight research element that controls ISS (and STS) development and operations activities. The ISS flight program is developing the following set of specialized and cross-disciplinary research facilities: The Biotechnology Facility (BTF) that will be housed in multi-purpose Express racks, the Fluids and Combustion Facility (FCF - currently composed of the Fluids Integrated Rack (FIR) and Combustion Integrated Rack (CIR)), the Materials Science Research Rack (MSRF - currently composed of MSRR-1), the Low Temperature Microgravity Physics Facility (LTMPF) on the external payload facilities, and a series of pressurized environment sub-rack apparatuses (eg; Physics of Colloids in Space (PCS)). PSR is a multiple-project and single-program theme with program responsibility in the Office of Biological and Physical Research at NASA HQ. The theme director is Dr. Eugene Trinh in the Physical Sciences Research Division at NASA HQ.

| Strategy (start dates of below items to be revised) | Schedule by Fiscal Year<br>96 97 98 99 00 01 02 03 04 05 06 07 08 09 10 | Purpose |
|---|---|---|
| Microgravity Science Glovebox Research & Developmen | | Low-gravity laboratory facility for real-time astronaut interaction. |
| Combustion Integrated Rack (CIR) | | Flight-based research facility for fundamental research in energy and pollutant production processes and spaceflight fire safety issues. |
| Materials Science Research Rack 1 (MSRR-1) | | Materials science facility for understanding of the diverse forms of matter, materials manufacturing and development for space-based systems. |
| Fluids Integrated Rack (FIR) | | Perform investigations in fundamental fluid flows in physiological phenomena, and to develop a scientific data base. |
| Low-Temperature Microgravity Physics Facility (LTMPF) | | Remotely-controlled facility to test fundamental laws of condensed matter physics and to develop ultra-precise atomic clocks. |
| Biotechnology Research Facility (BTF) | | Consolidated facility to perform cell assembling and tissue culturing research. |

Research Development Operations

### STATUS

The PSR theme prepared and carried out an ISS research investigation on colloidal physics, protein crystallization and three-dimensional tissue culture. They initiated the definition of a Bio-science and Engineering program to drive novel concepts for space-based investigations in biomedical systems. Other achievements were: Investigated fundamental and unresolved issues in condensed matter physics and atomic physics, and carried out atomic clock development for space-based utilization; Produced scientific discoveries in atomic and condensed matter physics, and published in mainstream peer-reviewed archival journals; Designed and developed flight experiment apparatus for low-temperature physics, laser cooling, and atomic physics investigations on the ISS; Completed the preparation and carried out ISS investigations in fundamental materials science to be carried out in the Microgravity Science Glovebox; 30 ground research proposals were selected in CY 2002.

Please follow this link for additional data: http://spaceresearch.nasa.gov

## THEME: Physical Sciences Research (PSR)

### PERFORMANCE MEASURES

| Annual Performance Goals | |
|---|---|
| OUTCOME: 3.5.1 | Use the unique low-gravity environment to resolve scientific issues that impact Earth-based technological and industrial applications. |
| 4PSR1 | Improve understanding of the detailed physical and chemical processes associated with combustion, the efficiency of combustion, and how soot is produced in flames; the properties and behavior of granular materials such as soils and powders; growing crystals of large molecules for applications in drug development and biomedical research; and growing tissues outside the body (cellular assembling processes in tissue cultures) for research and medical treatments. Progress toward accomplishing this Performance Goal will be assessed by an advisory committee. |
| OUTCOME: 4.2.1 | Advance the scientific understanding of complex biological and physical systems. |
| 4PSR2 | Use research in the low gravity environment of space to advance the scientific understanding of complex biological and physical systems. FY 04 accomplishments will include maintaining an open, competitive, and productive research community, and carrying out and analyzing results of ISS experiments in colloidal physics. Progress toward accomplishing this performance goal will be assessed by an advisory committee. |
| OUTCOME: 4.2.2 | Advance understanding of fundamental issues in condensed matter physics and atomic physics. |
| 4PSR3 | Investigate fundamental and unresolved issues in condensed matter physics and atomic physics. FY 04 activities will include maintaining an open, competitive and productive research program in condensed matter physics, Bose-Einstein condensation, and atomic clocks development for space-based utilization. Progress toward accomplishing this performance goal will be assessed by an advisory committee. |
| OUTCOME: 6.1.1 | Kindergarten through graduate students will be more proficient in science, technology, engineering and mathematics (STEM). |
| 4PSR4 | Engage students in inquiry-based learning experiences through development and distribution of classroom activities that simulate biological and physical sciences space research investigations. These activities will align with standards-based curriculum. |
| OUTCOME: 6.3.1 | Improve quality of STEM instruction. |
| 4PSR5 | Develop collaborations with Professional Education Associations directed to enhancement of educator proficiency in use of space research content and classroom, educational hardware focused on standards-based curriculum. |
| 4PSR6 | Develop and train facilitators for dissemination of 3 comprehensive Educator Professional Development Seminar packages focused on biological and physical sciences research that coordinates with standard's based science, math, and technology concepts. |
| OUTCOME: 7.2.4 | Broaden OBPR research information to diverse audiences. |
| 4PSR7 | In FY 04 increase mailing list of Space Research newsletter by 5,000 over FY 03 mailing list. |
| 4PSR8 | Through collaboration with PAO, establish and sustain a series of media presentations of OBPR research highlights. There will be a series of presentations to the media of research results; this campaign of media presentations will be ongoing and will be increased in FY 04 over the initial series that will take place in FY 03. |
| 4PSR9 | OBPR will expand its involvement in reaching minority and under-represented sectors of the public, through participation in conferences and community events that reflect cultural awareness and outreach. There will be at least one new venue more associated with a minority and/or under-represented community, then outreach efforts taking place in FY 03. |
| OUTCOME: 9.3.1 | Increase research database with results from radiation measurements, microgravity combustion and heat transport investigations. |
| 4PSR10 | Extend the available database on radiation effects in materials using the newly commissioned Booster Application Facility at Brookhaven. Progress will be reviewed by an advisory committee. |
| 4PSR11 | Analyze results of ISS and Space Shuttle (STS 107) investigations on fire safety and microgravity combustion. Progress will be reviewed by an Advisory Committee. |
| 4PSR12 | Prepare for and carry out microgravity heat exchange investigation on ISS. Progress will be reviewed by an advisory committee. |

### INDEPENDENT REVIEWS

| Types of Review | Performer | Last Review | Next Review | Purpose |
|---|---|---|---|---|
| Indep Annual Review | ReMaP | 1-Sep-02 | None Planned | Research Prioritization |
| Indep Peer Reviews | IDI | 20-Nov-02 | 3-Dec-02 | NRA Announcement Panel Rev. |
| National Research Council Committees | NAS/NRC | 1-Jun-02 | None Planned | NAS research progress/quality |
| External Advisory Committees | NASA | 27-Aug-02 | Annual | Advisory Committees Research |

## THEME: Physical Sciences Research (PSR)

### BUDGET

| Budget Authority ($millions) | FY02 | FY03 | Change | FY04 | Comments |
|---|---|---|---|---|---|
| **Physical Science Research** | **227.4** | **247.1** | **+106.1** | **353.2** | |
| Development | 40.8 | 29.9 | +18.0 | 47.9 | Changes in PSR programs due to full cost, ReMaP decisions, and addition of Human Research Initiative. |
| Fluids and Combustion Facility | 22.3 | 12.0 | +10.9 | 22.9 | |
| Low Tempature Microgravity Physics Facility | 13.9 | 12.9 | -3.0 | 9.9 | |
| Materials Science Research Rack-1 | 4.6 | 5.0 | +10.1 | 15.1 | |
| Operations | 66.7 | 83.1 | +76.7 | 159.8 | |
| ISSRC Physical Science Research | 66.7 | 83.1 | +76.7 | 159.8 | |
| Research | 119.9 | 134.1 | +11.4 | 145.5 | |
| Physical Science Research (Strategic and Fundamental) | 119.9 | 134.1 | +11.4 | 145.5 | |

Note: For all formats, the FY 02 column reflects the FY 2002 Congressional Operating Plan letter dated 9/30/02. The FY 03 column reflects the FY 2003 Presidents Budget Submit (PBS) as Amended. The Change column includes both programmatic and full cost adjustments. FY 2004 column is in full cost.

Indicates budget numbers in Full Cost.
Indicates changes since the FY 2003 Presidents Budget Submit.
FY 2002 and FY 2003 are not in full cost.

| THEME: | Physical Sciences Research (PSR) |
|---|---|
| **DEVELOPMENT:** | **Fluids and Combustion Facility (FCF)** |

## PURPOSE

| Objectives | Reference 2003 Strategic Plan | Performance Measures |
|---|---|---|
| 3.5; 4.2; 9.3 | | 4PSR1, 4PSR2, 4PSR3, 4PSR10, 4PSR11, 4PSR12 |

The primary purpose of the Fluids and Combustion Facility (FCF) is to use the space environment as a laboratory to test the fundamental principles of physics, chemistry, and biology and to generate the required scientific microgravity database to enable the development of technologies for human space exploration beyond LEO.

## OVERVIEW

The Fluids Integrated Rack (FIR) is an ISS science rack designed to study the properties of simple and complex fluids in various forms (i.e. liquid, gas, multi-phase mixture) in an orbital microgravity environment. The objective is to remove the effects of sedimentation, buoyancy, and convection in order to investigate natural phenomena and industrial processes and systems that are greatly affected by gravitational forces. The FIR provides the laboratory infrastructure to carry out detailed observations and accurate measurements by implementing an ingenious and award-winning rotatable optical bench that allows the quick removal and installation of experiment containers and various diagnostic instrumentation such as imaging, confocal microscopy, environment control, and automation. The Combustion Integrated Rack (CIR) provides similar research capability for investigations requiring insight into the behavior of laminar flames, turbulent droplet and spray combustion, and flame spread over fuel surfaces when the influence of gravity is greatly reduced. Both racks allow the implementation of many different investigations because of their modular design that is conducive to the use of a variety of experimental inserts to accommodate a wide range of research topics.

Please follow this link for additional data: http://fcf.grc.nasa.gov

## PROGRAM MANAGEMENT

Enterprise official is Mary Kicza, Associate Administrator for Biological and Physical Research at HQ. Theme Director is Gene Trinh, Director for Physical Sciences Research at HQ. The FCF program responsibility is delegated to the Glenn Research Center. Project Manager is Robert Zurawskil at the Glenn Research Center. Full compliance with NPG 7120.5B will be achieved in FY 03 for the relevant portions.

## TECHNICAL COMMITMENT

Baseline Commitment as of OBPR Basis of Estimates (BOE) dated 1/22/02

| Technical Specifications | FY04 President's Budget | Change from Baseline |
|---|---|---|
| Launch Vehicle: | Shuttle | -- |
| Fluids and Combustion Facitliy: | 1 FIR / 1 CIR | -- |
| Power to Payloads: | 3 kW rack power | -- |
| Facility operational lifetime: | 10 years | |
| Operational capability: | Provides gas mixing, thermal control, data storage, power conditioning and digital imaging | |
| Science Instruments: | Gas Chromatograph, Infrared Imaging, Fiber Illumination, Optics Bench and a High-Pressured Containment Vessel | |

| Schedule | FY04 President's Budget | Change from Baseline |
|---|---|---|
| CIR Critical Design Review (CDR) | May-02 | 2 months |
| CIR Flight Hardware Available (FHA) | Jan-04 | BOE contained TBD |
| FIR Critical Design Review (CDR) | Dec-02 | 2 month |
| FIR Flight Hardware Available (FHA) | Aug-04 | -- |

**THEME:** Physical Sciences Research (PSR)

# DEVELOPMENT: Fluids and Combustion Facility (FCF)

## ACQUISITION STRATEGY & PERFORMING ORGANIZATIONS

Data current as of 1/18/2003

Major acquisitions for FCF are: Power Supply, Avionics/control, Common illumination, PI Integration optics bench, Fluid diagnostics, Environmental Control, Imaging and frame capture, Combustion Diagnostics, Combustion Chamber with Northop Grumman as the prime contractor. **Changes since FY03 Pres. Budget: Combustion Integrated Rack added for FY03 - FY08**

| Current Acquisitions | Actual* | Selection Method | Actual* | Performer | Actual* |
|---|---|---|---|---|---|
| Cooperative Agreements | 0% | Full & Open Competition | 90% | Industry | 89% |
| Cost Reimbursable | 0% | Sole Source | 10% | Government | 4% |
| Fixed Price | 42% | | 100% | NASA Intramural | 6% |
| Grants | 0% | | | University | 1% |
| Other (Cost +) | 58% | Science Peer Review | 0% | Non Profit | 0% |
| | 100% | *% based on FY 02 direct proc. | | | 100% |

| Future Acquisitions - Major | Selection | Goals |
|---|---|---|
| Change to Cost Plus | Fall 03 | 100% Full & Open Competition, 10% SB, 100% Cost Plus |

## AGREEMENTS

Data current as of 1/18/2003

Internal: None.
External: None.
**Changes since FY03 Presidents Budget: None.**

## INDEPENDENT REVIEWS

Data current as of 1/18/2003

| Types of Review | Performer | Last Review | Next Review | Purpose |
|---|---|---|---|---|
| Critical Design Reviews | Indep. Panel | 5/28-31/2002 | 9-13 Dec. 2002 | NASA technical and programmatic assessment. |

## BUDGET / LIFE CYCLE COST

Total budget authority represents a ROM Life Cycle Cost (LCC) for the development of this facility.

| Budget Authority ($ in millions) | Prior | FY02 | FY03 | FY04 | FY05 | FY06 | FY07 | FY08 | BTC | Total | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|
| FY 2004 President's Budget (LCC) | 107.5 | 22.3 | 12.0 | 22.9 | 12.5 | 4.9 | 0.0 | 0.0 | 0.0 | 182.2 | |
| Development | 107.5 | 22.3 | 12.0 | 22.9 | 12.5 | 4.9 | | | | 182.2 | |
| Changes since FY 03 Pres. Budget | -0.4 | +0.0 | +0.0 | +15.0 | +7.3 | +4.9 | +0.0 | +0.0 | | +26.8 | **Reason for Change:** |
| Development | -0.4 | +0.0 | +0.0 | +15.0 | +7.3 | +4.9 | | | | +26.8 | Add back of the CIR and full cost. |
| FY 2003 President's Budget (LCC) | 108.0 | 22.3 | 12.0 | 7.9 | 5.2 | 0.0 | 0.0 | 0.0 | | 155.4 | |
| Development (Mar 02) | 108.0 | 22.3 | 12.0 | 7.9 | 5.2 | 0.0 | | | | 155.4 | |
| Basis of Estimate (BOE) | 108.0 | 20.1 | 11.8 | 7.4 | 1.9 | 0.0 | 0.0 | 0.0 | | 149.1 | |
| Development (Mar 02) | 108.0 | 20.1 | 11.8 | 7.4 | 1.9 | 0.0 | | | | 149.1 | Baseline Mar 2002 |

Indicates budget numbers in Full Cost.
Indicates changes since the FY 2003 Presidents Budget Submit.
FY 2002, FY 2003, Prior and BTC are not in full cost.

| THEME: | Physical Sciences Research (PSR) |
|---|---|
| **DEVELOPMENT:** | Low Temperature Microgravity Physics Facility (LTMPF) |

## PURPOSE

| Objectives Reference 2003 Strategic Plan | Performance Measures |
|---|---|
| 3.5; 4.2; 9.3 | 4PSR1, 4PSR2, 4PSR3, 4PSR10, 4PSR11, 4PSR12 |

The Low Temperature Microgravity Physics Facility (LTMPF) will use the space environment as a laboratory to test the fundamental principles of physics, chemistry, and biology. LTMPF will allow the scientific community to carry out definitive experiments in condensed matter physics and critical phenomena. The currently selected space-based investigations are considered capstone research, offering groundbreaking opportunities not before available.

## OVERVIEW

The Low Temperature Microgravity Physics Facility (LTMPF) is an external unpressurized payload. The LTMPF is designed for long-duration science investigations whose objectives can only be achieved in a microgravity environment and at ultra-low temperatures provided by a space-qualified cryogenic dewar system. The facility will allow automated and remotely-commanded of unique experimental apparatuses operated at near absolute zero temperature and implementing stable high resolution thermometry. The combination of low-gravity and the use of this high-precision instrumentation will allow the accurate measurement of fundamental parameters such as the heat capacity and compressibility in the critical region of superfluid helium. Such measurements are required to verify fundamental theoretical predictions, but are impossible to carry out on earth. LTMPF will also lead to the development of on-orbit super-stable microwave cavity and to the implementation of a novel Laser Cooling and Atomic Physics facility for the development of ultra-precise atomic clocks.

## PROGRAM MANAGEMENT

Enterprise official is Mary Kicza, Associate Administrator for Biological and Physical Research at HQ. Theme Director is Gene Trinh, Director for Physical Sciences Research at HQ. The LTMPF Project program responsibility is delegated to the Jet Propulsion Laboratory. Project Manager is John Pensinger at the Jet Propulsion Laboratory. Full compliance with NPG 7120.5B will be achieved in FY 03 for the relevant portions.

## TECHNICAL COMMITMENT

Baseline Commitment as of OBPR Basis of Estimates (BOE) dated 2/26/02.

| Technical Specifications | FY04 President's Budget | Change from Baseline |
|---|---|---|
| Launch Vehicle | Shuttle | -- |
| External attached payload | Attached payload located on Japanese Module | -- |
| Power to Payloads | 300 W power | -- |
| Facility operational lifetime | 10 years (5 missions of 6 months each, every 22 months) | -- |
| Operational capability: 5-6 months of Helium and 4.5 months Data Acquition per mission | | -- |
| Science Instruments: MISTE/COEX and DYNAMX/CQ | | |

| Schedule | FY04 President's Budget | Change from Baseline |
|---|---|---|
| LTMPF Critical Design Review (CDR) | Sep-03 | 3 months |
| LTMPF Final Assembly and Test (FAT) | May-06 | -- |
| LTMPF Flight Hardware Available (FHA) | Aug-07 | 18 months |

| | |
|---|---|
| **THEME:** | Physical Sciences Research (PSR) |
| **DEVELOPMENT:** | Low Temperature Microgravity Physics Facility (LTMPF) |

## ACQUISITION STRATEGY & PERFORMING ORGANIZATIONS

Major acquisitions for LTMPF are: Facility (includes dewar, enclosure, common electronics & software), Dewar (provides cryostat) and Probe (houses two ISP's). Ball Aerospace and Technology Corporation (BATC) selected in 1995 as prime contractor. In 2001 BATC's content was descoped to only provide the Dewar and Enclosure Subsystem (DES) and Deign_Net Engineering was selected to provide Electronics and Software Subsystem (ESS). **Changes since FY03 Pres. Budget: Two-year delay due to JEM-EF slip.**

| Current Acquisitions | Actual* | Selection Method | Actual* | Performer | Actual* |
|---|---|---|---|---|---|
| Cooperative Agreements | 0% | Full & Open Competition | 100% | Industry | 100% |
| Cost Reimbursable | 0% | Sole Source | 0% | Government | 0% |
| Fixed Price | 0% | | 100% | NASA Intramural | 0% |
| Grants | 0% | | | University | 0% |
| Other (Cost + Award Fee) | 100% | Sci Peer Review | 0% | Non Profit | 0% |
| | 100% | *% based on FY 02 direct proc. | | | 100% |

| Future Acquisitions - Major | Selection | Goals |
|---|---|---|
| Cost + Award Fee | Fall 03 | 100% Full & Open Competition, 10% SB, 100% Cost Plus Award Fee |

## AGREEMENTS

Internal: None

External: Payload Interface Unit (PIU), Flight Releasable Attachment Mechanism (FRAM), Flight Releasable Grapple Fixture (FRGF) and H Fixture from NASA JSC and SAMS accelerometer from NASA GRC.

**Changes since FY03 Pres. Budget: TBD.**

## INDEPENDENT REVIEWS

| Types of Review | Performer | Last Review | Next Review | Purpose |
|---|---|---|---|---|
| Independent Assessment | MSFC CFO | 26-Jul-01 | 3-Mar-03 | Cost and schedule assessment. |

## BUDGET / LIFE CYCLE COST

Total budget authority represents a ROM Life Cycle Cost (LCC) for the development of this facility.

| Budget Authority ($ in millions) | Prior | FY02 | FY03 | FY04 | FY05 | FY06 | FY07 | FY08 | BTC | Total | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|
| FY 2004 President's Budget (LCC) | 14.5 | 13.9 | 12.9 | 9.9 | 6.4 | 1.3 | 0.0 | 0.0 | 0.0 | 58.9 | |
| Development | 14.5 | 13.9 | 12.9 | 9.9 | 6.4 | 1.3 | | | | 58.9 | |
| Changes since FY 03 Pres. Budget | 0.0 | 0.0 | +0.8 | -0.6 | +0.0 | +0.3 | +0.0 | +0.0 | | +0.5 | ***Reason for Change:*** |
| Development | 0.0 | 0.0 | +0.8 | -0.6 | +0.0 | +0.3 | | | | +0.5 | Appropriation increase and full cost adjustments. |
| FY 2003 President's Budget (LCC) | 14.5 | 13.9 | 12.1 | 10.5 | 6.4 | 1.0 | 0.0 | 0.0 | | 58.4 | |
| Development | 14.5 | 13.9 | 12.1 | 10.5 | 6.4 | 1.0 | 0.0 | | | 58.4 | |
| Basis of Estimate (BOE) | 14.5 | 9.2 | 12.1 | 9.5 | 6.3 | 1.2 | 0.0 | 0.0 | | 52.8 | |
| Development (Mar 02) | 14.5 | 9.2 | 12.1 | 9.5 | 6.3 | 1.2 | 0.0 | | | 52.8 | Baseline Mar 2002 |

Indicates budget numbers in Full Cost.

Indicates changes since the FY 2003 Presidents Budget Submit.

FY 2002, FY 2003, Prior and BTC are not in full cost.

| THEME: | Physical Sciences Research (PSR) |
|---|---|
| **DEVELOPMENT:** | **Materials Science Research Rack- 1 (MSRR-1)** |

## PURPOSE

| Objectives Reference 2003 Strategic Plan | Performance Measures |
|---|---|
| 3.5; 4.2; 9.3 | 4PSR1, 4PSR2, 4PSR3, 4PSR10, 4PSR11, 4PSR12 |

The strategic objective of the Materials Science Research Rack-1 is to use the space environment as a laboratory to test the fundamental principles of physics, chemistry, and biology. The fundamental purpose of the MSRR-1 will be to evaluate the reactions of various materials to a low gravity environment while contained in a specialized compartment.

## OVERVIEW

The MSRR-1 is a modular autonomous rack that implements a set of furnace modules and diagnostic instrumentation for the study of a variety of materials such as glass, ceramics, metals and alloys, electronic materials, and composites in a low gravity environment. The MSRR-1 includes subsystems that provide basic resources, and experiment modules and module inserts, which contain the scientific experiments. An Active Rack Isolation System (ARIS) is provided for vibration isolation. The MSRR-1 accommodates the Materials Science Laboratory through a cooperative project with the European Space Agency. A second experiment module is provided through the Space Products Development program.

Please follow this link for additional data: http://msrf.msfc.nasa.gov/index.html

## PROGRAM MANAGEMENT

Enterprise official is Mary Kicza, Associate Administrator for Biological and Physical Research at HQ. Theme Director is Gene Trinh, Director for Physical Sciences Research at HQ. The MSRR - 1 program responsibility is delegated to the Marshall Space Flight Center. Project Manager is Charles Darby at the Marshall Space Flight Center. Full compliance with NPG 7120.5B will be achieved in FY 03 for the relevant portions.

## TECHNICAL COMMITMENT

Baseline Commitment as of OBPR Basis of Estimates (BOE) dated 1/22/02.

| Technical Specifications | FY04 President's Budget | Change from Baseline |
|---|---|---|
| Launch Vehicle | Shuttle | -- |
| MSRR-1 | 1 MSRR rack, 1 Quench Module Insert (QMI) insert, and 1 SPD furnace module accommodation | -- |
| Power to Payloads | 3 kW rack power | -- |
| Operational capability: | Provides support for 2 Experiment Modules Processing parameters can be updated or changed through telescience control of the payload. Sample exchange is manual. | |
| ARIS equipped ISPR | | |
| | Major support subsystems: Master Controller, Solid State Power Control Module, Thermal and Environmental Control System, Vacuum Access System, Support Structure, Experiment Modules and Module Inserts. | |
| Science Instruments: | | |
| Materials Science Laboratory EM | Support precise temperature stability and control, high resolution temperature resolution and measurement, furnace translation capability, mass spectrometer failure detection system, rotating magnetic field, current pulsing capability for sample interface demarcation, and shear cell motor drive capability. Module Inserts Quench Module Insert(QMI) Large Gradient Furnace (LGF) & Solidification Quench Furnace (SQF) are exchangeable on-orbit for tailored experiment conditions including high temperature processing with high and low temperature gradients, rapid heat extraction through quenching, and isothermal heated regions. | |
| Space Product Development EM | Supports on-orbit exchange of transparent and opaque furnace inserts for vapor crystal growth and processing of glass performs. Samples are exchanged with furnace inserts. Provides temperature control and telescience monitoring and control of processing parameters. | |

| Schedule | FY04 President's Budget | Change from Baseline |
|---|---|---|
| MSRR - 1 Flight Hardware Available (FHA) | Jan-05 | 6 months |
| Integrated Payload CDR | Complete 5/02 | -- |
| QMI Flight Hardware Available (FHA) | Jan-05 | Not in baseline BOE |
| Payload Safety Review | Oct-03 | -- |

| THEME: | Physical Sciences Research (PSR) |
|---|---|
| **DEVELOPMENT:** | **Materials Science Research Rack- 1 (MSRR-1)** |

## ACQUISITION STRATEGY & PERFORMING ORGANIZATIONS

Data current as of 1/18/2003

Major acquisitions for MSRR - 1 are: Solid State Power Control Module (SSPCM), Active Rack Isolation System (ARIS), and International Standard Payload Rack (ISPR). The Quench Module Insert (QMI) and additional Rack Support Systems (RSS) which consisting of Master Controller (MC), Thermal & Environment Control System, Vacuum Access System and Support Structure are developed and acquired through the in house effort. The Materials Science Laboratory Experiment Module (MSL-EM), Space Product Development - Experiment Module (SPD-EM) are acquire through other agreements. **Changes since FY03 Pres. Budget: Selection of Prime Contractor with tasks transferred from in-house effort starting in FY03.**

| Current Acquisitions | Actual* | Selection Method | Actual* | Performer | Actual* |
|---|---|---|---|---|---|
| Cooperative Agreements | 0% | Full & Open Competition | 100% | Industry | 30% |
| Cost Reimbursable | 0% | Sole Source | 0% | Government | 0% |
| Fixed Price | 30% | | 100% | NASA Intramural | 70% |
| Grants | 0% | | | University | 0% |
| Othe (In House) | 70% | Sci Peer Review | 0% | Non Profit | 0% |
| | 100% | *% based on FY 02 direct proc. | | | 100% |

| Future Acquisitions - Major | Selection | Goals |
|---|---|---|
| Change to On-Site Contractors | Fall 03 | 100% Full & Open Competition |

## AGREEMENTS

Data current as of 1/18/2003

Internal*:* None

External*:* Interagency Bilateral Cooperative Research Agreement (dated August 1999), as authorized by the early Station Utilization Memorandum of Understanding (MOU) between NASA and ESA. **Changes since FY03 Pres. Budget: None.**

## INDEPENDENT REVIEWS

| Types of Review | Performer | Last Review | Next Review | Purpose |
|---|---|---|---|---|
| Independent Annual Review | MSFC/SMO | 20-Jul-02 | 1-Jul-03 | Independent Audit |

## BUDGET / LIFE CYCLE COST

Total budget authority represents a ROM Life Cycle Cost (LCC) for the development of this facility.

| Budget Authority ($ in millions) | Prior | FY02 | FY03 | FY04 | FY05 | FY06 | FY07 | FY08 | BTC | Total | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|
| FY 2004 President's Budget (LCC) | 35.1 | 4.6 | 5.0 | 15.1 | 1.5 | 0.0 | 0.0 | 0.0 | 0.0 | 61.3 | |
| Development | 35.1 | 4.6 | 5.0 | 15.1 | 1.5 | 0.0 | 0.0 | | | 61.3 | |
| Changes since FY 03 Pres. Budget | -27.2 | +0.0 | +0.0 | +8.7 | -1.4 | -1.7 | -1.7 | +0.0 | | -23.2 | ***Reason for Change:*** |
| Development | -27.2 | +0.0 | +0.0 | +8.7 | -1.4 | -1.7 | -1.7 | | | -23.2 | Facility only adjustments and full cost. |
| FY 2003 President's Budget (LCC) | 62.3 | 4.6 | 5.0 | 6.4 | 2.9 | 1.7 | 1.7 | 0.0 | | 84.5 | |
| Development (Mar 02) | 62.3 | 4.6 | 5.0 | 6.4 | 2.9 | 1.7 | 1.7 | | | 84.5 | |
| Basis of Estimate (BOE) | 62.3 | 7.4 | 7.7 | 4.7 | 0.8 | 0.0 | 0.0 | 0.0 | | 82.8 | |
| Development (Mar 02) | 62.3 | 7.4 | 7.7 | 4.7 | 0.8 | 0.0 | 0.0 | | | 82.8 | Baseline Mar 2002. |

Indicates budget numbers in Full Cost.

Indicates changes since the FY 2003 Presidents Budget Submit.

FY 2002, FY 2003, Prior and BTC are not in full cost.

| THEME: | Physical Sciences Research (PSR) |
|---|---|
| **OPERATIONS:** | **Physical Sciences Research (PSR)** |

## PURPOSE

| Objectives | Reference 2003 Strategic Plan | Performance Measures |
|---|---|---|
| 3.5; 4.2; 9.3 | | 4PSR1, 4PSR2, 4PSR3, 4PSR10, 4PSR11, 4PSR12 |

The Physical Sciences Research (PSR) Program will combine unique experimental facilities with long-duration access to Low-Earth Orbit and beyond to enable new scientific discoveries and the development of technologies for the benefit of space exploration and Earth-based applications.

## OVERVIEW

The Physical Sciences Research Program will continue fabrication of ISS research racks and experiment inserts for the CIR, FIR, and MSRR-1. PSR plans to carry out manifested ISS research investigations in the first discipline focused racks (CIR) as well as in EXPRESS Racks and the Microgravity Science Glovebox in order to process the already selected flight investigations in the queue. The program will also initiate the newly validated and prioritized research program content and continue ground-based and flight research in the validated and prioritized research areas. PSR has a current roster of 85 flight investigations to be implemented between 2004 and 2008. PSR will also collaborate with the International Partners (ESA, DLR, CNES, NASDA) in order to plan the efficient utilization of all available ISS experiment facilities. Starting in FY 2004 OBPR will begin the Human Reserach Inititative. This will accelerate the acquisition of knowledge and technology needed for decisions on human exploration beyond low-Earth-orbit.

Please follow this link for additional data: http://spaceresearch.nasa.gov/

## PROGRAM MANAGEMENT

Enterprise official is Mary Kicza, Associate Administrator for Biological & Physical Sciences at HQ Theme Director and Point of Contact is Dr. Eugene Trinh, Director for Physical Sciences Research at HQ. The PSR program responsibility is delegated to the Glenn Research Center, Jet Propulsion Laboratory, Johnson Space Center and Marshall Space Flight Center. Full compliance with NPG 7120.5B will be achieved in FY 03 for the relevant portions.

## TECHNICAL COMMITMENT

The definition of the baseline is the Basis of Estimate (BOE)

| Technical Specifications | FY04 President's Budget | Change from Baseline |
|---|---|---|
| Combustion Integrated Rack | Provide laboratory capability for combustion research | -- |
| Fluids Integrated Rack | Implement cross disciplinary research | -- |
| Materials Science Research Rack-1 | Provides materials science research platform | -- |
| Physics of Colliods in Space + (PCS+) | Implements fundamental research in complex systems | -- |
| Low Temp Microgravity Physics Facility | Implements fundamental physics external platform | -- |
| Space Acceleration Measurement System | Implements environmental acceleration measurements | -- |
| Protein Crystal Growth | Implements structural biology research in Express racks | -- |
| BSTC/BTR | Implements cell biotechnology research | -- |
| Microgravity Science Glovebox | Provides a cross-disciplinary hands-on research platform | -- |

| Schedule | FY04 President's Budget | Change from Baseline |
|---|---|---|
| Combustion Integrated Rack | Launch on ULF-2 | -- |
| Fluids Integrated Rack | Launch on UF-5 | -- |
| Materials Science Research Rack-1 | Launch on UF-5 | -- |
| Physics of Colliods in Space + (PCS+) | FHA in '03 | -- |
| Low TemP Microgravity Physics Facility | Launch is TBD | -- |
| Space Acceleration Measurement System | Operations in US Lab | -- |
| Protein Crystal Growth | Operations in US Lab | -- |
| BSTC/BTR | Operations in US Lab | -- |
| Microgravity Science Glovebox | Operations in US Lab | -- |

| THEME: | Physical Sciences Research (PSR) |
|---|---|
| **OPERATIONS:** | Physical Sciences Research (PSR) |

## ACQUISITION STRATEGY & PERFORMING ORGANIZATIONS

Data current as of 1/18/2003

The major prime contractors for PSR inserts or hardware are: Northrup-Grumman, Boeing and in-house civil service. Contracts typically cover 4 - 5 years of operation build time. Other activities include; integration and ops, utilization and institutional requirements. **Changes since FY03 Pres. Budget: None.**

| Current Acquisitions | Actual* | Selection Method | Actual* | Performer | Actual* |
|---|---|---|---|---|---|
| Cooperative Agreements | 0% | Full & Open Competition | 90% | Industry | 60% |
| Cost Reimbursable | 65% | Sole Source | 10% | Government | 0% |
| Fixed Price | 5% | | 100% | NASA Intramural | 35% |
| Grants | 0% | | | University | 5% |
| Other (Cost +) | 30% | Sci Peer Review | 0% | Non Profit | 0% |
| | 100% | *% based on FY 02 direct proc. | | | 100% |

| Future Acquisitions - Major | Selection | Goals |
|---|---|---|
| Change to Cost Plus | Fall 03 | 100% Full & Open Competition, 5% SB, 100% Cost Plus |

## AGREEMENTS

Data current as of 1/18/2003

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

## INDEPENDENT REVIEWS

| Types of Review | Performer | Last Review | Next Review | Purpose |
|---|---|---|---|---|
| Independent Annual Review | ReMaP | 1-Sep-02 | N/A | Science Reprioritization |
| National Academy | NRC/SSB | 1-Jun-02 | None Planned | Independent science assessment |

## BUDGET

| Budget Authority ($ in millions) | FY02 | FY03 | FY04 | Comments |
|---|---|---|---|---|
| FY 2004 President's Budget | 66.7 | 83.1 | 159.8 | |
| ISSRC Physical Sciences Research (Operations) | 66.7 | 83.1 | 159.8 | |
| Changes since FY 03 President's Budget | +2.4 | +62.7 | +67.8 | ***Reason for Change:*** |
| | +2.4 | +62.7 | +67.8 | Full cost accounting, project changes, and addition of the Human Research Initiative (HRI). |

Indicates budget numbers in Full Cost.
Indicates changes since the FY 2003 Presidents Budget Submit.
FY 2002 and FY 2003 are not in full cost.

| | |
|---|---|
| **THEME:** | Physical Sciences Research (PSR) |
| **RESEARCH:** | **Physical Sciences Research (PSR)** |

## PURPOSE

| Objectives | Reference 2003 Strategic Plan | Performance Measures |
|---|---|---|
| 3.5; 4.2; 6.1, 6.3, 7.2, 9.3 | | 4PSR1- 4PSR12 |

The strategic objective of the Physical Sciences Research thrust area is twofold: Strategic Research and Fundamental Research. The Strategic Research area emphasizes the basic and applied research that the Agency relies uniquely upon OBPR to conduct to enable NASA's mission to explore the Universe and search for life. The Fundamental Research area emphasizes the basic and applied research to address the role of gravity in biological and physical processes of inherent scientific interest and of potential technological applications on Earth.

## OVERVIEW

The Physical Sciences Research (PSR) Program sponsors peer-reviewed, interdisciplinary ground-based and flight research focusing on most recent and exciting areas of atomic and biomolecular physics and chemistry, groundbreaking research in biotechnology, and significant new developments in materials science, fluid physics, and combustion research. A unique component of the program is the cross-disciplinary research in the microgravity environment of space to increase understanding of those physical and chemical phenomena affecting biological systems that are masked by the effects of gravity on Earth. The PSR research program is divided into two thrust areas: strategic research and fundamental microgravity research. The key difference between the two thrust areas is the strategic research focus on developing advanced technology for both robotic and human deep space flight. Fundamental microgravity research will focus on tackling both challenging basic scientific issues as well as addressing technical challenges relevant to earth-based applications. The PSR program is unique within NASA due to its constituency in academia, government, and the private sector that can be leveraged through joint endeavors with other federal research funding agencies. The program is reviewed by the external research community through the National Research Council (National Academy of Sciences), NASA-convened external Advisory Committees, and NASA-convened ad-hoc Review Committees. Standing Discipline Working Groups review the progress of the detailed research activities. Starting in FY 2004 OBPR will begin the Human Reserach Inititative. This will accelerate the acquisition of knowledge and technology needed for decisions on human exploration beyond low-Earth-orbit.

Please follow this link for additional data: http://spaceresearch.nasa.gov

## PROGRAM MANAGEMENT

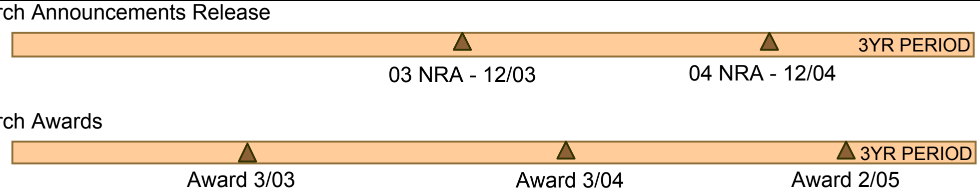
Enterprise official is Mary Kicza, Associate Administrator for Biological & Physical Sciences at HQ. Theme Director and Point of Contact is Dr. Eugene Trinh, Director for Physical Sciences Research at HQ. The PSR research program has program responsibility delegated to the Glenn Research Center, Ames Research Center, Jet Propulsion Laboratory, Johnson Space Center and Marshall Space Flight Center. Full compliance with NPG 7120.5B will be achieved in FY 03 for the relevant portions.

## TECHNICAL COMMITMENT

The definition of the baseline is the Basis of Estimate (BOE) as of March 2002

| Technical Specifications | | FY04 President's Budget | Change from Baseline |
|---|---|---|---|
| R & T | NRA commitments | Conduct productive and innovative ground and flight peer-reviewed research using a broad scientific and technological community. | -- |
| R & T | NASA Center Support | Provide research and development support to the PSR investigator communities. | -- |
| R & T | Science Disciplines | The relevant science disciplines are: Biotechnology, Bio-engineering, Combustion, Fluid Physics, Fundamental Physics, Materials Science. | -- |

| Schedule | FY04 President's Budget | Change from Baseline |
|---|---|---|
| Research Announcements Release | 03 NRA - 12/03; 04 NRA - 12/04; 3YR PERIOD | -- |
| Research Awards | Award 3/03; Award 3/04; Award 2/05; 3YR PERIOD | -- |



| | |
|---|---|
| **THEME:** | Physical Sciences Research (PSR) |
| **RESEARCH:** | Physical Sciences Research (PSR) |

## ACQUISITION STRATEGY & PERFORMING ORGANIZATIONS

The initial NASA Research Announcements (NRA) was first issued in 1988. Research is selected by competitive sourcing through these annual NRAs by disciplines in area research emphasis. Grants typically are for 2 - 4 year inccrements. In FY02, direct NRA Grant procurement represented 75% of budget authority. Changes since FY03 Pres. Budget: None.

| Current Acquisitions | Actual* | Selection Method | Actual* | Performer | Actual* |
|---|---|---|---|---|---|
| Cooperative Agreements | 0% | Full & Open Competition | 100% | Industry | 25% |
| Cost Reimbursable | 0% | Sole Source | 0% | Government | 0% |
| Fixed Price | 0% | | 100% | NASA Intramural | 15% |
| Grants | 75% | | | University | 60% |
| Other | 25% | Sci Peer Review | 75% | Non Profit | 0% |
| | 100% | *% based on FY 02 direct proc. | | | 100% |

| Future Acquisitions - Major | Selection | Goals |
|---|---|---|
| Annual research announcements | Winter 03 | 100% Sci Peer Review, 100% Grants |

## AGREEMENTS

Internal: None

External: MOUs with NIH and DOE for ground-based and flight research.

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

## INDEPENDENT REVIEWS

| Types of Review | Performer | Last Review | Next Review | Purpose |
|---|---|---|---|---|
| National Research Council Committee | NAS/NRC | 1-Jun-02 | None Planned | NAS research progress & quality evaluation |
| External Advisory Committees | NASA | 27-Aug-02 | Annual | Advisory Committees Research progress reviews |

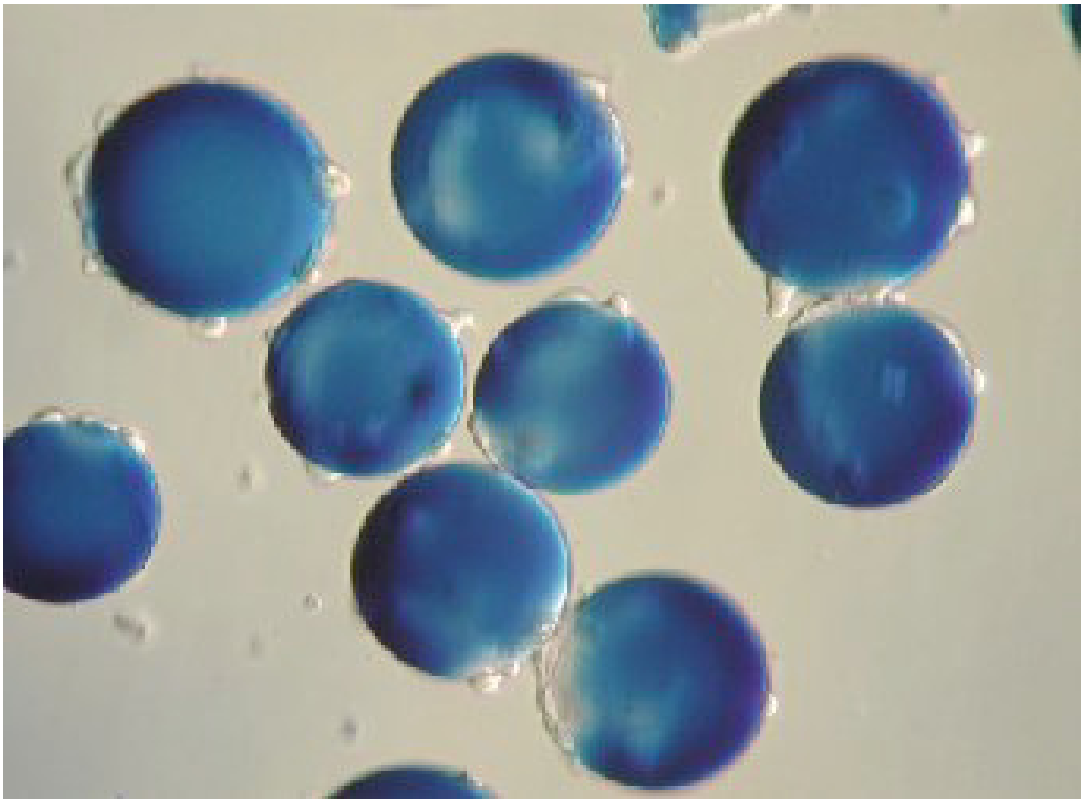
## LIFE CYCLE COST

| Budget Authority ($ in millions) | FY02 | FY03 | FY04 | Comments |
|---|---|---|---|---|
| FY 2004 President's Budget | 119.9 | 134.1 | 145.4 | |
| Physical Science Research (Strategic/Fundamental) | 119.9 | 134.1 | 145.4 | |
| Changes since FY 03 President's Budget | -0.1 | -17.1 | -20.7 | ***Reason for Change:*** |
| | -0.1 | -17.1 | -20.7 | FY02 recission, Enterprise reprioritization, full cost accounting, and addition of HRI. |

Indicates budget numbers in Full Cost.

Indicates changes since the FY 2003 Presidents Budget Submit.

FY 2002 and FY 2003 are not in full cost.



Liver cells like these were the subject of new research conducted by the fifth crew aboard the International Space Station. One of the specialized functions of the human liver is to break down drugs or toxins into less harmful and more water-soluble substances that are more easily excreted from the body. The StelSys experiment -- a joint study by NASA and Baltimore-based biotechnology research company StelSys, LLC – is testing this function of human liver cells in the microgravity environment aboard the International Space Station, comparing the results to the typical function of duplicate cells on Earth. The findings of this experiment will provide unprecedented information about the effects of microgravity on the proper function of human liver cells, offering new insight into maintaining the health of humans living and working in space.

# RESEARCH PARTNERSHIPS AND FLIGHT SUPPORT

## MAJOR EVENTS IN FY 2004

- 12 flight experiments from Space Product Development scheduled to be conducted on the Space Shuttle and Space Station.
- Multi-User Systems and Support will be involved in preparation of CIR and Express Research launches to Station in July 2004 and Europe's five research racks and two attached payloads planned for launch with the Columbus Module in October 2004, the first international partner laboratory module to be deployed on the Space Station.

## THEME: Research Partnerships and Flight Support

### OVERVIEW

The Research Partnerships and Flight Supports theme is composed of several sections that directly contribute to the NASA mission: Space Product Development (SPD), Research Partnership Centers (formerly known as Commercial Space Centers), Multi-User Systems and Support (MUSS), and the Alpha Magnetic Spectrometer (AMS). The SPD component makes space research capabilities available to American business so businesses can explore the potentials of space-based research. SPD has historically accomplished this through the RPCs, located at academic institutions and funded by NASA, which seek industry partners to pursue specific areas of commercial research. As a part of this budget request, the SPD and RPC programs are being significantly realigned and reduced, with most being phased out over the next few years. Remaining realigned activities will ensure that all of NASA's investments will directly contribute to the agency mission. NASA will continue to facilitate the commercialization of space, and will focus on ensuring that commercial researchers have efficient access to space.

In addition to the RPCs, SPD has other cross-cutting functions such as: Mission Integration, which provides assistance to crew and payload requirements needed to prepare for flight; the Alpha Magnetic Spectrometer (AMS) is a major high-energy space particle physics experiment planned for the ISS.

The theme also provides flight support through the Multi-User Systems & Support (MUSS), which encompasses the multi-use hardware development projects, and the overall ISS payload integration, ground processing, and operations support.

| Missions | Goals supported by this theme | Objectives supporting those goals Reference 2003 Strategic Plan |
|---|---|---|
| Understand and Protect Our Home Planet | 3 Create a more secure world and improve the quality of life by investing in technologies and collaborating with other agencies, industry, and academia. | 3.4 Support national priorities through partnerships across industry, academia, and government for market-driven research in space.<br><br>3.5 Use the unique low-gravity environment of space to resolve scientific issues impacting Earth-based technological and industrial applications |
| Inspire the Next Generation of Explorers | 6. Inspire and motivate students to pursue careers in science, technology, engineering, and mathematics | 6.3 Enhance science, technology, & mathematics instruction with unique teaching tools & experiences that are compelling to educators and students as only NASA can provide. |
| | 7. Engage the public in shaping & sharing the experience of exploration and discovery. | 7.2 Engage the public in NASA missions and discoveries and their benefits, through such avenues as public programs, community outreach, mass media, and the internet. |

### RELEVANCE

The SPD program provides researchers with the capabilities to pursue product lines with direct application to NASA's mission, improving life on Earth, and ensuring the safety of our planet.

MUSS provides end-to-end payload integration processing from initial manifesting; it provides engineering integration, training, mission integration, ground testing, on-orbit operations, and finally return of the experiment to the principle investigator for the ISS. MUSS develops and sustains multi-use hardware for payload/principle investigators.

AMS will study the origin of the universe, and in particular, search for mysterious forms of matter such as anti-matter, dark matter, and strange matter, if existing.

## THEME: Research Partnerships and Flight Support

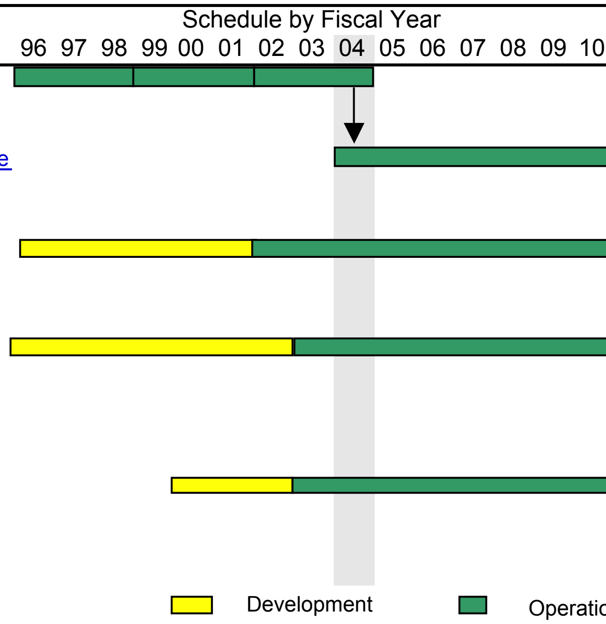
### Education and Public Benefits

This theme opens NASA's capabilities to research that can lead to new businesses, products and services that are of value to the public and the national economy. Products have or may come on the market that support human health, agriculture, and new technologies in communication, power generation and many other areas. Examples of product lines are: Nutraceuticals, functional foods and biopharmaceuticals, fermentation research, flavors and fragrances, structure-based drug design improved insulin formulation, porous ceramic bone replacements, catalytic combustion, water mist fire suppression technology, and advanced casting techniques.

Through partner universities, many college students are involved in this research. This "hands-on" experience provides students with expertise in emerging fields and a direct understanding of the benefits of the space environment for research and development.

## IMPLEMENTATION

This theme is composed of the Space Product Development Division and the Mission Integration Division at NASA Headquarters Office of Biological and Physical Research, the SPD Office at MSFC, and the RPCs, and the JSC Payloads Office to achieve the aforementioned goals and objectives. POC is Mark Uhran, Acting Director of the Space Product Development Division and Director of the Mission Integration Division.




| Strategy | Purpose |
|---|---|
| SPD: 1) Fund Research Partnerships | Fund current research and begin to refocus the overall program. |
| SPD 2) Refocus and rescope the Research Partnerships | Transition emphasis to continue research that is directly related to the NASA mission. |
| MUSS: Payload Ops and Integration Ctr (POIC) | The POIC provides operational payload flight control, planning & development systems for the ISS. |
| MUSS: EXPRESS Racks | The EXPRESS rack is a standardized payload rack system that transports, stores, and supports experiments aboard the ISS. |
| MUSS: Window Observational Res. Facility (WORF) | Optical quality window of the ISS for attaching cameras, multi-spectral scanners, and other instruments. |

### Tailoring

Full compliance with NPG 7120.5B will be achieved in FY 03 for the relevant portions.

## STATUS

In FY 2002, SPD transitioned four Research Partnership Centers (RPCs, a.k.a. CSC) from another NASA Enterprise. Some of the major accomplishments included the flight of six commercial research experiments to the ISS, addition of more than 15 new industrial partners, and the marketing of two commercial products. Currently, the SPD and RPC programs are being rescoped to ensure that all of NASA's investments will directly contribute to the overall mission.

## THEME: Research Partnerships and Flight Support

### PERFORMANCE MEASURES

| Annual Performance Goals | |
|---|---|
| OUTCOME | 3.4.1 Advance NASA's vision and mission by leveraging industry investment in space-based commercial activity through active partnerships with industry and academia. |
| | Performance Goals: |
| 4RPFS1 | Complete realignment plans of SPD, initiate phaseout, and demonstrate contributions to agency mission. |
| 4RPFS2 | Enable industry research in space that allows them to bring 1 commercial product under investigation to market by FY04. |
| OUTCOME | 3.5.1 Use the unique low-gravity environment to resolve scientific issues that impact Earth-based technological and industrial applications |
| | Performance Goal: |
| 4RPFS3 | Integrate and prepare the Combustion Integrated Rack research facility for launch in the FY 2004 time frame. |
| OUTCOME | 6.3.1 Improve quality of STEM instruction. |
| | Performance Goal: |
| 4RPFS4 | Develop collaborations with Professional Education Associations directed to enhance educator proficiency in use of space research content and classroom, education hardware focused on standards-based curriculum. |
| 4RPFS5 | Develop and train facilitators for dissemination of 3 comprehensive Educator Professional Development Seminars focused on biological and physical sciences research that coordinates with standard's based science, math, and technology concepts. |
| OUTCOME | 7.2.4 Broaden OBPR research information to diverse audiences. |
| | Performance Goals: |
| 4RPFS6 | Increase distribution of the *Space Research* newsletter by 5,000 over FY 03 circulation in order to further educate the general public, industry and acedemia on space-baeed research. |
| 4RPFS7 | Establish and sustain a series of media presentations of OBPR research, through collaboration with PAO, to convey important space-based research results to the general public, industry and acedemia. |
| 4RPFS8 | OBPR will expand its involvement in reaching minority & under-represented sectors of the public, through participation in conferences and community events that reflect cultural awareness and outreach. There will be at least one new venue associated with a minority and/or under-represented community over outreach efforts taking place in FY 03. |

### INDEPENDENT REVIEWS

| Types of Review | Performer | Last Review | Next Review | Purpose |
|---|---|---|---|---|
| RP Independent Review | Booz Allen Hamilton | 9/02-2/04 | 2005/2007 | Retrospective evaluation of on-going tasks. HQs directed tri-annual independent review of the status and progress of the RPs. |
| Space Station Indept. Asses. | NASA | Oct 1, 2001 | Annual | Assess ISS Program and the MUSS activities. |
| POCAAS | RPC (a.k.a. CSC) | Jan 23, 2002 | None Planned | Assess the payload ops and associated flight/ground architecture. |

## THEME: Research Partnerships and Flight Support

### BUDGET

| Budget Authority ($millions) | | FY02 | FY03 | Change | FY04 | Comments |
|---|---|---|---|---|---|---|
| **Research Partnerships & Flight Support** | | **196.9** | **169.5** | **+91.4** | **260.9** | |
| | | | | | | |
| Operations | | 180.1 | 154.7 | +76.3 | 231.0 | |
| | Space Product Development | 15.5 | 15.8 | +3.0 | 18.8 | Change due to full cost accounting and |
| | Multi-User System & Support | 164.6 | 138.9 | +73.3 | 212.2 | realignment of programs. |
| | | | | | | |
| Research | | 16.8 | 14.8 | +15.1 | 29.9 | |
| | Research Partnership Center | 16.6 | 14.6 | -1.6 | 13.0 | In FY02 the RPC line includes 4 new centers |
| | Mission Integration | 0.2 | 0.2 | +16.7 | 16.9 | Includes consolidated taxes (starts FY 03) and FY 04 includes AMS |

Note: For all formats, the FY 02 column reflects the FY 2002 Congressional Operating Plan letter dated 9/30/02. The FY 03 column reflects the FY 2003 Presidents Budget Submit (PBS) as Amended. The Change column includes both programmatic and full cost adjustments. FY 2004 column is in full cost.

Indicates budget numbers in Full Cost. (yellow)
Indicates changes since the FY 2003 Presidents Budget Submit. (blue)
FY 2002 and FY 2003 are not in full cost.

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| | |
|---|---|
| **THEME:** | Research Partnerships and Flight Support |
| **OPERATIONS:** | Space Product Development |

## PURPOSE

| Objectives | Reference 2003 Strategic Plan | Performance Measures |
|---|---|---|
| 3.4; 6.3; 7.2 | | 4RPFS1/2/4/5/6/7/8 |

The Space Product Development (SPD) Program will seek to advance NASA's mission and develop opportunities for commerce in space through research partnerships. SPD couples NASA capabilities and private sector technology development to the advantage of both. Facilitating the use of space for commercial products and services can help enable sustainable space exploration by NASA. In FY 2004 the SPD program will begin rescoping the program to ensuring that all of NASA's investments will directly contribute to the agency vision and mission.

## OVERVIEW

The research performed in Space Product Development must be of benefit to NASA's visions and mission. The program is executed through Research Partnership Centers (former known as Commercial Space Centers) working with industry partners that they recruit and for which they act as a liaison with NASA. The current rescoping and refocusing of the program will reduce the number of RPCs and will ensure that all research contributes to the NASA mission, is industry supported, product oriented, and can be eventually brought to market.

## PROGRAM MANAGEMENT

The SPD program responsibility delegated to Mary Kicza, the OBPR Associate Administrator, to the HQs Division Director and then to Marshall Space Flight Center under the authority of the Space Product Development Office. The CAS (The Commercial Advisory Subcommittee) assists in an advisory capacity. All SPD projects are projects of the RPCs and therefore subject to the project reqirements of theRPCs. For details, see the SPD Program Plan. NPG 7210.5B does not have application to this program.

## TECHNICAL COMMITMENT

The definition of the baseline is contained in the SPD BOE package dated 12/2002

| Technical Specifications | | | FY04 President's Budget | | | Change from Baseline |
|---|---|---|---|---|---|---|
| S/DRUMS | PDR - 10/98 | CDR - 9/99 | H/W Ready-02 | Launch 4/03/Flight - ULF-1 | | -- |
| ZCG-HTF | PDR - 03/01 | CDR-11/01 | H/W - 12/02 | Launch - 5/03 | Flight: 12A.1 | -- |
| CBTM | PDR - 02/03 | CDR-09/03 | H/W Ready-04 | Launch/Flight | | -- |
| CGBA | PDR-Completed | CDR-Compl. | H/W Ready-02 | Launch-4/02 | Flight - 8A | -- |
| PGBA | PDR-Completed | CDR-Compl. | H/W Ready-03 | Launch-8/02 | Flight 9A | -- |
| CPCG-H | PDR-Completed | CDR-Compl. | H/W Ready-04 | Launch-4/02; 1/03 | Flight 8A and ULF-1 | -- |
| CPCG-V | PDR-9/97 | CDR-8/99 | H/W Ready-03 | Launch 1/03 | Flight-ULF-1 | -- |
| DOME | PDR-8/01 | CDR-12/01 | H/W-TBD-03 | Launch- 8/03/Flight - 13A | | -- |
| MEPS | PDR-Completed | CDR-Compl. | H/W Ready-02 | Launch-5/02 | Flight-UF2 | -- |

| Schedule | FY04 President's Budget | Change from Baseline |
|---|---|---|
| Nov 02-07 | Annual renewal of Research Partnership Center Cooperative Agreements. | -- |
| 2002-2004, 2005-2007 | Independent review of Research Partnership Centers, 3 year cycle. | -- |
| April 02-07 | 6-month review of RPC milestone accomplishments. | -- |

| THEME: | Research Partnerships and Flight Support |
|---|---|
| **OPERATIONS:** | Space Product Development |

## ACQUISITION STRATEGY & PERFORMING ORGANIZATIONS

The SPD/ISSRC program is in place through five-year Cooperative Agreements with competitively-procured university-based Commercial Space Centers. These agreements are renewable each year after receipt of the annual report and other indicators that the agreed-to milestones/deliverables have been met.

| Current Acquisitions | Actual* | Selection Method | Actual* | Performer | Actual* |
|---|---|---|---|---|---|
| Cooperative Agreements | 99% | Full & Open Competition | 100% | Industry | 3% |
| Cost Reimbursable | 0% | Sole Source | 0% | Government | 0% |
| Fixed Price | 0% | | 100% | NASA Intramural | 10% |
| Grants | 0% | | | University | 87% |
| Other | 1% | Sci Peer Review | 0% | Non Profit | 0% |
| | 100% | * % based on FY 02 direct proc. | | | 100% |

| Future Acquisitions - Major | Selection | Goals |
|---|---|---|
| Renewal of Cooperative Agreements | Fall '02 | Annual renewal of grant is based on grantee meeting milestones and deliverables agreed to in current year grant. |

## AGREEMENTS

Internal: None.

External: Space Act Agreements with private companies/individuals. Cooperative Agreements are in existence with each RPC and host university.

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

## INDEPENDENT REVIEWS

| Types of Review | Performer | Last Review | Next Review | Purpose |
|---|---|---|---|---|
| RPC Independent Review | Booze Allen Hamilton | 9/02-2/04 | 2005/2007 | Retrospective evaluation of ongoing tasks. HQ directed tri-annual independent review of the states and progress of the RPCs. |

## BUDGET / LIFE CYCLE COST

| Budget Authority ($ in millions) | FY02 | FY03 | FY04 | Comments |
|---|---|---|---|---|
| FY 2004 President's Budget | 15.5 | 15.8 | 18.8 | |
| Space Product Development | 15.5 | 15.8 | 18.8 | |
| Changes since FY 03 President's Budget | 0.0 | 0.0 | -0.4 | ***Reason for Change:*** |
| | | -0.4 | -0.6 | Realignment and rescope of program. |
| | | | +1.5 | Full cost accounting. |

Indicates budget numbers in Full Cost.

Indicates changes since the FY 2003 Presidents Budget Submit.

FY 2002, FY 2003, Prior and BTC are not in full cost.

| THEME: | Research Partnerships and Flight Support |
|---|---|
| **OPERATIONS:** | Multi-User System & Support (MUSS) |

## PURPOSE

| Objectives | Reference 2003 Strategic Plan | Performance Measures |
|---|---|---|
| 3.5 | | 4RPFS3 |

MUSS supports this objective by providing end-to-end payload integration processing from initial manifesting, to engineering integration, to training, to mission integration, to ground testing, to on-orbit operations, and return of the experiment to the principle investigator for the International Space Station (ISS). MUSS develops and sustains multi-use hardware for payload/principle investigators.

## OVERVIEW

The Multi-User Systems and Support (MUSS) encompasses the multi-use hardware development projects, and the overall ISS payload integration and operations support. Multi-use hardware development projects include the EXPRESS (EXpedite the PRocessing of Experiments on Space Station) Racks and EXPRESS Transportation Racks, and the Window Observational Facility (WORF). Logistics and sustaining engineering is supported for these racks as well as the Human Research Facility and the Habitat Holding Racks. Development oversight is provided for the EXPRESS Pallet as well. New active and passive biotransportation freezer units are presently undergoing a procurement phase. Utilization support services for ISS payload integration and operations are provided to both U.S. and International Partners. This includes services for payload planning and engineering support, crew and user team training, sub-rack and sub-pallet level payload integration, ground processing, and on-orbit payload operations for all research related hardware and software on-board the ISS. The utilization effort also includes the development and operations of the ground facilities, including the Payloads Operations Information Center (POIC) and the Payloads Office Information Facility (POIF).

## PROGRAM MANAGEMENT

Enterprise official is Mary Kicza, Associate Administrator with Mark Uhran as the Mission Integration Division Director. MUSS program management is implemented by the Jonhson Space Center Payloads Office (JSC/OZ) by Lesa Roe. Full compliance with NPG 7120.5B will be achieved in FY 03 for the relevant portions.

## TECHNICAL COMMITMENT

The definition of the baseline is OBPR's Basis of Estimate (BOE) dated Feb 2002

| Technical Specifications | FY04 President's Budget | Change from Baseline |
|---|---|---|
| ARTIC Freezer Unit | Units 1, 2 | -- |
| Payload Rack Checkout Unit (PRCU) | Units 1, 2, 4, 5, 6 | -- |
| Passive Rack Isolation System (PaRIS) | Units 1, 2 | -- |
| EXPRESS | Racks 1, 2, 3, 4, 5, 7, 8 | -- |
| Window Observational Research Facility (WORF) | | -- |
| BioTransportion Hardware | Units 1 - 10 | -- |

| Schedule | FY04 President's Budget | Change from Baseline |
|---|---|---|
| Artic Freezer Unit 1 FHA | Jan-02 | -- |
| Artic Freezer Unit 2 FHA | Mar-02 | -- |
| PRCUs (Units 1, 2, 4, 5, 7) | Delivered (Feb 02) | -- |
| PaRIS Unit 1 for HHR 1 | Sep-02 | -- |
| PaRIS Unit 2 for HHR 2 | Mar-03 | -- |
| EXPRESS Racks | Delivered ( 1 - 8 Aug 02) | -- |
| WORF | Delivered (Mar 02) | -- |
| Biotransportion Hardware | Under Review | New Requirement |
| PaRIS Unit 3 for CIR | Dec-02 | New Requirement |

| THEME: | Research Partnerships and Flight Support |
|---|---|
| **OPERATIONS:** | Multi-User System & Support (MUSS) |

## ACQUISITION STRATEGY & PERFORMING ORGANIZATIONS

Data Current as of 1/18/2003

The prime contractor for the Payload Operations & Integration Center (POIC) is Lockheed Martin. Present work includes sustaining engineering and maintenance of the facility. This contract runs through the end of FY03 and subsequently recompeted. The prime contractor for the ISS Payload Integration Contract is Boeing. This contract runs through FY 04 with an option for FY05. In FY02, direct procurement represented 100% of budget authority. Changes since FY03 Pres. Budget: None.

| Current Acquisitions | Actual* | Selection Method | Actual* | Performer | Actual* |
|---|---|---|---|---|---|
| Cooperative Agreements | 0% | Full & Open Competition | 50% | Industry | 45% |
| Cost Reimbursable | 100% | Sole Source | 50% | Government | 0% |
| Fixed Price | 0% | | 100% | On-site Contractors | 55% |
| Grants | 0% | | | University | 0% |
| Other | 0% | Sci Peer Review | 0% | Non Profit | 0% |
| | 100% | * % based on FY 02 direct proc. | | | 100% |

| Future Acquisitions - Major (FY03) | Selection | Goals |
|---|---|---|
| Biotransportation Hardware | 12/02 | Develop cryogenic transportation capabilities for the ISS. |

## AGREEMENTS

Internal: None

External: None

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

## INDEPENDENT REVIEWS

Data Current as of 1/18/2003

| Types of Review | Performer | Last Review | Next Review | Purpose |
|---|---|---|---|---|
| POCAAS | RPC | 23-Jan-02 | None Planned | Assess payload ops and associated flight/ground architecture. |

## BUDGET/LIFE CYCLE COST

| Budget Authority ($ in millions) | FY02 | FY03 | FY04 | Comments |
|---|---|---|---|---|
| FY 2004 President's Budget | 164.6 | 138.9 | 212.2 | |
| Multi-User System and Support | 164.6 | 138.9 | 212.2 | |
| Changes since FY 03 President's Budget | 0.0 | 0.0 | +68.1 | ***Reason for Change:*** |
| Full Cost/REMAP | | 0.0 | +68.1 | Delta due to full cost and ReMaP. |

Indicates budget numbers in Full Cost.

Indicates changes since the FY 2003 Presidents Budget Submit.

FY 2002 and FY 2003 are not in full cost.

| THEME: | Research Partnerships and Flight Support |
|---|---|
| **RESEARCH:** | **Research Partnership Centers** |

## PURPOSE

| Objectives | Performance Measures |
|---|---|
| 3.4; 6.3; 7.2 | 4RPFS1/2/4/5/6/7/8 |

The Research Partnership Centers (RPC) will develop opportunities for commerce in space. RPC's couple NASA capabilities and private sector technology development to the advantage of both. The RPC program is being rescoped and realigned to ensuring that all of NASA's investments will directly contribute to the agency vision and mission.

## OVERVIEW

The research performed in the Research Partnership Centers must contribute directly to the NASA mission and be industry driven and thus requires industry participation, cash and in-kind financial support. The program is executed through the Research Partnership Centers working with industry partners that they recruit and for which they act as a liaison with NASA. The current rescoping and refocusing of the program will reduce the number of RPCs and will ensure that all research contributes to the NASA mission, is industry supported, product oriented, and can be eventually brought to market.

## PROGRAM MANAGEMENT

The RPCs program responsibility delegated to Mary Kicza, the OBPR Associate Administrator, to the HQs Division Director then to Marshall Space Flight Center under the authority of the Space Product Development Office. The CAS (The Commercial Advisory Subcommittee) assists in an advisory capacity. All SPD projects are projects of the RPCs and therefore subject to the project requirements of the RPCs. For details, see the SPD Program Plan. The AMS is managed from HQs, the Mission Integration Division-Mark Sistilli is Program Manager. Full compliance with NPG 7120.5B will be achieved in FY 03 for the relevant portions.

## TECHNICAL COMMITMENT

(Listed below are some of the current Research Partnership Centers, and examples of their projects.)

The definition of the baseline is described in the BOE package as of the FY03 PBS.

| Technical Specifications | FY04 President's Budget | Change from Baseline | |
|---|---|---|---|
| Bioserve Space Technologies Center | Commercial Generic Bioprocessing Apparatus | TBD | (Biotech) |
| Cntr for Advanced Microgravity Materials Processing | Zeolites/Nucleation & Control Methods | TBD | (materials) |
| Cntr for Commercial Applications of Comb. in Space | Space Drums, Water Mist | TBD | (materials) |
| Cntr f/Biophysical Sciences & Engineering | Influenza Med., Organ Rejection, Auto-Immune | TBD | (Biotech) |
| Cntr for Space Power | Miniaturization technology, etc. | TBD | (Infrastructure) |
| Commercial Space Center for Engineering | Engineering Center | TBD | (Infrastructure) |
| Consortium for Materials Development in Space | NonLinear Optics | TBD | (Biotech/Mat.) |

In FY 2004 the RPC program will be realigned and reduced to ensure that all of NASA's investments are directly contributing to the agency vision and mission.

| Schedule | FY04 President's Budget | Change from Baseline |
|---|---|---|
| 6-month reviews | Apr, Oct — 1 YR PERIOD | TBD |
| Annual Renewals | Nov — 1 YR PERIOD | TBD |
| Independent Reviews | 2003 Independent Review, 2006 Independent Review, 2009 Independent Review — 3YR PERIOD | TBD |

| THEME: | Research Partnerships and Flight Support |
|---|---|
| RESEARCH: | Research Partnership Centers |

## ACQUISITION STRATEGY & PERFORMING ORGANIZATIONS

Data Current as of 1/18/2003

The SPD program is accomplished through the competitively selected, university based Research Partnership Centers. These Centers are brought on-board through five-year Cooperative Agreements which are renewable yearly, after mutually agreed-to milestones and deliverables have been met.

| Current Acquisitions | Actual* | Selection Method | Actual* | Performer | Actual* |
|---|---|---|---|---|---|
| Cooperative Agreements | 87% | Full & Open Competition | 90% | Industry | 3% |
| Cost Reimbursable | 0% | Inhouse | 10% | Government | 0% |
| Fixed Price | 0% | | 100% | NASA Intramural | 10% |
| Grants | 0% | | | University | 87% |
| Other | 13% | Sci Peer Review | 0% | Non Profit | 0% |
| | 100% | * % based on FY 02 direct proc. | | | 100% |

| Future Acquisitions - Major | Selection | Goals |
|---|---|---|
| Renewal of Cooperative Agreements | Fall '03 | Annual renewal of each grant is based on grantee meeting milestones and deliverables agreed to in the current year grant. |

## AGREEMENTS

Internal: None

External: Space Act Agreements are in existence with private companies. Cooperative Agreements are in existence with each RPC and host university.

## INDEPENDENT REVIEWS

Data Current as of 1/18/2003

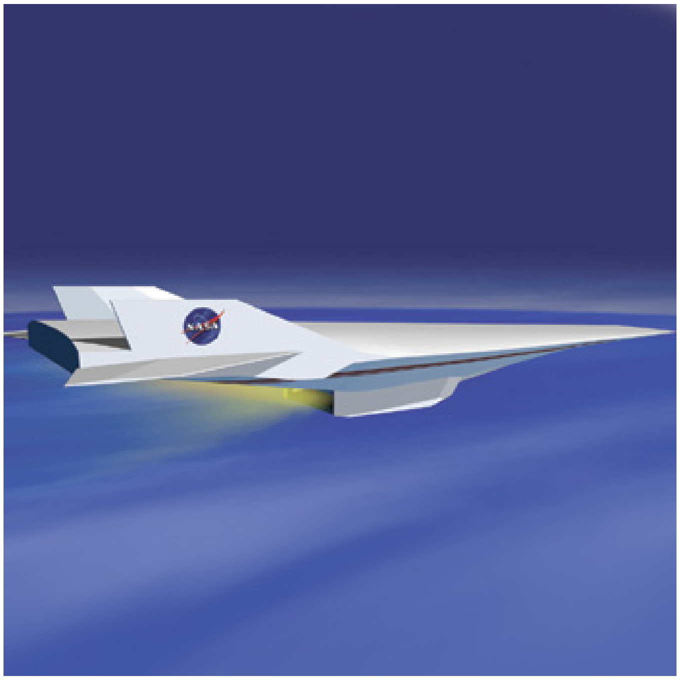
| Types of Review | Performer | Last Review | Next Review | Purpose |
|---|---|---|---|---|
| RPC Independent Review | Booz Allen H. | 9/02-2/04 | 2005/2007 | Retrospective evaluation of ongoing tasks. Hqs directed tri-annual independent review of the status and progress of the RPCs. |

## BUDGET/LIFE CYCLE COST

| Budget Authority ($ in millions) | FY02 | FY03 | FY04 | Comments |
|---|---|---|---|---|
| FY 2004 President's Budget | 16.8 | 14.8 | 29.9 | |
| Research Partnership Centers (RPC) | 16.6 | 14.6 | 13.0 | |
| Mission Integration | 0.2 | 0.2 | 0.2 | |
| Alpha Magnetic Spectrometer | 0.0 | 0.0 | 2.5 | |
| Program support funds consolidation | 0.0 | 0.0 | 14.2 | |
| Changes since FY 03 President's Budget | +0.4 | -0.2 | +14.3 | ***Reason for Change:*** |
| | | | +2.5 | AMS is added starting in FY04. |
| | | | +14.2 | Program support consolidation in FY04. |
| RPC Adjustments | +0.4 | -0.2 | -2.4 | Program realocation in '02 and RPC reduction in 03-04. |
| FY03 President's Budget (RPC) | 16.2 | 14.8 | 15.4 | Late 01 Op Plan. |

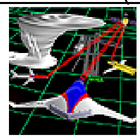
Indicates budget numbers in Full Cost.
Indicates changes since the FY 2003 Presidents Budget Submit.
FY 2002 and FY 2003 are not in full cost.

## ENTERPRISE: Aerospace Technology



The 12-foot long X-43A hypersonic demonstrator is a scramjet-powered test. Powered by a supersonic combustion ramjet engine and at a speed of Mach-5, this technology could enable travel to any point on Earth in two-hours, if the ultra high-speed flight proves successful in September 2003 as planned.

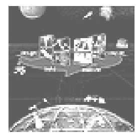
**THEMES** (Aeronautics)



**Aeronautics Technology**

**THEMES** (Crosscutting Technologies)

**Space Launch Initiative**



**Mission and Science Measurement Technology**

**Innovative Technology Transfer Partnerships**

Note: The four Themes of the Aerospace Technology Enterprise are split across the two appropriations. Aeronautics Technology can be found here in the Science, Aeronautics, and Exploration appropriation.

# AEROSPACE TECHNOLOGY

### (AERONAUTICS)

## PURPOSE

The *Aeronautics Technology* theme holds a unique role within NASA as the sole steward of the Agency's aeronautics investments. By developing and transferring technologies, NASA's investments in Aeronautics Technology play a key role in creating a safer, more secure, environmentally friendly and efficient air transportation system, increasing performance of military aircraft, and developing new platforms for science or commercial uses. This theme also enhances the Nation's security through its partnerships with Department of Defense (DOD) and Federal Aviation Administration (FAA). Research areas include advanced propulsion technologies, lightweight high-strength adaptable structures, adaptive controls, advanced vehicle designs, and new collaborative design and development tools. In collaboration with the FAA, research is conducted in air traffic management technologies for new automation tools and concepts of operations.

# ENTERPRISE: Aerospace Technology

## FY 2002 ACCOMPLISHMENTS

During FY 2002, the Aerospace Technology Enterprise made substantial progress in developing aeronautics technologies that, when implemented, will support a 21st Century air transportation system that is safer, more efficient, environmentally friendly, flexible, and able to meet the increasing demands of the Nation.

In cooperation with the FAA and industry, aviation safety research addresses accidents and incidents involving hazardous weather, controlled flight into terrain, human performance, and mechanical or software malfunctions. Data analysis of an air turbulence warning system demonstration indicated excellent performance with probability of detection of severe turbulence with at least 30 seconds lead time at 81%. Collaboration with industry enabled digital communications and graphical weather display technologies to be flight-tested and transferred a year earlier than originally planned for transport and general aviation aircraft. A self-paced, computer-based training aid was developed presenting student and professional pilots with information and tools to avoid ice, detect ice and minimize exposure. A simulation of aircraft dynamics under adverse conditions improves aircrew training for upset recovery and provides an advanced simulation capability for accident investigations.

Among the chemicals produced during the combustion of aircraft fuel, two have the most significant impacts on the environment. Nitrogen oxides ($NO_X$) degrade the local air quality by creating smog and impact global air quality by contributing to the loss of ozone. Carbon dioxide ($CO_2$) degrades global air quality by contributing to global warming. NASA is developing critical engine and airframe technologies that provide a significant reduction in emissions. Low $NO_X$ (combustor sector) testing demonstrated 67% reduction below 1996 standards and increased confidence in meeting the 70% reduction goal. A ceramic thermal barrier coating process was developed to create a low conductivity thermal barrier coating to increase the temperature capability and efficiency of aircraft engine turbine blades and reduce $CO_2$ emissions.

Confining objectionable air transport noise within the airport boundary will benefit homes and businesses close to airports. Aircraft noise reduction concepts were evaluated. Technology development continued on the most promising concepts to reduce noise closer to the runway threshold.

In cooperation with the FAA, NASA is developing decision support tools to improve air traffic management by helping air traffic controllers, pilots, and aircraft operators use airspace more efficiently through reduced spacing, improved scheduling, collaboration with operators, and other techniques. The tools are matured through field-testing at airports, such as Dallas-Ft. Worth. Tools have been delivered to the FAA for implementation in their "Free Flight" concept. A simulation at "FutureFlight Central" provided data to analyze the efficiency of combining two decision support tools: the Surface Management System to control flow of traffic on taxiways and the Traffic Management Advisor to control air traffic arriving and departing airports. Combining the two tools shows promise in increasing capacity of airports through improved scheduling and departure runway balancing.

By developing new small aircraft technologies that could permit operations during any weather conditions at thousands of airports in the United States, the ability of the Nation's air system to transport goods, individuals, families, or groups of business associates could be greatly increased. The Small Aircraft Transportation System (SATS) partners, including NASA, the FAA and industry's National Consortium for Aviation Mobility, have established baselines for key documents, including: the systems engineering management plan, concepts of operations, functional architecture, and operational and technical requirements. These documents provide the framework for developing, evaluating, and demonstrating new operating capabilities.

## THEME DISTRIBUTIONS

| Budget Authority ($ in millions) | FY 2002 | FY 2003 President's Budget, As Amended | FY 2004 President's Budget |
|---|---|---|---|
| Aeronautics Technology | 645.8 | 541.4 | 959.1 |
| Institutional Support | 385.7 | 445.0 | -- |
| Total | 1,031.5 | 986.4 | 959.1 |

Note: For all formats, the FY 2002 column reflects the FY 2002 Congressional Operating Plan dated 9/30/02. The FY 2003 column reflects the FY 2003 Presidents Budget Submit (PBS) as Amended. FY2004 column is in full cost.

Indicates budget numbers in Full Cost.

## Aeronautics Technology

This theme plays a key role in creating a safer, more secure, environmentally friendly and efficient air transportation system, increasing performance of military aircraft, and developing new uses for science or commercial missions. This theme also enhances the Nation's security through its partnerships with the DOD and Federal Aviation Administration (FAA). Research areas include advanced propulsion technologies, lightweight high-strength adaptable structures, adaptive controls, advanced vehicle designs, and new collaborative design and development tools. In collaboration with the FAA, research is conducted in air traffic management technologies for new automation tools and concepts of operations. Highlights for FY 2004 include:

**Overall budget**
FY 2004 request is $959 million, a $10 million or 1.0 percent increase over FY 2003 President's Request (full cost).

- $169 million for Aviation Safety and Security projects aimed at reducing accident and fatality rates.
- $217 million for Airspace Systems projects to provide technologies that can dramatically increase the capacity and mobility of the nation's air transportation system.
- $574 million for Vehicle Systems projects focused on development of breakthrough technologies for future aircrafts and air vehicles.

**New Initiative – Aviation Security**
Request includes $20 million for this new initiative ($195 million over five years).

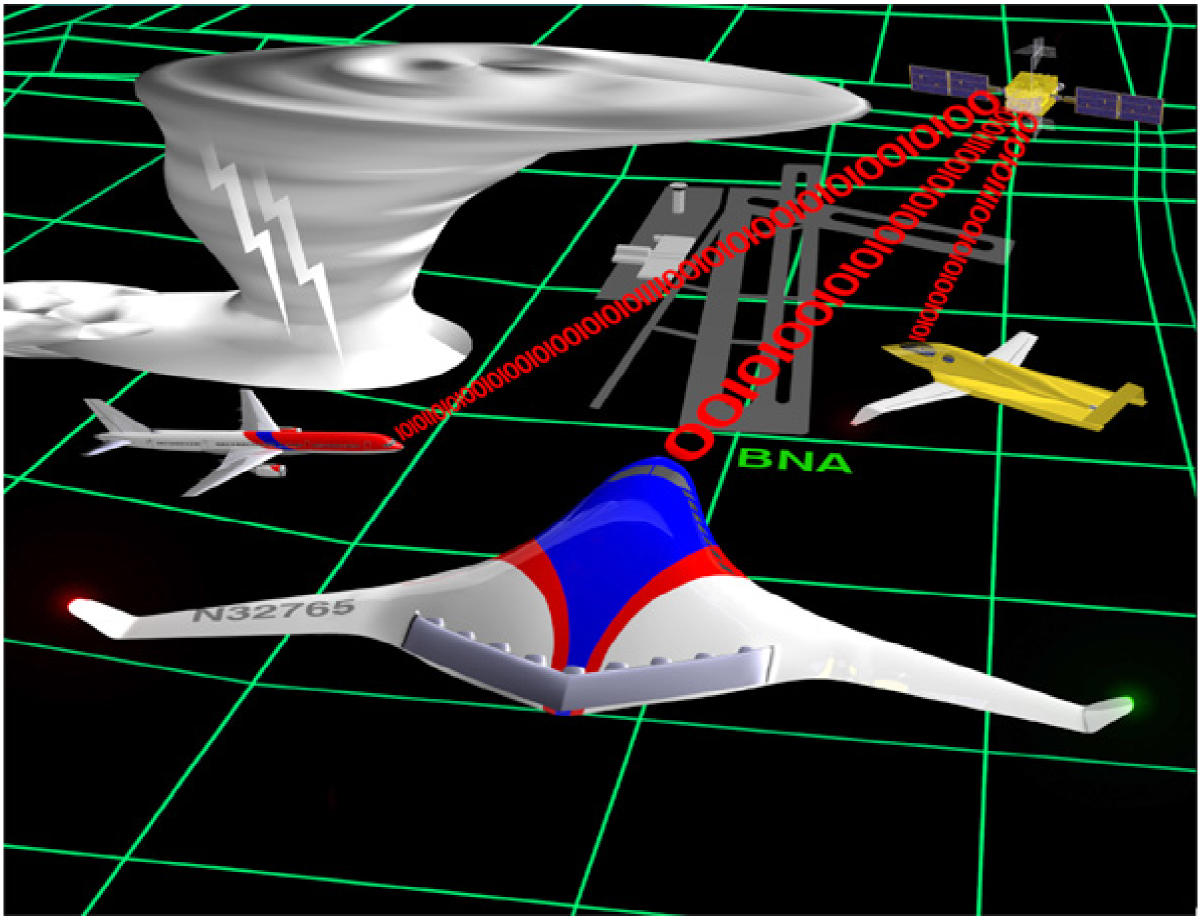
- Addresses critical aviation security needs that NASA is uniquely qualified to provide.
- Develops technology for commercial aircraft and airspace protection, including development of damage-tolerant structures and autonomous and reconfigurable flight controls technology to prevent aircraft from being used as weapons and to protect against catastrophic loss of the aircraft in the event of damage from sabotage or explosives.

**New Initiative – National Airspace System Transition Augmentation**
Request includes $27 million for this new initiative ($100 million over five years).

- Enables technology, in cooperation with FAA, to transition to a next-generation National Airspace System that would increase the capacity, efficiency, and security of the system to meet the mobility and economic-growth needs of the Nation, reducing delays and increasing air transportation efficiency.

**New Initiative – Quiet Aircraft Technology Acceleration**
Request includes $15 million for this new initiative ($100 million over five years).

- Accelerate development and transfer of technologies that will reduce perceived noise in half by 2007 compared to the 1997 state-of-the-art.
- Fully implemented throughout the system, eliminates unacceptable noise outside the boundary of the airport.




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

# AERONAUTICS TECHNOLOGY

## MAJOR EVENTS IN 2004

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

## THEME: Aeronautics Technology (AT)

### OVERVIEW

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

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

Last year, NASA released an Aeronautics Blueprint in that identifies a new and revolutionary vision for aviation in the 21st Century which guides the Aerospace Technology Theme. The blueprint primarily addresses the challenges that confronted aviation in the United States before the terrorist attacks of September 11, 2001. Safety and security have taken on a new perspective since that event, but many of the technology solutions to these issues are presented in the Aeronautics Blueprint. Many issues that were facing air travel prior to September 11 remain and require innovative technology solutions that are addressed by the Blueprint addresses how new technologies can be brought to bear on these issues. These technologies can do more than resolve existing issues; they have the potential to open a whole new era in aviation and provide new opportunities in air transportation safety and efficiency, national defense, economic growth, and quality of life.

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

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

## THEME: Aeronautics Technology (AT)

### RELEVANCE

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

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

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

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

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

### IMPLEMENTATION

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

## THEME: Aeronautics Technology (AT)

### IMPLEMENTATION (Continued)

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

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

Tech. & Adv. Development Operations

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

## THEME: Aeronautics Technology (AT)

### STATUS

**Aviation Safety Program**

- Conducted flight demonstration of a forward looking turbulence warning system to provide advance warning of severe turbulence. Data analysis (using human judgment) indicated excellent performance with probability of detection of severe turbulence with a lead time greater than 30 seconds.
- Demonstrated a National Aviation Weather Information Network and data link capability to bring aerospace weather information into the cockpit that improves aviation safety and on time performance by providing the aircrew with the real time information necessary for the aircraft to avoid areas of hazardous weather and turbulence.

**Airspace Systems Program**

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

**Vehicle Systems Program.**

- Demonstrated a 67% reduction in NOX emissions during sector tests of a combustor that when fully developed will reduce NOX emissions by 70%.
- Identified and initiated development of a suite of noise reduction technologies that would meet the Enterprise 10 year goal (10dBA).

### PERFORMANCE MEASURES

| Annual Performance Goals | |
|---|---|
| | **OUTCOME:** A well managed program in accordance with Agency implementing strategies. |
| 4AT1 | Each Development project will complete its current phase within 10% of total life-cycle cost shown on the table below. |
| 4AT2 | The Theme will allocate 75% of its procurement funding competitively during FY 2004. |
| 4AT3 | The Theme will complete 90% of the major milestones planned for FY 2004. |
| **2.1.1** | **OUTCOME:** Develop & demonstrate technologies that will enable the reduction of the aviation fatal accident rate by 50% from the FY 1991 - 1996 average. |
| 4AT4 | Utilizing results of component testing, simulations, and analyses, complete an integrated program assessment of the suite of aviation safety technologies to determine their synergistic effect on reducing the fatal accident rate. (AvSSP) |
| 4AT5 | Propulsion system malfunctions are cited in 25% of fatal accidents, with disk and/or fan blade component failures being attributed to about 15% of these malfunctions. In FY 2004 NASA will provide deliver prototype disks, and engine containment materials wit inherent failure resistant characteristics that will be ready for a full scale engine system integration test to be conducted jointly with the FAA in FY 2005. (AvSSP) |
| 4AT6 | Controlled Flight into Terrain (CFIT) accounts for 30% of General Aviation fatal accidents. During FY 2004, NASA will complete the flight evaluation of a synthetic vision system that improves pilot situational awareness by providing a display of “out-the–window” information that is not effected by adverse metrological conditions. This system when fully implemented has the potential to eliminate 90% of CFIT accidents. (AvSSP) |
| **2.1.2** | **OUTCOME:** Develop & demonstrate decision support technologies for ground-based and air/ground air traffic management |
| 4AT7 | Complete a preliminary demonstration, in a realistic operational environment, of an automated system to provide real-time identification of flight path deviations and a means to alert authorities in a prompt and consistent manner. (AvSSP) |
| **2.2.1** | **OUTCOME:** Validate aircraft component technologies and advanced operations for reducing noise by 10dB (re: CF 1997 SOA) in laboratory and relevant environment to enable air traffic growth. |
| 4AT8 | Laboratory validate initial concepts for engine and airframe source noise reduction by 5dB (re: to CY 2001 SOA). (Vehicle Systems) |
| **2.2.2** | **OUTCOME:** Demonstrate combustor configurations for reducing NOx emission by 70% (re. to 1996 ICAO standard) to reduce smog and lower atmospheric ozone. Demonstrate airframe and engine component technologies for reducing the green-house gas, $CO_2$, emissions by 25% (re. to 2000 SOA). |
| 4AT9 | Experimentally demonstrate a 2-stage highly loaded compressor for increasing pressure rise per stage. (Vehicle Systems) |
| **2.3.1** | **OUTCOME:** Develop & demonstrate technologies that enable an 50% increase in the aviation system throughput. |
| 4AT10 | Complete validation and assessment of the Advanced Air Transportation Technologies products (tools/concepts) through field and laboratory demonstrations, analyses, evaluations, and assessments on a tool-by-tool basis to demonstrate an increase in terminal throughput by 35 percent and an increase in en route throughput by 20 percent. (Airspace Systems) |
| **2.3.2** | **OUTCOME:** Provide the technologies and processes for conducting trade-off analyses amongst future air transportation system’s concepts and technologies. |

***Chart continued on Next Page***

## THEME: Aeronautics Technology (AT)

### PERFORMANCE MEASURES

**Annual Performance Goals**

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

### INDEPENDENT REVIEWS

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

### BUDGET

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

Indicates budget numbers in Full Cost.

Indicates changes since the FY 2003 Presidents Budget Submit.

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

| THEME: | Aeronautics Technology |
|---|---|
| **DEVELOPMENT:** | Environmental Research Aircraft and Sensor Technology (ERAST) |

## PURPOSE

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

The ERAST project has the following performance characteristics:
1) Demonstrate solar powered UAV flight operations to 100,000 feet.
2) Demonstrate consumable fueled UAV technologies and capabilities that enable flight altitudes greater than 40,000 feet with a 660 pound payload with a flight endurance of at least 24 hours. Requirements were established by the Earth Science Enterprise (July 02, 1997).
3) Develop and safely fly a prototype solar powered UAV capable of sustaining 96 hrs above 50,000 feet.

## OVERVIEW

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

## PROGRAM MANAGEMENT

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

## TECHNICAL COMMITMENT

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

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

| THEME: | Aeronautics Technology |
|---|---|
| **DEVELOPMENT:** | Environmental Research Aircraft and Sensor Technology (ERAST) |

## ACQUISITION STRATEGY & PERFORMING ORGANIZATIONS

Data current as of 1/23/2003

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

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

## AGREEMENTS

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

## INDEPENDENT REVIEWS

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

## BUDGET/LIFE CYCLE COST

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

Indicates budget numbers in Full Cost

Indicates changes since the FY 2003 Presidents Budget Submit

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

| THEME: | Aeronautics Technology (AT) |
|---|---|
| **DEVELOPMENT:** | Hyper - X (X-43-A) |

## PURPOSE

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

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

## OVERVIEW

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

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

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

## PROGRAM MANAGEMENT

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

## TECHNICAL COMMITMENT

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

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

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

**THEM** Aeronautics Technology (AT)

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

## ACQUISITION STRATEGY & PERFORMING ORGANIZATIONS

Data current as of 1/23/2003

| Current Acquisitions | Actual * | Selection Method | Actual * | Performer | Actual * |
|---|---|---|---|---|---|
| Cooperative Agreements | 0% | Full & Open Competition | 13% | Industry | 54% |
| Cost Reimbursable | 0% | Sole Source | 87% | Government | 0% |
| Fixed Price | 2% | | 100% | NASA Extramural | 44% |
| Grants | 2% | | | University | 2% |
| Other (JSRA) | 40% | Sci Peer Review | % | Non Profit | 0% |
| * as % of FY02 direct procurement | 100% | * as % of FY02 direct procurement | | * as % of FY02 direct procurement | 100% |

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

## AGREEMENTS

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

## INDEPENDENT REVIEWS

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

## BUDGET/LIFE CYCLE COST

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

Indicates budget numbers in Full Cost.
Indicates changes since the FY 2003 Presidents Budget Submit.
*Note: For all formats, the FY02 column reflects the FY02 Congressional Operating Plan dated 9/30/02. The FY03 column reflects the FY03 President's Budget Submit (PBS) as Amended. The Change column includes both programmatic and full cost adjustments. The FY04 column is in full cost.*

| THEME: | Aeronautics Technology |
|---|---|
| **TECHNOLOGY AND ADVANCED CONCEPTS:** | Aviation Safety & Security Program (AvSSP) |

## PURPOSE

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

AvSSP directly addresses the safety and security needs of the National Airspace System (NAS) and the aircraft that fly in the NAS. AvSSP will develop prevention, intervention, and mitigation technologies and strategies aimed at one or more causal, contributory, or circumstantial factors associated with aviation accidents. High priority is given to strategies that address factors determined to be the largest contributors to accident and fatality rates, as well as those that address multiple classes of factors. The AvSSP will also develop and integrate information technologies needed to build a safer aviation system, to support pilots and air traffic controllers, as well as provide information to assess situations and trends that might indicate unsafe conditions before they lead to accidents. AvSSP will also be developing concepts and technologies which reduces the vulnerability of aircraft and the NAS to criminal and terrorist attacks while dramatically improving the efficiency of security.

## OVERVIEW

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

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

## PROGRAM MANAGEMENT

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

## TECHNICAL COMMITMENT

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

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

| THEME: | Aeronautics Technology |
|---|---|

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

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

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

## ACQUISITION STRATEGY & PERFORMING ORGANIZATIONS

Data current as of 1/21/2003

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

## ACQUISITION STRATEGY & PERFORMING ORGANIZATIONS (Continued)

Data current as of 1/21/2003

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

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

## AGREEMENTS

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

**External:**

1. Umbrella agreement between the FAA and NASA concerning a Partnership to Achieve Goals in Aviation and Future Space Transportation; October 1998.
2. Memorandum of Understanding #FNA/05 between the FAA and NASA on Program Support; August 1990.
3. Memorandum of Agreement #FNA/05-97-01 between the FAA and NASA for support of FAA R&D Field Offices at NASA Research Centers, March 1997.
4. Memorandum of Understanding #FNA/08 between the FAA and NASA concerning Aviation Safety Reserch; July 1999.
5. Memorandum of Agreement #FNA/08-99-01 between the FAA and NASA concerning the Aviation Safety Reporting System; June 1999.
6. Memorandum of Agreement #FNA/08-00-01 between the FAA and NASA concerning Weather Accident Prevention R&D Activities; June, 2000.
7. Memorandum of Agreement #FNA/08-01-01 between the FAA and NASA concerning Accident and Incident Mitigation Research; June 2001.
8. Memorandum of Agreements between the FAA and NASA for Weather Information Network, and the Development and Evaluation of Enhanced Situational Awareness Technologies; currently pending.
9. Agreements with Rannoch, Research Triangle Institute, Ohio University, BAE Systems Aerospace, Rockwell Collins, Jeppenson-Sanderson, Inc., Barron Associates, Delta, Honeywell International, ARINC, ARNAV, and Honeywell.

## INDEPENDENT REVIEWS

Data current as of 1/23/2003

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

| THEME: | Aeronautics Technology |
|---|---|
| **TECHNOLOGY AND ADVANCED CONCEPTS:** | Aviation Safety & Security Program (AvSSP) |

## BUDGET

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

Indicates budget numbers in Full Cost.

Indicates changes since the FY 2003 Presidents Budget Submit.

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

| THEME: | Aeronautics Technology |
| --- | --- |
| **TECHNOLOGY AND ADVANCED CONCEPTS:** | Airspace Systems Program |

## PURPOSE

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

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

## OVERVIEW

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

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

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

## PROGRAM MANAGEMENT

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

**THEME:** Aeronautics Technology

# TECHNOLOGY AND ADVANCED CONCEPTS: Airspace Systems Program

## TECHNICAL COMMITMENT

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

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

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

***Chart Continued On Next Page***

**THEME:** Aeronautics Technology

# TECHNOLOGY AND ADVANCED CONCEPTS: Airspace Systems Program

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

## ACQUISITION STRATEGY & PERFORMING ORGANIZATIONS

Data current as of 1/6/2003

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

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

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

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

| THEME: | Aeronautics Technology |
|---|---|
| **TECHNOLOGY AND ADVANCED CONCEPTS:** | Airspace Systems Program |

## AGREEMENTS

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

**External:**

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

## INDEPENDENT REVIEWS

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

## BUDGET

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

Indicates budget numbers in Full Cost.

Indicates changes since the FY 2003 Presidents Budget Submit.

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

| THEME: | Aeronautics Technology |
|---|---|
| **TECHNOLOGY AND ADVANCED CONCEPTS:** | Vehicle Systems Program |

## PURPOSE

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

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

## OVERVIEW

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

## PROGRAM MANAGEMENT

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

## TECHNICAL COMMITMENT

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

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

***Chart Continued on Next Page***

| THEME: | Aeronautics Technology |
|---|---|
| TECHNOLOGY AND ADVANCED CONCEPTS: | Vehicle Systems Program |

## TECHNICAL COMMITMENT (Continued)

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

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

## TECHNICAL COMMITMENT (Continued)

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

## ACQUISITION STRATEGY & PERFORMING ORGANIZATIONS

Data current as of 1/23/2003

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

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

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

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

## AGREEMENTS

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

**External:**

1. Umbrella agreement between the FAA and NASA concerning a Partnership to Achieve Goals in Aviation and Future Space Transportation; October 1998.
2. Memorandum of Understanding #FNA/09 between the FAA and NASA concerning Aviation Environmental Compatibility; October 1990.
3. Memorandum of Agreement #FNA/09-01-01 between the FAA and NASA concerning the Impact of Aviation Air Emissions on Climate and Global Atmospheric Composition; April 2001.
4. Memorandum of Agreement #FNA/09-02-01 between the FAA and NASA concerning Aircraft Noise Reduction Technology; June 2002.
5. NASA will enter into additional external agreements to facilitate accomplishment of their objectives and the transfer of technology. A variety of mechanisms will be employed, including Memoranda of Understanding, Memoranda of Agreement, Interagency Agreements and Cooperative Agreements. Where applicable, the respective program plans will provide specifics of these agreements explaining involvement of external organizations, other agencies or international partners, and a brief overview of the external support necessary to meet program objectives. Some of the entities the program office has agreements with are: DoE, DoT, FAA, AFRL, Navy, AEDC, Sandia National Lab, DARPA, GE, PW, Honeywell, Allison/R&R, Boeing, The Cleveland Clinic, University of Nevada and others.

## INDEPENDENT REVIEWS

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

## COST

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

Indicates budget numbers in Full Cost.

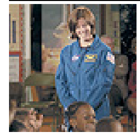
Indicates changes since the FY 2003 Presidents Budget Submit.

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

# ENTERPRISE: Education Programs


NASA and Education: A Perfect Fit.

## THEMES



**Education Programs**

# EDUCATION PROGRAMS

## PURPOSE

To develop the next generation of explorers, NASA must do its part to inspire and motivate students to pursue careers in science, technology, engineering, and mathematics. NASA's mission to understand and explore depends upon educated, motivated people with the ingenuity to invent tools and solve problems and the courage to always ask the next question. It is not enough to depend on the excitement generated by our images; we must capitalize on that interest to provide meaningful education programs that will benefit NASA and the Nation. To meet this challenge, education has become a core part of NASA's mission, and educational programs are an integral part of every major NASA activity. If we are to inspire the next generation, we must motivate students to pursue careers in science, technology, engineering, and mathematics, provide educators with unique teaching tools and compelling teaching experiences, ensure that we invest the public resources wisely, and fully engage minority and underrepresented students, educators and researchers in NASA's Education Programs. By doing so, we will strive to reach every young person in the Nation, to inspire the next generation of scientists, inventors, and explorers.

## THEME DISTRIBUTIONS

| Budget Authority ($ in millions) | FY 2002 | FY 2003 President's Budget, As Amended | FY 2004 President's Budget |
|---|---|---|---|
| Education Programs | 227.3 | 143.7 | 169.8 |
| Total | 227.3 | 143.7 | 169.8 |

Note: For all formats, the FY 2002 column reflects the FY 2002 Congressional Operating Plan dated 9/30/02. The FY 2003 column reflects the FY 2003 Presidents Budget Submit (PBS) as Amended. FY2004 column is in full cost.

Indicates budget numbers in Full Cost.

# ENTERPRISE: Education Programs

## Education Programs

The Education Enterprise will provide unique teaching and learning experiences, as only NASA can, through the Agency's research and flight capabilities. Students and educators will be able to work with NASA and university scientists to use real data to study the Earth, explore Mars, and conduct other scientific investigations. They will work with our engineers to learn what it takes to develop the new technology required to reach the farthest regions of the solar system and to live and work in space. It is important that the next generation of explorers represents the full spectrum of the U.S. population, including minority students and those from low-income families. To ensure the diversity in NASA's workforce, our educational programs pay particular attention to under-represented groups. NASA Education will support our Nation's universities to educate more students in science and engineering by providing meaningful research and internship opportunities for qualified students, plus a roadmap for students to seek NASA careers. Highlights for FY 2004 include:

**Overall budget**
FY 2004 request is $170 million, a $10 million or 6.1 percent increase over FY 2003 President's Request (full cost):

- $78 million for education programs including the continuation of pipeline development programs for students at all educational levels and the continuation of the Space Grant/EPSCOR programs, providing a national link with the higher education community.

- $92 million for minority university research and education including funding opportunities for minority institutions to increase the number and percentage of state-certified mathematics, science, or technology teachers.

- Education Enterprise funding is coordinated with an estimated $55 million in education-related funding managed by the five other NASA Enterprises.

**New Initiative – Education Initiative**
Request includes $26 million for this new initiative ($130 million over five years):

- $2 million for the Educator Astronaut Program that will select teachers and transport them into space to inspire and motivate students.

- $13 million for the NASA Explorer Schools Program that will provide target middle schools with a customized and sustained learning environment using NASA's most recent discoveries and latest technologies to garner greater interest in science and engineering careers.

- $9 million for Scholarship for Service that will link scholarship with service at a NASA Center and help NASA better attract top students into our workforce.

- $2 million for Explorer Institutes, NASA's direct link with the informal education community (science centers and museums) through openly competed grants.

Barbara Morgan, educator-astronaut, in the classroom.

# EDUCATION PROGRAMS

## MAJOR EVENTS IN FY 2004

- New solicitation for the university research center program that will further expand and strengthen the research capacity of minority institutions.
- Selection of the first class of educator astronauts.
- Pilot implementation of approximately 50 Explorer Schools.
- Initiate Explorer Institutes linking the informal education community to NASA's programs.
- Implement pilot scholarship for service.

## THEME: Education Programs (ED)

### OVERVIEW

To develop "the next generation of explorers," NASA must do its part to inspire and motivate students to pursue careers in science, technology, engineering, and mathematics. Diverse student populations need to become proficient in these academic disciplines and enter the science and technology workforce, becoming the next generation that will "understand and protect our home planet" and "explore the universe and search for life." NASA's Education Program provides a wealth of opportunities for educators and students at all levels of the education system. Those opportunities will inspire and motivate students and engage the public. With the FY04 budget request, NASA will expand our efforts to inspire the next generation of explorers by continuing to align all education programs with the new mission, and by building on new initiatives that were piloted in FY03: the NASA Explorer Academies/Institutes, the Educator Astronaut Program, and the Scholarship for Service.

| Missions | Goals supported by this theme | Objectives supporting those goals (Reference 2003 Strategic Plan) |
|---|---|---|
| Inspire the Next Generation of Explorers | 6. Inspire and motivate students to pursue careers in science, technology, engineering, and mathematics (STEM). | 6.1 Improve student proficiency in STEM by creating a culture of achievement using educational programs, products and services based on NASA's unique missions, discoveries and innovations.<br>6.2 Motivate K-16+ students from diverse communities to pursue science and mathematics courses, and ultimately college degrees in science, technology, engineering, and mathematics.<br>6.3 Enhance science, technology, engineering, and mathematics instruction with unique teaching tools and experiences that are compelling to educators and students as only NASA can provide.<br>6.4 Improve higher education capacity to provide for NASA's and the Nation's future science and technology workforce requirements. |
| | 7. Engage the public in shaping and sharing the experience of exploration and discovery. | 7.1 Improve the capacity of science centers, museums, and other institutions and organizations through the development of partnerships, to translate and deliver engaging NASA content. (Supporting role.) |

### RELEVANCE

Our Nation's education system is currently not producing the number of scientists, technologists, engineers, and mathematicians needed to replace those that are leaving the Nation's worrkforce. NASA is uniquely positioned to be able to positively effect an increase in the numbers of scientists, technologists, engineers, and mathematicians. Our Enterprises produce amazing scientific discoveries, cutting edge technologies, and marvelous feats of engineering. Our mission, our people, and our facilities are unique assets that help NASA inspire the next generation of explorers to see learning about science and technology in a new light that is relevant and exciting.

If we are to inspire the next generation, we must motivate students to pursue careers in science, technology, engineering, and mathematics, provide educators with unique teaching tools and compelling teaching experiences, ensure that we invest the public resources wisely, and fully engage minority and underrepresented students, educators, and researchers in NASA's Education Program.

| Education and Public Benefits |
|---|
| By supporting the mathematics and science components of the No Child Left Behind Act, and by participating with the Department of Education and the National Science Foundation in the Math/Science Partnership, the NASA Education Program broadens the reach of science and technology literacy across numerous Federal programs to the education community and the general public. The NASA Education Program is fully responsive to our stakeholders -- the taxpayer -- by actively engaging with other Federal agencies, Federal education policy, and the non-governmental organization community. |

## **THEME:** Education Programs (ED)

### IMPLEMENTATION

NASA has elevated education to a core mission. Reflecting this new priority, NASA in 2003 established a new Enterprise charged with the overall guidance and direction of the Agency's education efforts. Every NASA Enterprise makes important contributions to education, and these are coordinated and planned strategically by the Associate Administrator for Education. The new Education organization will unify the Education programs at NASA Headquarters and all NASA Field Centers under a One NASA Education vision, with a clear mandate to inspire and prepare the next generation of explorers…as only NASA can.

NASA's Education strategy pays particular attention to minority and under-represented populations. We must ensure that our Nation's diverse communities have access to all NASA opportunities that can advance student achievement in science, technology, engineering, and mathematics. NASA will use the excitement of its missions and programs to inspire more students to pursue the study of science, technology, engineering, and mathematics, and ultimately to pursue careers in aeronautics and space. NASA will also support educators in their efforts to increase student proficiency in these disciplines.

Two key components of NASA's education strategy are the Educator Astronaut and the NASA Explorer Academies Programs. Under the Educator Astronaut Program, NASA will recruit and select three to six educators to join the Astronaut Corps. The objectives are to make educators a permanent component of the Astronaut Corps to broaden our educational impact, and to engage students, teachers, and the public, drawing national attention to the importance of STEM.

The NASA Explorer Academies Program will engage educators, students, administrators, parents and the community by providing a customized, school-based, sustained learning environment using NASA discoveries, technologies, and exploration opportunities to support increased student interest and achievement in STEM.

NASA will continue to collaborate with institutions of higher learning through student and faculty involvement in NASA research, contributing to more students pursuing science, technology, engineering and mathematics degrees and ultimately careers in those fields.

| Strategy | Schedule by Fiscal Year<br>96 97 98 99 00 01 02 03 04 05 06 07 08 | Purpose |
|---|---|---|
| Educator Astronaut Program | | To expand exploration into U.S. classrooms; support student achievement, expand/strengthen NASA's education mission, and enhance the public perception of educators. |
| Explorer Academies/Institutes Program | | Provide NASA-unique learning experiences for students and professional development opportunities for teachers; electronic education portal network to include family involvement; 3-year commitment to participating schools. |
| Minority University Base Program | | Comprehensive program of opportunities for students and faculty in minority-serving institutions. Program is currently under review for alignment with new priorities. Review is scheduled for completion in FY2003 and new program direction will be developed according to the outcomes. |
| Education Base Program | | Comprehensive, national program of opportunities for students, faculty, and state based institutions. Program is currently under review for alignment with new priorities. Review is scheduled for completion in FY2003 and new program direction will be developed according to the outcomes. |

Development Operations

## THEME: Education Programs (ED)

### IMPLEMENTATION (Continued)

| Tailoring |
|---|
| No exceptions to NPG 7120.5B have been taken. |

### STATUS

During FY02 preliminary estimates of the total in-person involvement in NASA Education activities exceeded 2.6 million. Participant feedback from educational activities was highly favorable (5=excellent; 1=very poor): rate staff - 4.71; recommend to others - 4.63; expect to apply what was learned - 4.55; valuable experience - 4.66. In response to the NASA Education Program Evaluation Review Panel (NEPER), NASA has established a student tracking longitudinal data base; data entry will begin with selected student programs in FY 2003.

For more detailed status information, please go to: http://education.nasa.gov/ or http://mured.nasaprs.com/

### PERFORMANCE MEASURES

| Annual Performance Goals | |
|---|---|
| OUTCOME 6.1.1: | Kindergarten through graduate students will be more proficient in science, technology, engineering, and mathematics (STEM) |
| 4ED1 | Develop/implement customized education program for pilot cohort of 40 schools to improve student STEM proficiency. Progress will be validated through external evaluation conducted according to accepted professional standards. |
| 4ED2 | Develop at least 3 ethnic-focused space exploration teaching tools in FY04 that target Hispanic/Latino, African American, and Native American K-12 students in order to improve student proficiency in STEM. Identify institutions/schools, that enroll at least 60% of the targeted population to implement these tools no later than FY05. Progress will be validated through external evaluation conducted according to accepted professional standards. |
| 4ED3 | Support the achievement of education objectives as established by state and local education authorities through the coordinated application of NASA assets, conducting activities for educators and students as requested. Progress will be assessed through a standards-based, external evaluation, validated by an external panel. |
| OUTCOME 6.2.1: | More students from diverse communities motivited to pursue careers in STEM |
| 4ED4 | Provide educational assistance, through competitive scholarships and fellowships to at least 400 undergraduate and 200 graduate students from diverse communities to pursue degrees in STEM disciplines. A longitudinal database will be developed to track career development paths. |
| OUTCOME 6.3.1: | Improve quality of STEM instruction |
| 4ED5 | Engage K-12 educators in the Educator Astronaut Program to provide unique teaching resources to the STEM teaching profession. Progress will be validated through external evaluation conducted according to accepted professional standards. |
| 4ED6 | Establish engaging, interactive web-based teaching resources for educators that support STEM instruction. Progress will be assessed using standards-based evaluation techniques. |
| 4ED7 | Provide opportunities for minority institutions to enhance their capacity to prepare both pre-service and in-service teachers to teach mathematics and science. Program effectiveness will be measured by tracking the number of teachers who obtain certification to teach mathematics and science and who are then employed to teach. |
| 4ED8 | Provide financial resources and NASA research data to enable interdisciplinary teams from university teacher education programs to develop innovative courses for pre-service teachers. Outcomes will be evaluated by university faculty and graduate students through a multi-faceted protocol. |
| OUTCOME 6.4.1: | More students prepared to enter the STEM workforce |
| 4ED9 | Provide education and research opportunities to a diverse cohort of students and faculty in STEM disciplines that support human resources needs of the science and technology workforce (NASA, contractors, and/or universities). A longitudinal database to track students' career paths will be used to determine the number of graduates from NASA student programs who enter the science and technology workforce (NASA, contractors, and/or universities). |
| 4ED10 | Provide Minority Institutions with information and technical assistance on strategies that enhance STEM program development, management, and sustainability. Progress toward the outcome will be reviewed by an external panel. |
| 4ED11 | Develop partnerships and programs that strengthen research in NASA-related fields that enhance academic and research infrastructure at Minority Institutions. Progress toward the outcome will be reviewed by an external panel. |
| 4ED12 | Involve universities in states underrepresented in their share of competitively awarded grants, in NASA related research. An evaluation of the quality of research results will be conducted. |

## THEME: Education Programs (ED)

### PERFORMANCE MEASURES (continued)

Annual Performance Goals (continued)

OUTCOME 7.1.1: Improve the capacity of science centers, musuems, and other institutions through the development of partnerships, to translate and deliver engaging NASA content

4ED13 Establish a collaboration with the Association of Science and Technology Centers, in addition to partnerships with at least five major science centers or museums. Provide the science centers and museums with mechanisms to motivate students to pursue STEM subjects and to share with the public NASA's research, mission, and discoveries.

### INDEPENDENT REVIEWS

| Types of Review | Performer | Last Review | Next Review | Purpose |
|---|---|---|---|---|
| NEPER | Westat | 1-Jul-02 | N/A | External panel review of Program, requested by OMB. |
| Program Review | External panel | N/A | 30-Apr-03 | Review/evaluate Programs according to new direction. |

### BUDGET

| Budget Authority ($millions) | | FY02 | FY03 | Change | FY04 | Comments |
|---|---|---|---|---|---|---|
| **Education Programs** | | **227.3** | **143.7** | **+26.1** | **169.8** | |
| Education | | 142.6 | 61.6 | +16.7 | 78.3 | |
| | Base Program | 142.6 | 61.6 | +3.0 | 64.6 | |
| | New Initiative | | | +13.7 | 13.7 | |
| Minority University | | 84.7 | 82.1 | +9.4 | 91.5 | |
| | Base Program | 84.7 | 82.1 | -4.3 | 77.8 | |
| | New Initiative | | | +13.7 | 13.7 | |

Note: For all formats, the FY 02 column reflects the FY 2002 Congressional Operating Plan letter dated 9/30/02. The FY 03 column reflects the FY 2003 Presidents Budget Submit (PBS) as Amended. The Change column includes both programmatic and full cost adjustments. FY 2004 column is in full cost.

Indicates budget numbers in Full Cost.

Indicates changes since the FY 2003 Presidents Budget Submit.

FY 2002 and FY 2003 are not in full cost.

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| THEME: | Education Programs (ED) |
|---|---|
| **EDUCATION:** | Minority University Program |

## PURPOSE

| Objectives Reference 2003 Strategic Plan | Performance Measures |
|---|---|
| 6.1; 6.2; 6.3; 6.4; 7.1 | 4ED2; 4ED4; 4ED7; 4ED9; 4ED10; 4ED11; 4ED13 |

NASA's outreach to minority institutions through its Minority University Research and Education Program (MUREP) will expand the Agency's research base through continued investment in minority institutions' research and academic infrastructure; will contribute to the development of the science, technology, engineering, and mathematics pipeline; and inspire the next generation of explorers.

## OVERVIEW

The NASA MUREP achieves its objectives by employing a comprehensive and complementary array of strategies, which include (1) developing new research and education collaborations and partnerships with the NASA Strategic Enterprises, other government agencies and interested parties; (2) encouraging opportunities for faculty to conduct NASA research early in their careers; (3) providing incentives for students to enter and remain in mathematics, science and technology disciplines; (4) establishing measurable program goals and objectives; and (5) developing and implementing evaluations to assess the effectiveness and outcomes of the programs and financial performance, thereby improving program delivery and results.

For more information, go to: http://mured.nasaprs.com/

## PROGRAM MANAGEMENT

The Minority University Program responsibility is maintained at NASA Headquarters, with local implementation at each NASA Center. Enterprise official is Dr. Adena Loston, Associate Administrator for Education at HQ. This program is exempted from compliance with NPG7120.5B.

## TECHNICAL COMMITMENT

The baseline for this technical commitment was established in the FY03 President's budget. The Minority University Program is a comprehensive program of opportunities for students/faculty in minority-serving institutions. The following represents the current base program elements as well as a new initiative:

| Technical Specifications | FY04 President's Budget | Change from Baseline |
|---|---|---|
| Institutional Science, Engineering, Technology | This activity is designed to achieve a broad-based, competitive aerospace research capability among the Nation's minority institutions and is conducted in cooperation with the NASA Enterprises. | -- |
| Principal Investigators | This activity increases the participation of faculty and other professionals in conducting NASA research, research training, and/or administration. | -- |
| Partnerships | This activity enhances the academic infrastructure in specific NASA-related disciplines with a focus on interdisciplinary collaborations. | -- |
| Math & Science Education | This activity increases the participation and achievement of socially and economically disadvantaged and/or disabled students in the fields of science, technology, engineering, and mathematics at all levels of education. | -- |
| New Initiative | Incorporates two major strategies to ensure Agency success in inspiring the next generation of explorers: 1) expand the pool of students entering the STEM pipeline through programs such as the Educator Astronautand NASA Explorer Academies/Institutes; and 2) increase the number of individuals entering the STEM workforce through programs such as the Scholarship for Service. | Increase number of students in STEM pipeline and workforce |

| Schedule | FY04 President's Budget | Change from Baseline |
|---|---|---|
| Schedule of program activity to be determined pending Program Review recommendations; to be completed in FY 2003. | | |

| | |
|---|---|
| **THEME:** | Education Programs (ED) |
| **EDUCATION:** | Minority University Program |

## ACQUISITION STRATEGY & PERFORMING ORGANIZATIONS

Data current as of 1/18/2003

Minority University Program activities are conducted with a wide range of minority educational institutions and minority-serving organizations through competitive research announcements, cooperative agreement notices, and other procurement vehicles.

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

| Current Acquisitions | Actual * | Selection Method | Actual * | Performer | Actual * |
|---|---|---|---|---|---|
| Cooperative Agreements | 42% | Full & Open Competition | 62% | Industry | TBD |
| Cost Reimbursable | 0% | Sole Source | 38% | Government | TBD |
| Fixed Price | 0% | | 100% | NASA Intramural | TBD |
| Grants | 40% | | | University | TBD |
| Other | 18% | Sci Peer Review | 100% | Non Profit | TBD |
| | 100% | * as % of FY02 direct procurement | | | TBD |

| Future Acquisitions - Major | Selection | Goals |
|---|---|---|
| Research Announcements | TBD | 100% Sci Peer Review, 100% Grants/Cooperative Agreements. |

## AGREEMENTS

*Internal:* The program is not dependent on other NASA activities outside of the control of the Associate Administrator for Education.

*External:* Executive Order 13256: HBCU (Dated February 12, 2002); Executive Order 13320: Educational Excellence for Hispanic Americans (Dated October 12, 2001); and Executive Order 13270: Tribal College and Universities (Dated July 3, 2000).

*Changes since FY 2003 President's Budget:* None.

## INDEPENDENT REVIEWS

Data current as of 1/18/2003

| Types of Review | Performer | Last Review | Next Review | Purpose |
|---|---|---|---|---|
| Site reviews at each award location | TBD | Periodic | Periodic | Review/evaluate program progress. |
| Program review | External panel | N/A | 30-Apr-03 | Review/evaluate Programs according to new direction. |

## BUDGET

| Budget Authority ($ in millions) | **FY02** | **FY03** | **FY04** | Comments |
|---|---|---|---|---|
| FY 2004 President's Budget (Minority University Program) | 84.7 | 82.1 | 91.5 | |
| Institutional Science, Engineering & Tech | 29.1 | 31.1 | 30.7 | |
| Principal Investigator | 7.5 | 8.5 | 11.6 | |
| Partnerships | 16.5 | 13.4 | 8.5 | |
| Math & Science Education | 31.6 | 29.1 | 27.0 | |
| New Initiatives | | | 13.7 | New Initiative. |
| | | | | |
| Changes since FY 03 Pres. Budget | 0.0 | 0.0 | +9.4 | ***Reason for Change:*** |
| Institutional Science, Engineering & Tech | | | -0.4 | Internal agency reallocation for New Initiative. |
| Principal Investigator | | | +3.1 | Reallocation to new initiative. |
| Partnerships | | | -4.9 | Internal agency transfer for New Initiative. |
| Math & Science Education | | | -2.1 | Internal agency transfer for New Initiative. |
| New Initiatives | | | +13.7 | |

Indicates budget numbers in Full Cost.

Indicates changes since the FY 2003 Presidents Budget Submit.

FY 2002 and FY 2003 are not in full cost.

| THEME: | Education Programs (ED) |
| --- | --- |
| **EDUCATION:** | Education |

## PURPOSE

| Objectives | Reference 2003 Strategic Plan | Performance Measures |
| --- | --- | --- |
| 6.1; 6.2; 6.3; 6.4; 7.1 | | 4ED1; 4ED3; 4ED4; 4ED5; 4ED6; 4ED8; 4ED9; 4ED12; 4ED13 |

To inspire the next generation of explorers, NASA will use an integrated, focused approach to improve student proficiency in science, technology, engineering, mathematics disciplines, motivate more students to explore those areas, work to improve the way educators teach STEM-related subjects, improve the capacity of higher education to provide for NASA and the Nation's technological workforce needs, and improve the capacity of the informal education community.

## OVERVIEW

The Education Program brings students and educators, K-16+, into the NASA mission and research as participants and partners. NASA provides the opportunity for a diverse group of students and educators to directly interact with NASA's scientists and engineers, facilities, and research and development activities. The participants benefit from the opportunity to become involved in R&D endeavors, gain an understanding of the breadth of NASA's activities, and return to the classroom with enhanced knowledge and skills -- all to inspire the next generation into STEM related careers. Education Programs are categorized as student programs, teacher/faculty preparation and enhancement, curriculum support/dissemination, state based, and educational technology. In FY 2004, two new initiatives are underway: Educator Astronaut Program, Explorer Academies.

For more information go to: www.education.nasa.gov

## PROGRAM MANAGEMENT

The Education Program responsibility is maintained at NASA Headquarters, with local implementation at each NASA Center. The Enterprise official is Dr. Adena Loston, Associate Administrator for Education at HQ. This program is exempted from compliance with NPG7120.5B.

## TECHNICAL COMMITMENT

The baseline for this technical commitment was established in the FY03 President's budget. The Education Program is a comprehensive, national program of opportunities for students, faculty and state-based institutions. The following represents the current base program elements as well as a new initiative:

| Technical Specifications | FY04 President's Budget | Change from Baseline |
| --- | --- | --- |
| Student Support | Improve student proficiency in STEM by creating a culture of achievement educational programs, products and services based on NASA's unique missions, discoveries and innovations. | -- |
| Teacher/Faculty Prep/Enhance. | Improve science, technology, engineering, and mathematics instruction with unique teaching tools and experiences compelling to teachers and students. | -- |
| State-based | Use NASA's unique assets to support local, state, regional STEM education improvements through collaboration with stakeholders. | -- |
| Educational technology | Research/develop products/services which facilitate the application of technology to enhance the educational process for formal/informal education. | -- |
| New Initiative | Incorporates two major strategies to ensure Agency success in inspiring the next generation of explorers: 1) expand the pool of students entering the STEM pipeline through programs such as the Educator Astronaut, NASA Explorer Academies and Institutes; and 2) increase the number of individuals entering the STEM workforce. | Increase number of students in STEM pipeline and workforce. |

| Schedule | FY04 President's Budget |
| --- | --- |
| Educator Astronaut | |
| Announcement/recruitment | Jan 03 - Apr 03 |
| Candidate selection | May 03 - Mar 04 |
| EA training/preparation | Apr 04 - Jun 05 |
| Core operations at JSC | Jul-05 |
| NASA Explorer Academies | |
| Pilot program implemented | Jun 03 |

| THEME: | Education Programs (ED) |
|---|---|
| **EDUCATION:** | Education |

## ACQUISITION STRATEGY & PERFORMING ORGANIZATIONS

Data current as of 1/18/2003

Education Program activities are conducted with a wide range of educational institutions and non-profit organizations through competitive program announcements, cooperative agreement notices, and other procurement vehicles. **Changes since FY 2003 President's Budget: None.**

| Current Acquisitions | Actual * | Selection Method | Actual * | Performer | Actual * |
|---|---|---|---|---|---|
| Cooperative Agreements | 9% | Full & Open Competition | 46% | Industry | 0% |
| Cost Reimbursable | 0% | Sole Source | 54% | Government | 0% |
| Fixed Price | 4% | | 100% | NASA Intramural | 0% |
| Grants | 82% | | | University | 54% |
| Other | 5% | Sci Peer Review | 29% | Non Profit | 46% |
| | 100% | * as % of FY02 direct procurement | | | 100% |

| Future Acquisitions - Major | Selection | Goals |
|---|---|---|
| 1. Student program announcement | Spr 03 | 100% Full & Open Competition, Peer Review |
| 2. Faculty program announcement | Spr 03 | 100% Full & Open Competition, Peer Review |

## AGREEMENTS

*Internal:* The program is not dependent on other NASA activities outside of the control of the Associate Administrator for Education.

*External:* Memoranda of Understanding with the following organizations: National Aerospace Education Alliance, Experimental Aircraft Association Aviation Foundation.

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

## INDEPENDENT REVIEWS

Data current as of 1/18/2003

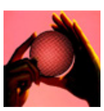
| Types of Review | Performer | Last Review | Next Review | Purpose |
|---|---|---|---|---|
| NEPER | Westat | 1-Jul-02 | N/A | External panel review of Program, requested by OMB. |
| Program review | External panel | N/A | 30-Apr-03 | Review/evaluate Programs according to new direction. |

## BUDGET

| Budget Authority ($ in millions) | FY02 | FY03 | FY04 | Comments |
|---|---|---|---|---|
| FY 2004 President's Budget (Education) | 142.6 | 61.6 | 78.3 | |
| Student support | 20.9 | 11.3 | 11.8 | |
| Teacher/faculty | 9.6 | 9.2 | 8.1 | |
| State-based support | 40.8 | 30.4 | 35.4 | |
| Educational technology | 69.7 | 9.1 | 7.6 | |
| Evaluation | 1.6 | 1.6 | 1.7 | |
| New Initiative | | | 13.7 | |
| Changes since FY 03 Pres. Budget | 0.0 | 0.0 | +16.7 | ***Reason for Change:*** |
| Student support | | | +0.5 | Realignment of priorities |
| Teacher/faculty | | | -1.1 | Reallocate to new initiative |
| State-based support | | | +5.0 | Reallocate to new initiative |
| Educational technology | | | -1.5 | Reallocate to new initiative |
| Evaluation | | | +0.1 | Reallocate to new initiative |
| New Initiative | | | +13.7 | Internal agency transfer of funds for new initiative |

Indicates budget numbers in Full Cost.
Indicates changes since the FY 2003 Presidents Budget Submit.
FY 2002 and FY 2003 are not in full cost.

## APPROPRIATION SUMMARY: Space Flight Capabilities

| | Millions of Dollars | FY 2002 | FY 2003 President's Budget, as amended | FY 2004 President's Budget |
|---|---|---|---|---|
| | **Space Flight** | **6,773.2** | **6,130.9** | **6,109.8** |
|  | **International Space Station** | **1,720.8** | **1,492.1** | **1,707.1** |
|  | **Space Shuttle** | **3,270.0** | **3,208.0** | **3,968.4** |
|  | **Space and Flight Support** | **600.9** | **238.7** | **434.3** |
| | **Institutional Support** | **1,181.5** | **1,192.1** | **--** |
| | **Aerospace Technology (Crosscutting Technologies)** | **1,518.1** | **1,829.4** | **1,672.3** |
|  | **Space Launch Initiative** | **535.1** | **879.4** | **1,064.6** |
|  | **Mission and Science Measurement Technology** | **276.1** | **274.9** | **438.4** |
|  | **Innovative Technology Transfer Partnerships** | **163.8** | **146.9** | **169.3** |
| | **Institutional Support** | **543.1** | **528.2** | **--** |
| | **TOTAL APPROPRIATION** | **8,291.3** | **7,960.3** | **7,782.1** |

**Note: For all formats, the FY 2002 column reflects the FY 2002 Congressional Operating Plan dated 9/30/02. The FY 2003 column reflects the FY 2003 Presidents Budget Submit (PBS) as Amended. FY2004 column is in full cost.**

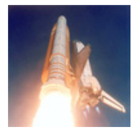
**Indicates budget numbers in Full Cost.**

# ENTERPRISE: Space Flight

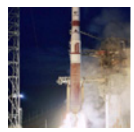
Astronauts Michael E. Lopez-Alegria and John B. Herrington work on the newly installed Port One (P1) truss on the International Space Station (ISS) during the STS-113 mission. The spacewalk lasted 6 hours, 10 minutes. The end effector of the Canadarm2 / Space Station Remote Manipulator System (SSRMS) and Earth's horizon are visible in bottom of frame.

## THEMES

**International Space Station**



**Space Shuttle**



**Space and Flight Support**

# SPACE FLIGHT

## PURPOSE

The Space Flight Enterprise programs ensure that the Nation will have reliable, safe, and affordable access to space for our human and robotic explorers, and open new exploration and research opportunities through the extension of human presence off Earth. The Space Flight Enterprise enables research by delivering transportation systems such as the Space Shuttle, providing operational research facilities in space such as the International Space Station, and by providing space communications systems and supporting space infrastructure. The Enterprise also provides the essential system necessary to open the space frontier to the broadest extent possible – the human system. In many cases, innovative technologies are most effective when used to leverage or enhance the productivity of humans.

Looking ahead, the Space Flight Enterprise is examining new capabilities and infrastructures to make possible new generations of space systems and space operations that could enable a range of future exploration objectives, including eventual campaigns of human/robotic exploration of the moon and the planets as well as the deployment and servicing of new generations of space observatories. The Space Flight Enterprise, because of its critical relationship to the future of human space flight, has a unique role to play in the inspiration of the next generation of explorers: our future on Earth and in space.

# ENTERPRISE: Space Flight

## FY 2002 ACCOMPLISHMENTS

On November 2, 2002, the International Space Station celebrated the second full year of continuous, permanent human habitation in space in the world's first international orbital outpost. For the Station, FY 2002 was an ambitious and virtually flawless year of expansion and research. What began as the largest, most sophisticated and powerful spacecraft ever built has grown to a capacious, efficiently organized laboratory and living complex whose internal volume now resembles that of a three-bedroom house. As construction of the Station continued, so did the amount of scientific research taking place on board. In FY 2002, crewmembers devoted approximately 920 hours to research, and NASA accomplished four successful Space Shuttle missions. Three of the missions delivered crew, supplies, and assembly pieces to the Space Station, bringing the total number of Shuttle flights to the Station to 15. The remaining Shuttle mission was a spectacularly successful servicing mission to the Hubble Space Telescope. This mission made one of the best astronomical observatories ever built even better by installing new solar panels, an improved central power unit, and a new camera that increased Hubble's "vision" tenfold. The crew even revived a disabled infrared camera on Hubble. The missions met or exceeded the indicators noted above: there were no mishaps over the threshold and flight anomalies were kept within goal.

Originally, NASA had planned seven shuttle flights for FY 2002. Three flights were delayed due to safety concerns with the propulsion system hardware. Diligent work went into the discovery and repair of tiny cracks in metal liners used to direct the fuel flow inside propellant lines on the Space Shuttle orbiters. This was just one example of NASA employees making a positive difference through their commitment to the safe accomplishment of our missions.

In FY 2002, NASA completed an independent assessment of potential business options for future Space Shuttle operations. This assessment is essential to the planned 2003 rollout of a Shuttle competitive sourcing plan that aligns with the President's Management Agenda. We also factored the independent assessment's results into the new Integrated Space Transportation Plan. This plan coordinates our space transportation investments to most effectively support science-driven exploration and provide continued safe, reliable human access to the Space Station.

## THEME DISTRIBUTIONS

| Budget Authority ($ in millions) | FY 2002 | FY 2003 President's Budget, As Amended | FY 2004 President's Budget |
|---|---|---|---|
| International Space Station | 1,720.8 | 1,492.1 | 1,707.1 |
| Space Shuttle | 3,270.0 | 3,208.0 | 3,968.4 |
| Space and Flight Support | 600.9 | 238.7 | 434.3 |
| Institutional Support | 1,181.5 | 1,192.1 | -- |
| Total | 6,773.2 | 6,130.9 | 6,109.8 |

Note: For all formats, the FY 2002 column reflects the FY 2002 Congressional Operating Plan dated 9/30/02. The FY 2003 column reflects the FY 2003 Presidents Budget Submit (PBS) as Amended. FY2004 column is in full cost.

Indicates budget numbers in Full Cost.

## International Space Station

This theme supports activities for establishing a permanent human presence in Earth orbit – the International Space Station. The Space Station provides a long-duration habitable laboratory for science and research activities to investigate the limits of human performance, expand human experience in living and working in space, and enable commercial development of space. The Space Station will allow unique, long-duration, space-based research in cell and developmental biology, plant biology, human physiology, fluid physics, combustion science, materials science, and fundamental physics. It will also provide a unique platform for observing the Earth's surface and atmosphere, the Sun, and other astronomical objects. Highlights for FY 2004 include:

# ENTERPRISE: Space Flight

**Overall budget**

FY 2004 request is $1,707 million, a $144 million or 7.8 percent decrease from FY 2003 President's Request (full cost):

- Funding drops as planned as development activities near an end and on-orbit operations and research becomes the focus of the program.
- Maintains proposal in FY 2003 Budget Amendment including additional funds for reserves plus funding Node 3 and Environmental Closed Life Support System (ECLSS) in FY 2004.
- Continues significant progress toward resolving the Space Station management and cost control issues that confronted the program at the end of 2001. Many changes based on recommendations of the ISS Management and Cost Evaluation (IMCE) task force have increased NASA's confidence in achieving success with the U.S. Core Complete station.
- A new management team is in place with the authority to control program content, to ensure station capabilities are driven by science requirements, and to make the appropriate decisions as the program moves from development into its operational phase.
- The development of NASA's integrated financial management core system and a management information system are progressing on schedule.
- The Space Station program is well on its way to completing work on the U.S. Core Complete configuration. Flight elements undergoing ground integration and test are proceeding on schedule, and the last U.S. flight element is scheduled for delivery to NASA by the spring of 2003.

## Space Shuttle

This theme builds on the Shuttle's primacy as the world's most reliable and versatile launch system. The shuttle, first launched in 1981, provides the only capability in the United States for human access to space. In addition to transporting people, materials, and equipment, the Space Shuttle allows astronauts to service and repair satellites and build the Space Station. The Space Shuttle can be configured to carry different types of equipment, spacecraft, and scientific experiments that help scientists understand and protect our home planet, explore the Universe, and inspire the imagination of the American people. Highlights for FY 2004 include:

**Overall budget**
FY 2004 request is $3,968 million, a $183 million or 4.8 percent increase over FY 2003 President's Request (full cost):

- Supports steady state flight rate of five per year.
- Provides $379 million ($1.7 billion over five-years) for Space Shuttle Service Life Extension, a program to improve safety and infrastructure needs to allow flying Space Shuttle into the next decade.
- Exploring all alternatives for competitive sourcing of Shuttle flight operations following the conclusion of the current Space Flight Operations Contract in order to best fly safely, meet flight schedule, and improve the existing Shuttle system.

## Space and Flight Support

This theme encompasses space communications, launch services, rocket propulsion testing, and advanced systems. Space communications consists of the tracking and data relay satellite system (TDRSS), which supports space shuttle, expendable launch vehicles, and research aircraft, and the NASA integrated services network, which provides telecommunications services at facilities such as flight support networks, mission control centers and science facilities, and administrative communications networks for NASA centers. The Launch Services program focuses on meeting the Agency's launch and payload processing requirements by assuring safe and cost effective access to space via the Space Shuttle and expendable launch vehicles. Rocket propulsion testing supports a core of highly trained test and engineering crews and test facilities. Advanced Systems program includes studies of human and robotic exploration of space. Highlights for FY 2004 include:

**Overall budget**
FY 2004 request is $434 million, a $36 million or 7.7 percent decrease from FY 2003 President's Request (full cost):

- $125 million for Space Communications budget. Continues support for formulation phase of TDRS Continuation project.
- $142 million for oversight of expendable launch vehicle flights and supporting payload carriers for Shuttle launches.
- $62 million for rocket propulsion testing.
- $85 million for environmental compliance including $44 million for Plum Brook cleanup.

The International Space Station (ISS) is a complex of research laboratories in low Earth orbit for conducting unique scientific and technological investigations in a micro-gravity environment. The Station provides space flight capabilities that help NASA to achieve each of its three missions.

# INTERNATIONAL SPACE STATION

## MAJOR EVENTS IN FY 2004

- Achieve U.S. core complete by spring 2004.
- 12 U.S. racks available for research.
- Expect awards for new contract opportunities for Space Station support.

## THEME: International Space Station (ISS)

### OVERVIEW

The ISS is a complex of research laboratories in low Earth orbit (LEO) in which American, Russian, Canadian, European, and Japanese astronauts are conducting unique scientific and technological investigations in a micro-gravity environment. The objectives of the Station are to support scientific research and other activities requiring the unique attributes of humans in space, and establish a permanent human presence in Earth orbit. Program estimates have been determined to be credible by independent assessment teams, however, concerns were raised in regard to the sufficiency of funding levels to cover risks to program performance. To this end, the FY 2004 Budget request maintains the budget reserve plan from the FY 2003 budget amendment and provides funding for continued development of the vehicle and for operations in support of continued assembly, logistics re-supply, crew exchange, research operations and other utilization. With fourteen U.S. assembly and logistic missions successfully completed, the budget includes funding to keep subsequent assembly missions on schedule through U.S. Core Complete (Flight 10A), currently planned for February 2004, to continue to expand research opportunities commensurate with the build-up of on-orbit utilization capabilities and resources.

| Missions and Goals supported by this theme | | Objectives supporting those goals — Reference 2003 Strategic Plan |
|---|---|---|
| Understand and Protect our Home Planet | 1. Understand the Earth system and apply Earth system science to improve prediction of climate, weather and natural hazards. | 1.1 Understand how the Earth is changing, better predict change, and understand the consequences for life on Earth. (supporting) |
| | 3. Create a more secure world and improve the quality of life by investing in technologies and collaborating with other agencies, industry and academia. | 3.2 Enhance the Nation's security through aeronautical partnerships with DOD and other government agencies. (supporting) |
| | | 3.5 Resolve scientific issues impacting Earth-based technological and industrial applications using the unique low-gravity environment of space. (supporting) |
| Explore the Universe and Search for Life | 4. Explore the fundamental principles of physics, chemistry, and biology through research in the natural laboratory of space. | 4.2 Understand the fundamental organizing principles of nature and how they give rise to structure and complexity in matter, using the unique low-gravity environment in space. (supporting) |
| Inspire the Next Generation of Explorers | 6. Inspire and motivate students to pursue careers in science, technology, engineering, and mathematics. | 6.1, 6.2, 6.3, 6.4 (Supporting Role) - See Education Programs Theme. |
| | 7. Engage the public in shaping and sharing the experience of exploration and discovery. | 7.2 Improve science literacy by engaging the public in NASA missions and discoveries, and their benefits, through such avenues as public programs, community outreach, mass media, and the internet. (supporting) |
| Space Flight Capabilities | 8.Ensure the Provision of Space Access for the nation, and improve it by increasing safety, reliability, and affordability. | 8.4 Assure capabilities for world class research on a laboratory in low Earth orbit. |
| | 9. Extend the duration and boundaries of human space flight to create new opportunities for exploration and discovery. | 9.4 Demonstrate the ability to support a permanent human presence in low Earth orbit as a stepping stone to human presence beyond. |

## THEME: International Space Station (ISS)

### RELEVANCE

The ISS will vastly expand the human experience in living and working in space, encourage and enable development of space, and provide a capability to perform unique, long duration, space-based research in cell and developmental biology, plant biology, human physiology, fluid physics, combustion science, materials science and fundamental physics. ISS will also provide a unique platform for making observations of the Earth's surface and atmosphere, the sun, and other astronomical objects. The experience and dramatic results obtained from the use of the ISS will guide the future direction of the Space Flight Enterprise. The International Space Station is critical to NASA's ability to fulfill its mission to explore, use, and enable the development of space for human enterprise.

The ISS represents an unprecedented level of international cooperation. Space Station Partnership agencies include NASA, the Russian Aviation and Space Agency (Rosaviakosmos), the Canadian Space Agency (CSA), the European Space Agency (ESA), and the National Space Development Agency of Japan (NASDA). Additionally, there are several bilateral agreements between NASA and other nations such as Italy and Brazil, resulting in a total of sixteen participating nations. International participation in the program has significantly enhanced the capabilities of the ISS.

| Education and Public Benefits |
| --- |
| The ISS is the world's only space station and is central to the NASA vision and mission. The ISS will be used as a unique teaching tool, opening a new frontier for human learning and experience, and allows the Agency and its partners to pursue a series of related goals. It allows basic and applied research in biological and physical sciences that cannot be conducted on Earth, research to enable human and robotic exploration and development of space, and applied research and development, which could not be effectively pursued on the ground. The ISS is the only facility that provides prolonged human research interaction in zero- gravity and routine sample return. |

# THEME International Space Station (ISS)

## IMPLEMENTATION

This theme is composed of two Development and three Operational areas. Individual information templates are included for each. Enterprise Official is William Readdy, AA for Space Flight. Theme Director is Michael Kostelnik.

Go to Project Homepage for more information: http://spaceflight.nasa.gov/station/index.html

| Strategy | **Schedule** | **Purpose** |
|---|---|---|
| 9A - S1 TRUSS | Oct '02 | Truss Assembly |
| 11A - P1 TRUSS | Nov '02 | Truss Assembly |
| ULF-1, MPLM: CMG | Mar '03 | Research and Re-supply; Maintenance |
| 12A - P3/P4 TRUSS Segments | May '03 | Truss Assembly |
| 12A.1 | Jul '03 | Logistical Support |
| 13A S3/S4 TRUSS Segments | Oct '03 | Truss Assembly |
| 13A.1 | Nov '03 | Logistical Support |
| 15A S6 TRUSS Segment | Jan '04 | Truss Assembly |
| 10A Node 2 | Feb '04 | Module Delivery - **US CORE COMPLETE** |
| ULF-2 Logistics Carriers | Jul '04 | Research and Re-supply; Maintenance |
| Subsequent Major Assembly Missions | Under Review | |
| 1E Columbus Module | FY05 | Partner Module Delivery & Activation |
| 1J/A JEM Experiment Logistics Module | FY06 | Partner Element Delivery & Activation |
| 1J JEM Pressurized Module | FY06 | Partner Module Delivery & Activation |
| 9A.1 MTsM, Science Power Platform | FY07 | Partner Element Delivery & Activation |
| UF-7 CAM | FY07 | Utilization and Module Delivery |
| 2J/A JEM Exposed Facility | FY07 | Partner Element Delivery & Activation |
| 14A Cupola, Express Pallet | FY08 | Element & Equipment Delivery |
| **Utilization Rack Build-up** | | |
| 5 US Racks | 2001 | |
| 2 US Racks | 2002 | |
| 3 US Racks | 2003 | |
| 2 US Racks | 2004 | |
| 4 US Racks - 5 ESA | 2005 | |
| 2 US RACKS - 3 NASDA | 2006 | |
| 1 US Rack | 2007 | |
| 2 US Racks | 2008 | |

Tailoring: Full compliance with NPG 7120.5B will be achieved in FY 2003.

## STATUS

By end of FY2002, a total of 29 U.S. and Russian flights, as well as five crew increments were accomplished. The current Expedition 5 crew will have operated the station for 107 days.

ISS achievements during FY2002 included the addition of the S0 truss segment, and the Mobile Transporter (MT) for the Canadian Space Station Remote Manipulator System (SSRMS), on Flight 8A (STS-110) in April 2002. The first U.S. utilization mission during FY2002, UF-1, was launched on the Space Shuttle (STS-108) on December 5, 2001. This flight replaced the Expedition 3 crew with Expedition 4 and carried one of the three Italian-built Multi Purpose Logistic Modules (MPLMs). The second utilization flight (UF-2/STS-111) added the Mobile Base System (MBS) to the SSRMS/MT and also served as a crew exchange flight replacing Expedition 4 with the Expedition 5 crew. The first Shuttle mission at the beginning of FY2003 in early October, STS-112/9A, delivered the second major truss segment, S1, as well as ancillary equipment for the S1 and SSRMS. By the end of FY2003, ISS mass will have grown to 188,700 kg (416,000 lb.), and a total of about 73 spacewalks (EVAs), with 450 hrs accumulated time, will have been conducted by U.S. and Russian crewmembers in support of ISS assembly.

During FY2002, two Russian Soyuz spacecraft (Soyuz 3 and 4) were launched from Baikonur. These “taxi” flight carried Claudie Haigneré and Mark Shuttleworth as paying Russian customers . The Russians also launched four Progress logistics flights, taking consumables, spare parts and propellants to the station.

## THEME: International Space Station (ISS)

### PERFORMANCE MEASURES

| Annual Performance Goals | |
|---|---|
| **Outcome: 1.1.3** | **Provision of Space Station accommodations to support Earth Science Research** |
| 4 ISS1 | Provide at least 80% of the upmass, middecks, and crewtime for Earth Science payloads as established at the beginning of FY 2004. |
| **Outcome: 3.2.1** | **Gain experience in multi-national space construction & operations to support future cooperative programs** |
| 4 ISS2 | The ISS will meet its commitments with the International Partners to provide Node-2 in FY 2004. |
| **Outcome: 3.5.2** | **Provision of ISS accommodations to support NASA, other U.S. Government Agencies, Industry and Academic research** |
| 4 ISS3 | Provide at least 80% of the upmass, middecks, and crewtime for technology development payloads as established at the start of FY 2004. |
| **Outcome: 4.2.3** | **Provision of Space Station accommodations to support Physics, Chemistry and Biological Research** |
| 4 ISS4 | Provide at least 80% of the upmass, middecks, and crewtime for Biological and Physical Science's payloads as established at the beginning of FY 2004. |
| **Outcome: 6.1.1** | **Kindergarten through graduate students will be more proficient in STEM** |
| 4 ISS5 | Ensure the development and distribution of OSF content for curricular use in NASA Explorer Schools and in the Education Mission Specialist Program. |
| **Outcome: 6.2.1** | **More students from diverse communities motivated to pursue careers in science, technology, engineering, and mathematics (STEM)** |
| 4 ISS6 | Increase by 10%, students participating in OSF research and development opportunities that enhance their academic experience, strengthens their professional skills, and supports their successful transition into scientific and technical workforce. |
| **Outcome: 6.3.1** | **Improve quality of STEM instruction** |
| 4 ISS7 | Reach and expose, through both formal and informal educations venues, 800 in-service and pre-service teachers, university teacher education faculty and students to mathematics and science careers and to OSF's unique educational resources. |
| 4 ISS8 | During the Academic year 2003-2004, increase by 2 the number of pre-college programs for student participation in OSF center sponsored education enrichment activities that promote their interest in and knowledge of mathematics, science, engineering and technology career fields. |
| **Outcome: 6.4.1** | **More students prepared to enter the STEM workforce** |
| 4 ISS9 | During the Academic year 2003-2004, increase by 4% the number of undergraduate and graduate students and faculty researchers exposed and gaining hands-on experience in OSF's state-of-the-art research instrumentation and methodologies. |
| 4 ISS10 | Host 2 forums to strengthen OSF partnership with the minority university community to more fully engage faculty and students from this community in OSF's mission. |
| **Outcome: 7.2.3** | **Use OSF unique facilities, education resources, formal and informal venues (conferences, workshops, science centers, museums) and print, web and TV media, to reach and engage an increasing number or percent of the public in exploration and space development activities.** |
| 4 ISS11 | Increase by 10% venues (education, and commercial) that provides "hands-on" opportunities for the public to experience and become more knowledgeable of benefits and contributions, particularly the International Space Station. |
| 4 ISS 12 | Increase the number of visits to the Space Flight Website. |
| **Outcome: 8.4.1** | **Provision of a well managed program that is safe, reliable, and affordable** |
| 4 ISS 13 | Achieve reduced costs and improved accountability through the reduction in the number of direct ISS Program Office contracts. |
| 4 ISS14 | Assure zero Type A or Type B on-orbit mishaps in FY04 as defined in the OSF Contingency Action Plan. |
| 4 ISS15 | Achieve 90% success and accomplishment for planned on-orbit ISS assembly and logistical activities on the Space Shuttle missions scheduled for FY 2004. |
| **Outcome: 9.4.1** | **Operation of the ISS as an on-going research facility to further human experience and develop technology for self sustaining systems** |
| 4 ISS16 | Maintain to within 90% , the predicted maintenance and logistics hardware replacement schedule. |
| 4 ISS17 | Provide 100% of the logistics required to sustain the permanent crew living aboard the ISS. |
| **Outcome:** | **Conduct a well managed program in accordance with Agency implementing strategies.** |
| 4 ISS18 | ISS development activities will complete their development phases with no more than 10% life-cycle cost growth. |
| 4 ISS19 | The ISS Program will complete all of its missions within 10% of its baseline schedules. |

### INDEPENDENT REVIEWS

| Types of Review | Performer | Last Review | Next Review | Purpose |
|---|---|---|---|---|
| Mgmt Cost and Eval (IMCE) | IMCE Tsk Force | Nov 2002 | Not Planned | Overall review of the Mgmt & cost of the ISS Program |
| Ind. Life Cycle Cost Estimate | NASA ICE Team | Aug. 2002 | Not Planned | Life Cycle cost estimate confirmation |
| Life Cycle Cost Estimate | CAIG | Aug. 2002 | Not Planned | Life Cycle cost estimate confirmation |

## THEME: International Space Station (ISS)

### BUDGET

| Budget Authority ($millions) | Prior | FY02 | FY03 | Chng | FY04 | FY05 | FY06 | FY07 | FY08 | BTC | Total | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **International Space Station** | **16835.9** | **1720.8** | **1492.1** | **+215.0** | **1707.1** | **1587.4** | **1585.9** | **1605.6** | **1603.0** | **cont** | **28,137.8** | **ISS BLI** |
| Development | 12525.1 | 437.1 | 310.2 | -156.7 | 153.5 | 78.1 | 54.0 | 67.2 | 41.1 | | 13,666.4 | |
| ISS Core Development | 11959.8 | 355.6 | 278.4 | -170.8 | 107.6 | 51.0 | 33.6 | 57.3 | 41.1 | | 12,884.5 | |
| ISS Capability Upgrades | 565.4 | 81.5 | 31.8 | +14.0 | 45.8 | 27.1 | 20.4 | 9.9 | 0.0 | | 781.8 | |
| (ECLSS/Node3 thru FY04, reserve coverage FY05-08; prior CRV & Russ. Prog.) | | | | | | | | | | | | |
| Operations | 2679.5 | 1283.7 | 1181.9 | +371.7 | 1553.6 | 1509.3 | 1531.9 | 1538.4 | 1561.8 | cont | 12,840.1 | |
| Spacecraft Operations | | | 710.4 | +126.2 | 836.6 | 797.9 | 796.7 | 795.6 | 804.6 | | 4,741.8 | New structure |
| Launch & Mission Operations | | | 202.8 | +289.7 | 492.5 | 508.5 | 530.3 | 535.6 | 549.7 | | 2,819.4 | New structure |
| Operations Program Integration | | | 268.7 | -44.2 | 224.5 | 202.8 | 204.9 | 207.2 | 207.5 | | 1,315.7 | New structure |
| Other Operations | 2679.5 | 1283.7 | | +0.0 | | | | | | | 3,963.2 | Old structure |
| Research | 1631.3 | | | +0.0 | | | | | | | 1,631.3 | ISS BLI funded |
| **Other ISS-Related Activities*** | **1083** | **373** | **347** | **+231** | **578** | **609** | **581** | **586** | **582** | **cont** | **4,740** | **Other BLI's** |
| Other HSF Core Dev. | 59 | | | +0 | | | | | | | 59 | FY94 Shuttle |
| Other HSF Cap. Upgrades | 310 | | | +0 | | | | | | | 310 | FY97-98 RPA |
| Other HSF Research | 150 | | | +0 | | | | | | | 150 | FY94-96 HSF |
| Other SAT Research | 564 | 373 | 347 | +231 | 578 | 609 | 581 | 586 | 582 | | 4,221 | FY94-BTC SAT |
| **TOTAL PROGRAM EST.** | **17919** | **2094** | **1839** | **+446** | **2286** | **2197** | **2167** | **2191** | **2185** | | **32,878** | |

*Other ISS-Related Activities have traditionally been included as related program activities and cost, but are funded and managed in other enterprises.

Indicates budget numbers in Full Cost.

Indicates changes since the FY 2003 Presidents Budget Submit.

FY 2002, FY 2003, Prior and BTC are not in full cost.

Note: For all formats, the FY 02 column reflects the FY 2002 Congressional Operating Plan dated 9/30/02. The FY 03 column reflects the FY 2003 Presidents Budget Submit (PBS) as Amended. The Change column includes both programmatic and full cost adjustments. FY 2004 column is in full cost.

FY03 and prior years reformulated in FY04 program budget structure, prior to full cost.

### COMPLIANCE WITH COST LIMITATIONS

NASA's evaluation of this budget is that the Space Station is within the $25 billion cost limitation imposed in the NASA Authorization Act of 2000 (P.L. 106-391), and that the Space Shuttle flights supporting the ISS are within the $17.7 billion cost limitation imposed by that Act. This is based on the assumption that the point at which substantial completion will be reached will occur in FY 2004 when the U.S. Core capability is reached, after which development spending will fall below 5% of the total annual budget.

Of the $20 billion appropriated for space station and related activities from FY 1994 through FY 2002, approximately $19.8 billion has been obligated as of September 30, 2002. Remaining FY 2002 funds will be obligated in the course of FY 2003 performance.

A separate report required by the Act will be prepared and submitted.

**THEME:** International Space Station

# DEVELOPMENT: ISS Core Development

## PURPOSE

| Objectives | Reference 2003 Strategic Plan | Performance Measures |
|---|---|---|
| 8.4 | Assure capabilities for world class research on a laboratory in low Earth orbit. | 4 ISS 15, 16 ,17 |

Vehicle development of the International Space Station (ISS) provides an on-orbit, habitable laboratory for science and research activities, including flight and test hardware and software, flight demonstrations for risk mitigation, facility construction, Shuttle hardware and integration for assembly and operation of the station, mission planning, and integration of Space Station systems.

## OVERVIEW

Space Station elements are provided by U.S. and international partners Russia, Europe, Japan, and Canada. The U.S. elements include nodes, laboratory module, airlock, truss segments, photovoltaic arrays, three pressurized mating adapters, unpressurized logistics carriers, and a cupola. Various systems have been developed by the U.S., including thermal control, life support, navigation, command and data handling, power systems, and internal audio/video. Other U.S. elements being provided through bilateral agreements include the pressurized logistics modules provided by the Italian Space Agency, Node 2 provided by ESA, and the centrifuge accommodation module (CAM)/centrifuge provided by the Japanese. During FY 2003 the remaining major truss elements constituting the power block will be deployed to orbit, Expeditions 6 and 7 crews will be launched, and another utilization flight will expand science capabilities. In 2003, activation of the thermal system will be completed and two of the three remaining solar array modules will be deployed. Both the S6 truss and Node 2, the final components of the U.S. Core, will be delivered in FY 2003 to NASA for final integration and pre-flight test and checkout to support planned launches in 2004.

## PROGRAM MANAGEMENT

The program management and reporting flows from the program manager, Bill Gerstenmaier, located at the Johnson Space Center, to the Deputy Associate Administrator for ISS and SSP. The DAA for ISS & SSP reports directly to the Assoc. Admin. Office of Space Flight who reports directly to the NASA Administrator. The agency Program Management Council (PMC) has ISS governing responsibility.
Full compliance with NPG 7120.5B will be achieved in FY 2003.

## TECHNICAL COMMITMENT

Baseline defined by May 2002 Cost Analysis Requirements Document (CARD).

| Technical Specifications | FY04 President's Budget | Change from Baseline |
|---|---|---|
| Crew Size | 3 International Crew Members | -- |
| Power | 80 Kilowatts | -- |
| Accommodations | 27 US User Racks | -- |
| External Payload Sites | 24 External Payload sites on Truss | -- |
| | 10 Sites on JEM Exposed Facility | -- |
| Optical Viewing | Nadir viewing optical research window | -- |
| Ku Band Downlink | 1.5 - 2.46 Terabits per day average | -- |
| Operational Life | 10 Years after deployment of the core and IP elements | -- |

| Schedule | FY04 President's Budget | | Change from Baseline |
|---|---|---|---|
| 9A - S1 TRUSS | Oct '02 | *Launched* | 2 months |
| 11A - P1 TRUSS | Nov '02 | *Launched* | 2 months |
| ULF-1, MPLM: CMG | Mar '03 | | 2 months |
| 12A - P3/P4 TRUSS Segments | May '03 | | 2 months |
| 12A.1 | Jul '03 | | 2 months |
| 13A S3/S4 TRUSS Segments | Oct '03 | | 2 months |
| 13A.1 | Nov '03 | | 2 months |
| 15A S6 TRUSS Segment | Jan '04 | | -- |
| 10A Node 2 | Feb '04 | | -- |

**THEME:** International Space Station

# DEVELOPMENT: ISS Core Development

## ACQUISITION STRATEGY & PERFORMING ORGANIZATIONS

The Prime Contractor for design, development, test and evaluation of major elements of U.S. Flight Hardware and Engineering Support for the integration of the Space Station is Boeing Aerospace. The Prime contract covers 10 years of development and operations (through Dec '03). In FY2002, direct procurements from Boeing represented about 51% of budget authority in development and operations. **Changes since FY03 Pres. Budget: None**

| Current Acquisitions | Actual * | Selection Method | Actual * | Performer | Actual * |
|---|---|---|---|---|---|
| Cooperative Agreements | 0% | Full & Open Competition | 32% | Industry | 90% |
| Cost Reimbursable | 84% | Sole Source | 68% | Government | 9% |
| Fixed Price | 9% | | 100% | NASA Intramural | 8% |
| Grants | 0% | | | University | 1% |
| Other | 7% | Sci Peer Review | 0% | Non Profit | 0% |
| * as % of FY02 direct procurement | 100% | * as % of FY02 direct procurement | | * as % of FY02 direct procurement | 100% |

| Future Acquisitions - Major | | Selection | Goals |
|---|---|---|---|
| 1. Contract restructuring | | Sept '03 | TBD Full& Open Comp; TBD Cost Reimbursable; |

## AGREEMENTS

*External:*

1. Intergovernmental Agreement (IGA) Active (1/29/98)
2. NASA/RSA Memorandum of Understanding (MOU) Active (1/29/98)
3. NASA/European Space Agency (ESA) MOU Active ( 1/29/98)
4. NASA/Government of Japan (GOJ) MOU Active (2/24/98)
5. NASA/Canadian Space Agency (CSA) MOU Active (1/29/98)
6. NASA/ESA Early Utilization Agreement Active ( 3/18/97)
7. NASA/Italian Space Agency (ASI) MOU on the Design, Development, Operation, and Utilization of Three Mini-Pressurized Logistics Modules for the ISS Active (10/9/97)
8. NASA-GOJ Agreement in Principle for CAM and Related Hardware Active ( 9/10/97)
9. NASA-Brazilian Space Agency Implementing Arrangement for ISS Cooperation Active (10/14/97)

## INDEPENDENT REVIEWS

| Types of Review | **Performer** | Last Review | Next Review | **Purpose** |
|---|---|---|---|---|
| Mgmt & Cost Evaluation | IMCE Tsk Force | Nov 2002 | Not Planned | Overall review of the mgmt and cost of the ISS Program |
| Ind. Life Cycle Cost Estimate | NASA ICE Team | Aug. 2002 | Not Planned | Life cycle cost estimate confirmation |
| Life Cycle Cost Estimate | CAIG | Aug. 2002 | Not Planned | Life cycle cost estimate confirmation |

## BUDGET/LIFE CYCLE COST

Total budget authority represents the Life Cycle Cost (LCC) for ISS Core Development only.

| Budget Authority ($ in millions) | Prior | FY02 | FY03 | FY04 | FY05 | FY06 | FY07 | FY08 | BTC | Total | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|
| FY 2004 President's Budget (LCC) | 11959.8 | 355.6 | 278.4 | 107.6 | 51.0 | 33.6 | 57.3 | 41.1 | | 12884.5 | |
| Flight Hardware | 9779.9 | 277.2 | 237.1 | 84.2 | 51.0 | 33.6 | 57.3 | 41.1 | | 10561.5 | Full cost elements |
| Test, Manufac & Assembly Supt | 470.6 | 50.4 | 23.3 | | | | | | | 544.3 | |
| Ops Capability Development | 880.9 | 28.0 | 17.9 | 23.5 | | | | | | 950.4 | |
| Other (Trans Supt, Prog Spt, FTD) | 828.4 | | | | | | | | | 828.4 | |
| Changes since FY 03 Pres. Budget | - | - | -4.7 | -23.5 | -10.9 | +3.0 | +38.0 | - | | +2.0 | ***Reason for Change:*** |
| Flight Hardware programmatic | - | - | +18.9 | -39.2 | -18.7 | -2.2 | +25.7 | | | -15.5 | Re-allocations, Ops transition |
| Test, Manufac & Assembly Supt | - | - | -19.0 | - | - | - | - | | | -19.0 | Ops transition |
| Ops Capability Development | - | - | -4.7 | -6.7 | -3.7 | -2.7 | -1.6 | | | -19.3 | Ops transition |
| Other (Trans Supt, Prog Spt, FTD) | - | - | - | - | - | - | - | | | - | |
| Flight Hardware full cost | | | - | +10.6 | +5.6 | +3.9 | +6.7 | | | +26.8 | C.S. & Travel allocation added |
| Flight Hardware full cost | - | - | - | +11.8 | +6.0 | +4.0 | +7.2 | | | +29.0 | Center & corporate G&A |
| FY 2003 President's Budget (LCC) | 11959.8 | 355.6 | 283.1 | 131.1 | 61.9 | 30.6 | 19.3 | | | 12841.4 | FY03 Bgt Amend., no full cost |
| Flight Hardware | 9779.9 | 277.2 | 218.2 | 105.8 | 58.2 | 27.9 | 17.7 | | | 10484.9 | Prior-FY04 ECLSS/Node-3 excl. |
| Test, Manufac & Assembly Supt | 470.6 | 50.4 | 42.3 | | | | | | | 563.3 | |
| Ops Capability Development | 880.9 | 28.0 | 22.6 | 25.3 | 3.7 | 2.7 | 1.6 | | | 964.8 | |
| Other (Trans Supt, Prog Spt, FTD) | 828.4 | | | | | | | | | 828.4 | |
| Initial Baseline (Jan-94) | 9010.0 | 79.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | | 9089.0 | FY 1995 budget estimates |
| Flight Hardware | 7060.9 | 79.0 | | | | | | | | 7139.9 | |
| Test, Manufac & Assembly Supt | 513.6 | | | | | | | | | 513.6 | |
| Ops Capability Development | 882.0 | | | | | | | | | 882.0 | |
| Other (Trans Supt, Prog Spt, FTD) | 553.5 | | | | | | | | | 553.5 | |

Indicates budget numbers in Full Cost.

Indicates changes since the FY 2003 Presidents Budget Submit.

FY 2002, FY 2003, Prior and BTC are not in full cost.

| THEME: | International Space Station |
|---|---|
| **DEVELOPMENT:** | **ISS Capability Upgrades** |

## PURPOSE

| Objectives | Reference 2003 Strategic Plan | Performance Measures |
|---|---|---|
| 8.4 | Assure capabilities for world class research on a laboratory in low Earth orbit. | 4 ISS 15, 16 ,17 |

The purpose of this budget line is to provide capability to enable potential enhancements that would allow for research driven requirements of additional crew time past U.S. core complete currently projected to be second quarter FY 04. Development of the U.S. designed Environmental Control and Life Support System (ECLSS) and Node 3 through FY 2004 are the only capability upgrades currently in the submit.

## OVERVIEW

**ECLSS and Node 3**, managed by the MSFC reporting to the ISS Program, and Node 3 built by Alenia, are critical pacing items requiring funding to enable option paths to expand the ISS crew to greater than 3 after U.S. core complete. They also provide critical life support dissimilar redundancy to the Russian life support system, Elektron Oxygen Generator. FY03 budget amendment funds through FY 2004; subsequent continuation to be decided during the FY 2005 budget formulation.

**CRV/X-38:** The JSC managed Project is being terminated with termination completion scheduled for 2003; the FY2004 budget submit contains no X-38 funding.

**RPA:** MSFC managed project for a U.S propulsion module was terminated in 2001.

## PROGRAM MANAGEMENT

The program management and reporting flows from the program manager, Bill Gerstenmaier, located at the Johnson Space Center, to the Deputy Associate Administrator for ISS and SSP. The DAA for ISS & SSP reports directly to the Assoc. Admin. Office of Space Flight who reports directly to the NASA Administrator. The agency Program Management Council (PMC) has ISS governing responsibility.

Full compliance with NPG 7120.5B will be achieved in FY 2003.

## TECHNICAL COMMITMENT

Baseline defined by May 2002 Cost Analysis Requirements Document (CARD).

| Technical Specifications | | **FY04 President's Budget** | **Change from Baseline** |
|---|---|---|---|
| **Node-3** | | | Baseline: 2002 CARD |
| Atmosphere | 14.7 psia | | |
| Length | 249 inches | (20.75 ft) | *No Changes* |
| Diameter | 175 Inches | (14.6 ft) | *to* |
| Volume | 3470 cu ft. | | *Baseline* |
| Ports | 6 (5 ACBM, 1 PCBM) | | |
| **Advanced ECLSS** | | | Baseline: 2002 CARD |
| Dissimilar design: | ECLSS redundancy (from Russian System) | | *No Changes* |
| | O2 Generation System-Up to 41K lbs of recycled Water | | *to* |
| | Water Recovery System - up to 7,500 lbs of O2 | | *Baseline* |
| Support Increased: | Crew size to 7 | | |

| Schedule | | **FY04 President's Budget** | | **Change from Baseline** |
|---|---|---|---|---|
| **Node-3** | | | | |
| Design Review #2 | | September | 2002 | |
| Delivery (to KSC) | | January | 2004 | *No* |
| Launch | | April | 2006 | *Changes* |
| **Advanced ECLSS** | | | | *to* |
| Water Processing Assembly | Integrated Testing | April | 2003 | *Baseline* |
| Urine Processing Assembly | Build | February | 2003 | |
| Oxygen Generator Assembly | Integration & Test | September | 2004 | |
| Water Recovery System | Integration & Test | March | 2004 | |

| THEME: | International Space Station |
|---|---|
| **DEVELOPMENT:** | **ISS Capability Upgrades** |

## ACQUISITION STRATEGY & PERFORMING ORGANIZATIONS

Data current as of 9/9/2002

The Prime Contractor for design, development, test and evaluation of major elements of U.S. Flight Hardware and Engineering Support for the integration of the Space Station is Boeing Aerospace. The Prime contract covers 10 years of development and operations (through Dec '03). In FY2002, direct procurements from Boeing represented about 51% of budget authority in development and operations. **Changes since FY03 Pres. Budget: None**

| Current Acquisitions | Actual * | Selection Method | Actual * | Performer | Actual * |
|---|---|---|---|---|---|
| Cooperative Agreements | 0% | Full & Open Competition | 32% | Industry | 90% |
| Cost Reimbursable | 84% | Sole Source | 68% | Government | 9% |
| Fixed Price | 9% | | 100% | NASA Intramural | 8% |
| Grants | 0% | | | University | 1% |
| Other | 7% | Sci Peer Review | 0% | Non Profit | 0% |
| * as % of FY02 direct procurement | 100% | | | | 100% |

| Future Acquisitions - Major | | Selection | Goals |
|---|---|---|---|
| 1. Contract restructuring | | Sept '03 | TBD Full& Open Comp; TBD Cost Reimbursable; |

## AGREEMENTS

*External:*

**1.** Intergovernmental Agreement (IGA) Active (1/29/98)
**2.** NASA/RSA Memorandum of Understanding (MOU) Active (1/29/98)
**3.** NASA/European Space Agency (ESA) MOU Active ( 1/29/98)
**4**. NASA/Government of Japan (GOJ) MOU Active (2/24/98)
**5.** NASA/Canadian Space Agency (CSA) MOU Active (1/29/98)
**6.** NASA/ESA Early Utilization Agreement Active ( 3/18/97)
**7.** NASA/Italian Space Agency (ASI) MOU on the Design, Development, Operation, and Utilization of Three Mini-Pressurized Logistics Modules for the ISS Active (10/9/97)
**8.** NASA-GOJ Agreement in Principle for CAM and Related Hardware Active ( 9/10/97)
**9.** NASA-Brazilian Space Agency Implementing Arrangement for ISS Cooperation Active (10/14/97)

## INDEPENDENT REVIEWS

| Types of Review | **Performer** | Last Review | Next Review | **Purpose** |
|---|---|---|---|---|
| Mgmt & Cost Evaluation | IMCE Tsk Force | Nov 2002 | Not Planned | Overall review of the mgmt and cost of the ISS Program |
| ECLSS/Node3 Ind Assessmen | JSC SMO | Sep. 2002 | Not Planned | Assessment of requirements, cost & schedule estimates |
| Ind. Life Cycle Cost Estimate | NASA ICE Tean | Aug. 2002 | Not Planned | Life cycle cost estimate confirmation |
| Life Cycle Cost Estimate | CAIG | Aug. 2002 | Not Planned | Life cycle cost estimate confirmation |

## BUDGET/LIFE CYCLE COST

Total budget authority represents the Life Cycle Cost (LCC) for ISS Capability Upgrades only.

| Budget Authority ($ in millions) | Prior | FY02 | FY03 | FY04 | FY05 | FY06 | FY07 | FY08 | BTC | Total | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|
| FY 2004 President's Budget (LCC) | 565.4 | 81.5 | 31.8 | 45.8 | 27.1 | 20.4 | 9.9 | 0.0 | | 781.8 | |
| ECLSS w/ full cost | 144.2 | 39.2 | 22.0 | 19.4 | 5.7 | 3.9 | 0.9 | | | 235.3 | Full cost |
| Node 3 w/ full cost | 6.0 | 2.3 | 9.8 | 26.4 | 21.4 | 16.4 | 9.0 | | | 91.3 | Full cost |
| CRV | 144.8 | 40.0 | | | | | | | | 184.8 | |
| RPA | 270.4 | | | | | | | | | 270.4 | |
| Ops Est. ECLSS/N-3 (Ops elements) | 5.5 | 5.0 | 10.4 | 16.6 | 24.2 | 32.4 | 11.0 | | | 105.1 | (Procurement only; non-add) |
| Changes since FY 03 Pres. Budget | - | - | - | +16.8 | +27.1 | +20.4 | +9.9 | - | | +74.2 | ***Reason for Change:*** |
| ECLSS Programmatic | - | - | - | - | +1.0 | +0.0 | +0.0 | | | +1.0 | Reserve coverage FY05 |
| Node 3 Programmatic | - | - | - | - | +14.4 | +10.5 | +7.7 | | | +32.6 | Reserve coverage FY05-08 |
| CRV & RPA | - | - | - | - | - | - | - | | | - | |
| ECLSS/Node 3 full cost | | | - | +7.6 | +6.1 | +5.5 | +1.2 | | | +20.4 | C.S. & Travel allocation |
| ECLSS/Node 3 full cost | - | - | - | +9.3 | +5.5 | +4.4 | +1.0 | | | +20.2 | G&A & Serv Pools allocation |
| FY 2003 President's Budget (LCC) | 565.4 | 81.5 | 31.8 | 29.0 | 0.0 | 0.0 | 0.0 | | | 707.7 | FY03 Bgt Amend., no full cost |
| ECLSS | 144.2 | 39.2 | 22.0 | 12.3 | | | | | | 217.7 | Bgt Amend funded through FY04 |
| Node 3 | 6.0 | 2.3 | 9.8 | 16.7 | | | | | | 34.8 | Bgt Amend funded through FY04 |
| CRV | 144.8 | 40.0 | | | | | | | | 184.8 | Project to be terminated in 2003 |
| RPA | 270.4 | | | | | | | | | 270.4 | Project terminated in 2001 |
| Ops Est. ECLSS/N-3 (Ops elements) | 5.5 | 5.0 | 10.4 | 16.6 | | | | | | 37.5 | Bgt Amend funded through FY04 |
| Initial Baseline | 1136.5 | 355.8 | 202.3 | 195.0 | 15.4 | 10.5 | 7.7 | | | 1923.2 | |
| ECLSS (Nov-02) | 144.2 | 39.2 | 22.5 | 12.3 | 1.0 | | | | | 219.2 | 2002 PMR est., development only |
| Node 3 (Nov-02) | 6.0 | 2.3 | 9.8 | 16.7 | 14.4 | 10.5 | 7.7 | | | 67.4 | 2002 PMR est., development only |
| CRV (Jan-98) | 288.0 | 173.0 | 165.0 | 166.0 | | | | | | 792.0 | FY 1999 budget estimates |
| RPA (Jan-99) | 698.3 | 141.3 | 5.0 | | | | | | | 844.6 | FY00 bgt est (+$310M HSF RPA) |
| Ops Est. ECLSS/N-3 (Ops elements) | 5.5 | 5.0 | 9.9 | 16.6 | 24.2 | 32.4 | 11.0 | | | 104.6 | 2002 PMR est., operations only |

Indicates budget numbers in Full Cost.
Indicates changes since the FY 2003 Presidents Budget Submit.
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| THEME: | International Space Station |
|---|---|
| **OPERATIONS:** | **Spacecraft Operations** |

## PURPOSE

| Objectives | | Reference 2003 Strategic Plan | Performance Measures |
|---|---|---|---|
| 8.4 | Assure capabilities for world class research on a laboratory in low Earth orbit. | | 4 ISS18 , 4 ISS19 |

The primary objective of the operations program is to safely and reliably assemble, activate, integrate, and operate the ISS, and to perform these activities in an affordable manner. This requires a significant level of planning, coordination, and execution. Most of the hardware engineering, manufacturing, and testing – leading to the final acceptance and launch of the ISS elements – have successfully been completed, and the vehicle has been operating successfully since the first element was launched in 1998. Spacecraft Operations provides the engineering expertise and analysis to sustain the performance and reliability of Space Station hardware and software systems, spares provisioning, and maintenance and repair as detailed on the budget table.

## OVERVIEW

The first crew was launched to the ISS in October 2000 and a progression of international crews has, and will continue to permanently inhabit the ISS. The ISS assembly period spans more than half a decade, with infrastructure and logistics deployed over multiple flights. Because of the program's complexity, the Space Station team has done extensive planning for operations of several different ISS vehicle configurations on-orbit. The Space Station program is drawing on the experience derived from Skylab, the Shuttle-Mir program, and that gained from operating the Space Shuttle for nearly two decades to address the unique circumstances of building and operating an ever-changing vehicle.

Engineering for sustaining and supporting the flight hardware and software, crew systems and maintenance, and extravehicular activity (EVA) systems, is consolidated and performed at the Johnson Space Center (JSC), and at the Marshall Space Flight Center (MSFC) for ECLSS related activities. Flight hardware spares and repair costs continue to be controlled by maintenance and repair capabilities, including hardware depots, that effectively utilize the Kennedy Space Center (KSC), and original equipment manufacturers or other certified industry repair resources.

## PROGRAM MANAGEMENT

The program management and reporting flows from the program manager, Bill Gerstenmaier, located at the Johnson Space Center, to the Deputy Associate Administrator for ISS and SSP. The DAA for ISS & SSP reports directly to the Assoc. Admin. Office of Space Flight who reports directly to the NASA Administrator. The agency Program Management Council (PMC) has ISS governing responsibility. Full compliance with NPG 7120.5B will be achieved in FY 2003.

## TECHNICAL COMMITMENT

Baseline defined by May 2002 Cost Analysis Requirements Document (CARD).

| Technical Specifications | FY04 President's Budget | Change from Baseline |
|---|---|---|
| (Development commitments also apply to operations elements) | | |
| (Development commitments also apply to operations elements) | | |
| Operational Life | Nominal operations and utilization lifetime to 2015, and a 1-year decommissioning period. | -- |
| Shuttle Logistical Flights | 5 per Year. | -- |
| Power to User Payloads | 26kW minimum continuous power & 30kW annual average after U.S. Core Complete. | -- |
| Micro-Gravity | At least 180 days annually (4 periods greater than 30 days). | -- |
| Crew Time | | |
| | Each flight increment nominally planned for 180 days on-orbit. | -- |
| Spacecraft | Maintain and sustain U.S. flight and ground hardware and software to ensure integrity of the ISS design and the | -- |

| Schedule | FY04 President's Budget | | Change from Baseline |
|---|---|---|---|
| 9A - S1 TRUSS | Oct '02 | *Launched* | 2 months |
| 11A - P1 TRUSS | Nov '02 | *Launched* | 2 months |
| ULF-1, MPLM: CMG | Mar '03 | | 2 months |
| 12A - P3/P4 TRUSS Segments | May '03 | | 2 months |
| 12A.1 | Jul '03 | | 2 months |
| 13A S3/S4 TRUSS Segments | Oct '03 | | 2 months |
| 13A.1 | Nov '03 | | 2 months |
| 15A S6 TRUSS Segment | Jan '04 | | -- |
| 10A Node 2 | Feb '04 | | -- |
| ULF-2 Logistics Carriers | Jul '04 | | -- |

**THEME:** International Space Station

# OPERATIONS: Spacecraft Operations

## ACQUISITION STRATEGY & PERFORMING ORGANIZATIONS

The Prime Contractor for design, development, test and evaluation of major elements of U.S. Flight Hardware and Engineering Support for the integration of the entire Space Station is Boeing Aerospace. The Prime contract covers 10 years of development and operations (through Dec '03). In FY2002, direct procurements from Boeing represented about 51% of budget authority in development and operations.

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

| Current Acquisitions | Actual * | Selection Method | Actual * | Performer | Actual * |
|---|---|---|---|---|---|
| Cooperative Agreements | 0% | Full & Open Competition | 32% | Industry | 90% |
| Cost Reimbursable | 84% | Sole Source | 68% | Government | 9% |
| Fixed Price | 9% | | #### | NASA Intramural | 8% |
| Grants | 0% | | | University | 1% |
| Other | 7% | Sci Peer Review | 0% | Non Profit | 0% |
| * as % of FY02 direct procurement | 100% | | | | 100% |

| Future Acquisitions - Major | Selection | Goals |
|---|---|---|
| 1. Contract restructuring | Sept '03 | TBD Full& Open Comp; TBD Cost Reimbursable; |

## AGREEMENTS

*External:*

**1.** Intergovernmental Agreement (IGA) Active (1/29/98)
**2.** NASA/RSA Memorandum of Understanding (MOU) Active (1/29/98)
**3.** NASA/European Space Agency (ESA) MOU Active ( 1/29/98)
**4.** NASA/Government of Japan (GOJ) MOU Active (2/24/98)
**5.** NASA/Canadian Space Agency (CSA) MOU Active (1/29/98)
**6.** NASA/ESA Early Utilization Agreement Active ( 3/18/97)
**7.** NASA/Italian Space Agency (ASI) MOU on the Design, Development, Operation, and Utilization of Three Mini-Pressurized Logistics Modules for the ISS Active (10/9/97)
**8.** NASA-GOJ Agreement in Principle for CAM and Related Hardware Active ( 9/10/97)
**9.** NASA-Brazilian Space Agency Implementing Arrangement for ISS Cooperation Active (10/14/97)

## INDEPENDENT REVIEWS

| Types of Review | **Performer** | Last Review | Next Review | **Purpose** |
|---|---|---|---|---|
| Mgmt & Cost Evaluation | IMCE Tsk Force | Nov 2002 | Not Planned | Overall review of the mgmt and cost of the ISS Program |
| Ind. Life Cycle Cost Estimate | NASA ICE Team | Aug. 2002 | Not Planned | Life cycle cost estimate confirmation |
| Life Cycle Cost Estimate | CAIG | Aug. 2002 | Not Planned | Life cycle cost estimate confirmation |

## BUDGET

| Budget Authority ($ in millions) | **FY02** | **FY03** | **FY04** | Comments |
|---|---|---|---|---|
| FY 2004 President's Budget (Operations) | 1283.7 | 1181.9 | 1553.6 | |
| Spacecraft Operations | 0.0 | 710.4 | 836.6 | |
| ISS Spacecraft Management | | 147.4 | 234.8 | Structure aligned w/ISS WBS |
| ISS Elements | | 61.7 | 28.0 | Structure aligned w/ISS WBS |
| Flight Systems | | 111.2 | 149.1 | Structure aligned w/ISS WBS |
| Avionics Systems | | 51.0 | 58.5 | Structure aligned w/ISS WBS |
| Crew Systems | | 11.9 | 14.7 | Structure aligned w/ISS WBS |
| Extra-Vehicular Activity Systems | | 37.9 | 48.9 | Structure aligned w/ISS WBS |
| Flight Software | | 130.8 | 154.4 | Structure aligned w/ISS WBS |
| Logistics & Maintenance | | 158.4 | 148.3 | Structure aligned w/ISS WBS |
| Crew Transfer Vehicles | | | | Structure aligned w/ISS WBS |
| Launch & Mission Operations | 0.0 | 202.8 | 492.5 | Structure aligned w/ISS WBS |
| Operations Program Integration | 0.0 | 268.7 | 224.5 | Structure aligned w/ISS WBS |
| Other Operations | 1283.7 | | | Previous Ops funding structure |
| Changes since FY 03 Pres. Budget | - | +4.7 | +352.2 | |
| Spacecraft Operations | | +710.4 | +684.6 | Allocation to new ops structure |
| Launch & Mission Operations | | +202.8 | +385.0 | Allocation to new ops structure |
| Operations Program Integration | | +268.7 | +185.5 | Allocation to new ops structure |
| Other Operations | | -1177.2 | -1201.4 | Allocated to new Ops structure |
| Direct Civil Service & Travel | | | +144.0 | C.S. & Travel allocation added |
| G&A Rates | | | +154.5 | Center & corporate G&A |

Indicates budget numbers in Full Cost.
Indicates changes since the FY 2003 Presidents Budget Submit.
FY 2002 and FY 2003 are not in full cost.

| THEME: | International Space Station |
|---|---|
| **OPERATIONS:** | **Launch and Mission Operations** |

## PURPOSE

| Objectives | | Reference 2003 Strategic Plan | Performance Measures |
|---|---|---|---|
| 9.4 | Demonstrate the ability to support a permanent human presence in low Earth orbit as a stepping stone to human presence beyond. | | 4 ISS18 , 4 ISS19 |

The primary objective of the operations program is to safely and reliably assemble, activate, integrate, and operate the ISS, and to perform these activities in an affordable manner. This requires a significant level of planning, coordination, and execution. Most of the hardware engineering, manufacturing, and testing – leading to the final acceptance and launch of the ISS elements – have successfully been completed, and the vehicle has been operating successfully since the first element was launched in 1998. Launch and Mission Operations provides training, mission control operations, operations engineering support, operations planning and cargo integration, medical support, and launch site processing.

## OVERVIEW

The first crew was launched to the ISS in October 2000 and a progression of international crews has, and will continue to permanently inhabit the ISS. The ISS assembly period spans more than half a decade, with infrastructure and logistics deployed over multiple flights. Because of the program's complexity, the Space Station team has done extensive planning for operations of several different ISS vehicle configurations on-orbit. Each time an element is added to the current Station, the flight characteristics and internal systems change, creating different thermal constraints and orbital characteristics. The Space Station Program is drawing on the experience derived from Skylab, the Shuttle-Mir program, and that gained from operating the Space Shuttle for nearly two decades to address the unique circumstances of building and operating an ever-changing vehicle.

The Mission Control Center-Houston (MCC-H) at JSC is the prime site for the planning and execution of integrated system operations of the Space Station. Communication links from both Mission Control Center-Moscow (MCC-M) and MCC-H support control activities, using the Tracking and Data Relay Satellite system (TDRSS) system and Russian communication assets. Crewmembers are trained in the Neutral Buoyancy Lab (NBL) and Space Station Training Facility (SSTF) on systems, operations, and other activities expected during a mission. Engineering support provides ground facility requirements and test support, ground display and limited applications development, resource planning, photo/TV training, medical operations tasks, and mission execution and systems performance assessment. Launch site processing at KSC includes requirement definition and processing planning, post delivery inspection/verification, servicing, interface testing, integrated testing, close-outs, weight and center of gravity measurement, and rack/component to carrier installation.

## PROGRAM MANAGEMENT

The program management and reporting flows from the program manager, Bill Gerstenmaier, located at the Johnson Space Center, to the Deputy Associate Administrator for ISS and SSP. The DAA for ISS & SSP reports directly to the Assoc. Admin. Office of Space Flight who reports directly to the NASA Administrator. The agency Program Management Council (PMC) has ISS governing responsibility. Full compliance with NPG 7120.5B will be achieved in FY 2003.

## TECHNICAL COMMITMENT

Baseline defined by May 2002 Cost Analysis Requirements Document (CARD).

| Technical Specifications | FY04 President's Budget | Change from Baseline |
|---|---|---|
| (Development commitments also apply to operations elements) | | |
| Operational Life | Nominal operations and utilization lifetime to 2015, and a 1-year decommissioning period. | -- |
| Shuttle Logistical Flights | 5 per Year. | -- |
| Power to User Payloads | 26kW minimum continuous power & 30kW annual average after U.S. Core Complete. | -- |
| Micro-Gravity | At least 180 days annually (4 periods greater than 30 days). | -- |
| Crew Time | Each flight increment nominally planned for 180 days on-orbit. | -- |
| Spacecraft | Maintain and sustain U.S. flight and ground hardware and software to ensure integrity of the ISS design and the continuous, safe operability of the vehicle. | -- |
| Integration & Operations | Operational & mission planning, coordination, training, & real-time support to ensure flight readiness & mission success. | -- |

| THEME: | International Space Station |
|---|---|
| **OPERATIONS:** | **Launch and Mission Operations** |

| Schedule | FY04 President's Budget | | Change from Baseline |
|---|---|---|---|
| 9A - S1 TRUSS | Oct '02 | *Launched* | 2 months |
| 11A - P1 TRUSS | Nov '02 | *Launched* | 2 months |
| ULF-1, MPLM: CMG | Mar '03 | | 2 months |
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| 13A.1 | Nov '03 | | 2 months |
| 15A S6 TRUSS Segment | Jan '04 | | -- |
| 10A Node 2 | Feb '04 | | -- |
| ULF-2 Logistics Carriers | Jul '04 | | -- |

## ACQUISITION STRATEGY & PERFORMING ORGANIZATIONS

The Prime Contractor for design, development, test and evaluation of major elements of U.S. Flight Hardware and Engineering Support for the integration of the Space Station is Boeing Aerospace. The Prime contract covers 10 years of development and operations (through Dec '03). In FY2002, direct procurements from Boeing represented about 51% of budget authority in development and operations. **Changes since FY03 Pres. Budget: None**

| Current Acquisitions | Actual * | Selection Method | Actual * | Performer | Actual * |
|---|---|---|---|---|---|
| Cooperative Agreements | 0% | Full & Open Competition | 32% | Industry | 90% |
| Cost Reimbursable | 84% | Sole Source | 68% | Government | 9% |
| Fixed Price | 9% | | 100% | NASA Intramural | 8% |
| Grants | 0% | | | University | 1% |
| Other | 7% | Sci Peer Review | 0% | Non Profit | 0% |
| * as % of FY02 direct procurement | 100% | | | | 100% |

| Future Acquisitions - Major | Selection | Goals |
|---|---|---|
| 1. Contract restructuring | Sept '03 | TBD Full& Open Comp; TBD Cost Reimbursable; |

## AGREEMENTS

*External:*

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2. NASA/RSA Memorandum of Understanding (MOU) Active (1/29/98)
3. NASA/European Space Agency (ESA) MOU Active ( 1/29/98)
4. NASA/Government of Japan (GOJ) MOU Active (2/24/98)
5. NASA/Canadian Space Agency (CSA) MOU Active (1/29/98)
6. NASA/ESA Early Utilization Agreement Active ( 3/18/97)
7. NASA/Italian Space Agency (ASI) MOU on the Design, Development, Operation, and Utilization of Three Mini-Pressurized Logistics Modules for the ISS Active (10/9/97)
8. NASA-GOJ Agreement in Principle for CAM and Related Hardware Active ( 9/10/97)
9. NASA-Brazilian Space Agency Implementing Arrangement for ISS Cooperation Active (10/14/97)

## INDEPENDENT REVIEWS

| Types of Review | **Performer** | Last Review | Next Review | **Purpose** |
|---|---|---|---|---|
| Mgmt & Cost Evaluation | IMCE Tsk Force | Nov 2002 | Not Planned | Overall review of the mgmt and cost of the ISS Program |
| Ind. Life Cycle Cost Estimate | NASA ICE Team | Aug. 2002 | Not Planned | Life cycle cost estimate confirmation |
| Life Cycle Cost Estimate | CAIG | Aug. 2002 | Not Planned | Life cycle cost estimate confirmation |

## BUDGET

| Budget Authority ($ in millions) | **FY02** | **FY03** | **FY04** | Comments |
|---|---|---|---|---|
| FY 2004 President's Budget (Operations) | 1283.7 | 1181.9 | 1553.6 | |
| Spacecraft Operations | 0.0 | 710.4 | 836.6 | |
| Launch & Mission Operations | 0.0 | 202.8 | 492.5 | Structure aligned w/ISS WBS |
| Mission Integration | | 41.5 | 139.6 | Structure aligned w/ISS WBS |
| Medical Support | | 14.2 | 19.5 | Structure aligned w/ISS WBS |
| Mission Operations | | 88.8 | 210.9 | Structure aligned w/ISS WBS |
| Launch Site Processing | | 58.3 | 122.5 | Structure aligned w/ISS WBS |
| Operations Program Integration | 0.0 | 268.7 | 224.5 | Structure aligned w/ISS WBS |
| Other Operations | 1283.7 | | | Previous Ops funding structure |
| Changes since FY 03 Pres. Budget | - | +4.7 | +352.2 | |
| Spacecraft Operations | | +710.4 | +684.6 | Allocation to new ops structure |
| Launch & Mission Operations | | +202.8 | +385.0 | Allocation to new ops structure |
| Operations Program Integration | | +268.7 | +185.5 | Allocation to new ops structure |
| Other Operations | | -1177.2 | -1201.4 | Allocated to new Ops structure |
| Direct Civil Service & Travel | | | +144.0 | C.S. & Travel allocation added |
| G&A Rates | | | +154.5 | Center & corporate G&A |

Indicates budget numbers in Full Cost.
Indicates changes since the FY 2003 Presidents Budget Submit.
FY 2002 and FY 2003 are not in full cost.

| THEME: | International Space Station |
|---|---|
| **OPERATIONS:** | **Operations Program Integration** |

## PURPOSE

| Objectives | | Reference 2003 Strategic Plan | Performance Measures |
|---|---|---|---|
| 9.4 | Demonstrate the ability to support a permanent human presence in low Earth orbit as a stepping stone to human presence beyond. | | 4 ISS18 , 4 ISS19 |

The primary objective of the operations program is to safely and reliably assemble, activate, integrate, and operate the ISS, and to perform these activities in an affordable manner. This requires a significant level of planning, coordination, and execution. Most of the hardware engineering, manufacturing, and testing – leading to the final acceptance and launch of the ISS elements – have successfully been completed, and the vehicle has been operating successfully since the first element was launched in 1998. Operations Program Integration provides the overall ISS program management functions, system engineering, analysis and integration, and safety and mission assurance activities.

## OVERVIEW

The first crew was launched to the ISS in October 2000 and a progression of international crews has, and will continue to permanently inhabit the ISS. The ISS assembly period spans more than half a decade, with infrastructure and logistics deployed over multiple flights. Because of the program's complexity, the Space Station team has done extensive planning for operations of several different ISS vehicle configurations on-orbit. Each time an element is added to the current Station, the flight characteristics and internal systems change, creating different thermal constraints and orbital characteristics. The Space Station Program is drawing on the experience derived from Skylab, the Shuttle-Mir program, and that gained from operating the Space Shuttle for nearly two decades to address the unique circumstances of building and operating an ever-changing vehicle.

Program integration is a continuous effort managing and coordinating program and international activities, and evaluating the technical performance of the flight, avionics and crew systems, and the necessary logistical systems required to support the on-orbit vehicle and crew. This is especially critical as the vehicle undergoes significant configuration changes as each of the final elements is assembled. Program management activities are centered at JSC and include contractor and government business management functions, international partner integration, configuration management and data integration, management information systems, and enterprise support. System engineering and integration responsibilities include requirements and interface documentation, integrated systems and performance analysis, assembly and configuration definition and analysis, and Shuttle/Station integration. Safe program operations remains a top priority, and safety and mission assurance (S&MA) functions provide for risk management, quality assurance, and reliability and maintainability activities, as well as overall S&MA integration and operations.

## PROGRAM MANAGEMENT

The program management and reporting flows from the program manager, Bill Gerstenmaier, located at the Johnson Space Center, to the Deputy Associate Administrator for ISS and SSP. The DAA for ISS & SSP reports directly to the Assoc. Admin. Office of Space Flight who reports directly to the NASA Administrator. The agency Program Management Council (PMC) has ISS governing responsibility. Full compliance with NPG 7120.5B will be achieved in FY 2003.

## TECHNICAL COMMITMENT

Baseline defined by May 2002 Cost Analysis Requirements Document (CARD).

| Technical Specifications | FY04 President's Budget | Change from Baseline |
|---|---|---|
| (Development commitments also apply to operations elements) | | |
| Operational Life | Nominal operations and utilization lifetime to 2015, and a 1-year decommissioning period. | -- |
| Shuttle Logistical Flights | 5 per Year. | -- |
| Power to User Payloads | 26kW minimum continuous power & 30kW annual average after U.S. Core Complete. | -- |
| Micro-Gravity | At least 180 days annually (4 periods greater than 30 days). | -- |
| Crew Time | Each flight increment nominally planned for 180 days on-orbit. | -- |
| Spacecraft | Maintain and sustain U.S. flight and ground hardware and software to ensure integrity of the ISS design and the continuous, safe operability of the vehicle. | -- |
| Integration & Operations | Operational & mission planning, coordination, training, & real-time support to ensure flight readiness & mission success. | -- |

**THEME:** International Space Station

# OPERATIONS: Operations Program Integration

| Schedule | FY04 President's Budget | | Change from Baseline |
|---|---|---|---|
| 9A - S1 TRUSS | Oct '02 | *Launched* | 2 months |
| 11A - P1 TRUSS | Nov '02 | *Launched* | 2 months |
| ULF-1, MPLM: CMG | Mar '03 | | 2 months |
| 12A - P3/P4 TRUSS Segments | May '03 | | 2 months |
| 12A.1 | Jul '03 | | 2 months |
| 13A S3/S4 TRUSS Segments | Oct '03 | | 2 months |
| 13A.1 | Nov '03 | | 2 months |
| 15A S6 TRUSS Segment | Jan '04 | | -- |
| 10A Node 2 | Feb '04 | | -- |
| ULF-2 Logistics Carriers | Jul '04 | | -- |

## ACQUISITION STRATEGY & PERFORMING ORGANIZATIONS

The Prime Contractor for design, development, test and evaluation of major elements of U.S. Flight Hardware and Engineering Support for the integration of the entire Space Station is Boeing Aerospace. The Prime contract covers 10 years of development and operations (through Dec '03). In FY2002, direct procurements from Boeing represented about 51% of budget authority in development and operations. **Changes since FY03 Pres. Budget: None**

| Current Acquisitions | Actual * | Selection Method | Actual * | Performer | Actual * |
|---|---|---|---|---|---|
| Cooperative Agreements | 0% | Full & Open Competition | 32% | Industry | 90% |
| Cost Reimbursable | 84% | Sole Source | 68% | Government | 9% |
| Fixed Price | 9% | | 100% | NASA Intramural | 8% |
| Grants | 0% | | | University | 1% |
| Other | 7% | Sci Peer Review | 0% | Non Profit | 0% |
| * as % of FY02 direct procurement | 100% | | | | 100% |

| Future Acquisitions - Major | Selection | Goals |
|---|---|---|
| 1. Contract restructuring | Sept '03 | TBD Full& Open Comp; TBD Cost Reimbursable; |

## AGREEMENTS

*External:*

**1.** Intergovernmental Agreement (IGA) Active (1/29/98)
**2.** NASA/RSA Memorandum of Understanding (MOU) Active (1/29/98)
**3.** NASA/European Space Agency (ESA) MOU Active ( 1/29/98)
**4**. NASA/Government of Japan (GOJ) MOU Active (2/24/98)
**5.** NASA/Canadian Space Agency (CSA) MOU Active (1/29/98)
**6.** NASA/ESA Early Utilization Agreement Active ( 3/18/97)
**7.** NASA/Italian Space Agency (ASI) MOU on the Design, Development, Operation, and Utilization of Three Mini-Pressurized Logistics Modules for the ISS Active (10/9/97)
**8.** NASA-GOJ Agreement in Principle for CAM and Related Hardware Active ( 9/10/97)
**9.** NASA-Brazilian Space Agency Implementing Arrangement for ISS Cooperation Active (10/14/97)

## INDEPENDENT REVIEWS

| Types of Review | **Performer** | Last Review | Next Review | **Purpose** |
|---|---|---|---|---|
| Mgmt & Cost Evaluation | IMCE Tsk Force | Nov 2002 | Not Planned | Overall review of the mgmt and cost of the ISS Program |
| Ind. Life Cycle Cost Estimate | NASA ICE Team | Aug. 2002 | Not Planned | Life cycle cost estimate confirmation |
| Life Cycle Cost Estimate | CAIG | Aug. 2002 | Not Planned | Life cycle cost estimate confirmation |

## BUDGET

| Budget Authority ($ in millions) | **FY02** | **FY03** | **FY04** | Comments |
|---|---|---|---|---|
| FY 2004 President's Budget (Operations) | 1283.7 | 1181.9 | 1553.6 | |
| Spacecraft Operations | 0.0 | 710.4 | 836.6 | |
| Launch & Mission Operations | 0.0 | 202.8 | 492.5 | Structure aligned w/ISS WBS |
| Operations Program Integration | 0.0 | 268.7 | 224.5 | Structure aligned w/ISS WBS |
| Ops Program Management | 0.0 | 230.1 | 181.2 | Structure aligned w/ISS WBS |
| Ops System Eng'g, Analysis & Integration | | 18.7 | 20.1 | Structure aligned w/ISS WBS |
| Ops Safety & Mission Assurance | | 19.9 | 23.2 | Structure aligned w/ISS WBS |
| Other Operations | 1283.7 | | | Previous Ops funding structure |
| Changes since FY 03 Pres. Budget | - | +4.7 | +352.2 | |
| Spacecraft Operations | | +710.4 | +684.6 | Allocation to new ops structure |
| Launch & Mission Operations | | +202.8 | +385.0 | Allocation to new ops structure |
| Operations Program Integration | | +268.7 | +185.5 | Allocation to new ops structure |
| Other Operations | | -1177.2 | -1201.4 | Allocated to new Ops structure |
| Direct Civil Service & Travel | | | +144.0 | C.S. & Travel allocation added |
| G&A Rates | | | +154.5 | Center & corporate G&A |

Indicates budget numbers in Full Cost.
Indicates changes since the FY 2003 Presidents Budget Submit.
FY 2002 and FY 2003 are not in full cost.

The Space Shuttle program plays a vital role in NASA's enabling goal to extend the duration and boundaries of human use and development of space by providing safe, routine access to space in support of both permanent commercial and human operations in low-earth orbit.

# SPACE SHUTTLE

## MAJOR EVENTS IN FY 2004

- Five flights focused on Space Station assembly.
- Space Shuttle Main Engine Health Management System ready for first flight.

## THEME: Space Shuttle Program (SSP)

### OVERVIEW

The Space Shuttle program plays a vital role in enabling NASA's vision and mission. This includes advancing human exploration and providing safe, routine access to space in support of human operations in low-earth orbit. In order to maintain a viable human transportation capability that will operate into this new century and support NASA's launch requirements, specific program investments are required. NASA is revamping its approach to selecting and managing these investments to ensure Shuttle operability into the next decade and avoid future project overruns. These investments will be consistent with NASA's strategy of ensuring the Space Shuttle remains viable until a new transportation system is operational. These projects will provide revitalization of the infrastructure, and combat obsolescence of vehicle, ground systems, and facilities. The FY04 budget request will allow NASA to meet the intended flight rates; provide appropriate contingency planning to assure transportation and assembly support to the International Space Station (ISS); & include high priority projects for service life extension.

| Missions | Goals supported by this theme | Objectives supporting those goals — Reference 2003 Strategic Plan |
|---|---|---|
| Understand & Protect Earth | 1. Understand the Earth system and apply Earth system science to improve prediction of climate, weather, and natural hazards. | 1.1 Understand how the Earth is changing, better predict change, and understand the consequences for life on Earth. (Supporting Role) |
| Explore | 4. Explore the fundamental principles of physics, chemistry, and biology through research in the unique natural laboratory of space. | 4.1 Understand how life responds to the space environment and the role of gravity in the processes of life. (Supporting Role) |
| | 5. Explore the solar system and the universe beyond, understand the origin and evolution of life, and search for evidence of life elsewhere. | 5.1 Learn how the solar system originated and evolved to its current diverse state. (Supporting Role) |
| Inspire | 6. Inspire and motivate students to pursue careers in science, technology, engineering, and mathematics. | 6.1, 6.2, 6.3, 6.4 (Supporting Role) - See Education Programs Theme. |
| | 7. Engage the public in shaping and sharing the experience of exploration and discovery. | 7.2 Improve science literacy by engaging the public in NASA missions and discoveries, and their benefits, through such avenues as public programs, community outreach, mass media, and the internet. |
| Enabling Capabilities | 8.Ensure the provision of space access, and improve it by increasing safety, reliability, and affordability. | 8.3 Improve the accessibility of space to better meet research, Space Station assembly, and operations requirements. |
| | 9. Extend the duration and boundaries of human space flight to create new opportunities for exploration and discovery. | 9.4 Demonstrate the ability to support a permanent human presence in low Earth orbit as a stepping stone to human presence beyond. (Supporting Role) |

### RELEVANCE

In 1972 President Nixon issued a statement to initiate the "development of an entirely new type of space transportation system designed to help transform the space frontier of the 1970s into familiar territory, easily accessible for human endeavor in the 1980s and '90s". Since 1991, operational savings have allowed shuttle costs to decrease, while Shuttle safety, capability and success have dramatically increased. The mission of the SSP remains consistent in that its key program goals are to Fly Safely, Meet the Manifest, Improve Mission Supportability, and Improve the System.

The Space Shuttle can be configured to carry many different types of equipment, spacecraft and scientific experiments. The Space Shuttle is essential in the assembly of the ISS (advancing life sciences & technology through long-duration missions) and repairing & servicing the Hubble Space Telescope (enabling many new discoveries in Space Science). As an enabling function, the SSP is fully engaged in providing services for earth & physical science research.

SSP also engages the private sector in the development of space by providing flight opportunities for industry, academia & government to conduct applied research relevant to NASA's mission through access to the space environment. Cooperative activities with the National Institutes of Health (NIH), the National Science Foundation (NSF), the Department of Defense (DoD) and other U.S. agencies are advancing knowledge of health, medicine, science and technology.

| Education and Public Benefits |
|---|
| · Long term benefits to the public through support to the ISS program & other primary payload customers.<br>· Enables researchers to undertake experiments in the unique environment of space.<br>· SSP is contributing to NASA's goal to get students excited about science & mathematics & help advance our nation's education goals by supporting the Educator Astronaut program . |

## THEME: Space Shuttle Program (SSP)

### IMPLEMENTATION

This theme is composed of many integrated parts which work together to achieve the aforementioned goals and objectives. Those elements are summarized below. Selected Development efforts have individual follow-on information sheets, as do Operations.

SSP is a multiple-project program and single-program theme with program responsibility in the Office of Space Flight at NASA HQ. The Agency Program Management Council (PMC) has SSP governing responsibility. Enterprise official is William F. Readdy, Associate Administrator for Space Flight at HQ. Theme Director is General Michael C. Kostelnik, Deputy Associate Administrator for ISS and SSP at HQ.

| Strategy | Schedule by Fiscal Year<br>96 97 98 99 00 01 02 03 04 05 06 07 08 09 10 | Purpose |
|---|---|---|
| Checkout & LaunchControl System (CLCS)<br>(Terminated in FY02 due to cost growth.) | | Replace the Kennedy Space Center (KSC) legacy launch control room system & reduce launch control system operations and maintenance. |
| SSME Adv Health Management System (AHMS) | | Provide improved real-time monitoring of engine performance and environmental data. |
| Cockpit Avionics Upgrade | | Increases crew performance margins throughout all critical flight operations phases. |
| Program Integration | | To ensure the proper technical integration of all Shuttle elements and payloads. |
| Ground Operations | | Provides final integration and checkout of all hardware elements for launch. |
| Flight Operations | | Includes a wide variety of pre-flight planning, crew training, operations control activities, flight crew operations support, aircraft maintenance and operations and life sciences operations support. |
| Flight Hardware | | Produce and maintain the various flight hardware and software elements. |
| Shuttle Service Life Extension Program | | Includes high priority projects for safety, supportability, and infrastructure to combat obsolescence of vehicle, ground systems, and facilities. |
| http://nasa-mis.nasa.gov/index.htm | Tech. & Adv. Concept   Development   Operations | |

| Tailoring |
|---|
| No exceptions to NPG 7120.5B have been taken. |

### STATUS

The Space Shuttle Program accomplished 4 flawless missions in FY2002. STS-108 (12-17-01) carried the Expedition 4 crew & logistics to the ISS. This mission also honored the victims of 9/11 terrorist attacks by the "Flags for Heroes and Families" campaign, carrying thousands of U.S. flags into space (which were distributed to the victims' families and to the survivors of the attacks). STS-109 (3-12-02), the 4th mission to service the Hubble Space Telescope, extended the lifetime and capabilities of the now-famous orbiting telescope. This also marked the 1st flight of the Block II Engine Cluster. STS-110 (4-19-02) was the 13th U.S. mission to the ISS, achieving distinction by carrying the 1st major external truss section for the station, referred to as the S0 integrated truss segment. STS-111 (6-5-02) carried a 5th resident crew to the station as well as the Leonardo logistics module filled with experiments.

Go to http://spaceflight.nasa.gov for more detailed status information.

## THEME: Space Shuttle Program (SSP)

### PERFORMANCE MEASURES

| Annual Performance Goals | |
|---|---|
| OUTCOME 1.1.2: | Expand Earth Science research opportunities through utilization of the unique capabilities of the Space Shuttle |
| 4SSP1 | Achieve 100% on-orbit mission success when carrying Earth science payloads. For this metric, mission success criteria are those provided to the prime contractor (SFOC) for purposes of determining successful accomplishment of the performance incentive fees in the contract. |
| OUTCOME 4.1.2: | Ensure the opportunity for successful scientific research projects and programs by providing safe, reliable, and affordable launch and recovery capability, sustaining payload resources, and a human presence. |
| 4SSP2 | Achieve 100% on-orbit mission success when carrying physical science payloads. For this metric, mission success criteria are those provided to the prime contractor (SFOC) for purposes of determining successful accomplishment of the performance incentive fees in the contract. |
| OUTCOME 5.1.1: | Support future exploration by providing Space Shuttle launch capability for research, technology development, and exploration missions. |
| 4SSP3 | Achieve 100% on-orbit mission success when servicing HST. For this metric, mission success criteria are those provided to the prime contractor (SFOC) for purposes of determining successful accomplishment of the performance incentive fees in the contract. |
| OUTCOME 6.1.1: | Kindergarten through graduate students will be more proficient in science, technology, engineering, and mathematics (STEM). |
| 4SSP4 | Ensure the development and distribution of OSF content for curricular use in NASA Explorer Schools and in the Educator Mission Specialist Program. |
| OUTCOME 6.2.1: | More students from diverse communities motivated to pursue careers in STEM. |
| 4SSP5 | Increase by 10%, students participating in OSF research and development opportunities that enhances their academic experience, strengthens their professional skills, and supports their successful transition into the scientific and technical workforce. |
| OUTCOME 6.3.1: | Improve quality of STEM instruction. |
| 4SSP6 | Reach and expose, through both formal and informal education venues, 800 in-service and pre-service teachers, university teacher education faculty and students to mathematics and science careers and to OSF's unique educational resources. |
| 4SSP7 | During academic year 2003-2004, increase by 2 the number of pre-college programs for students participation in OSF center sponsored education enrichment activities that promotes their interest in and knowledge of mathematics, science, engineering and technology career fields. |
| OUTCOME 6.4.1: | More students prepared to enter the STEM workforce. |
| 4SSP8 | During academic year 2003-2004, increase by 4% the number of undergraduate and graduate students & faculty researchers exposed and gaining hands-on experience in OSF's state-of-the-art research instrumentation and methodologies. |
| 4SSP9 | Host 2 forums to strengthen OSF partnership with the minority university community and to more fully engage faculty & students from this community in OSF's mission. |
| OUTCOME 7.2.3: | Use OSF unique facilities, education resources, formal and informal venues(conferences, workshops, science centers, museums) and print, web and TV media, to to reach and engage an increasing number or percent of the public in exploration and space development activities. |
| 4SSP10 | Increase by 10%, OSF venues (educational, commercial, and political) that provide "hands-on" opportunities for the public to experience and become more knowledgeable of OSF benefits and contributions, particularly ISS. |
| 4SSP11 | Increase the number of visits to the Space Flight websites. |
| OUTCOME 8.3.1: | Assure public, flight crew, and workforce safety for all Space Shuttle operations and safely meet the FY04 manifest and flight rate commitment. |
| 4SSP12 | Achieve zero type A (damage to property at least $1M or death) or B (damage to property at least $250K or permanent disability or hospitalization of 3 or more persons) mishaps in FY 2004. |
| 4SSP13 | Achieve an average of 8 or fewer flight anomalies per Space Shuttle mission. |
| 4SSP14 | Provide safe, reliable space transportation and/or a space-based platform that allows our customers to achieve 100% on-orbit mission success for all flights in FY 2004. For this metric, mission success criteria are those provided to the prime contractor (SFOC) for purposes of determining successful accomplishment of the performance incentive fees in the contract. |
| 4SSP15 | Perform annual critical review of requirements, priorities, risks, and progress to effectively support Shuttle service life extension. |

## THEME: Space Shuttle Program (SSP)

### PERFORMANCE MEASURES (continued)

| Annual Performance Goals | |
|---|---|
| OUTCOME 9.4.2: | Further the capability of humans to live and work safely in space by transporting crews to ISS for longer on-orbit durations. |
| 4SSP16 | Achieve 100% on-orbit mission success for all Shuttle flights to ISS in FY 2004. For this metric, mission success criteria are those provided to the prime contractor (SFOC) for purposes of determining successful accomplishment of the performance incentive fees in the contract. |
| UNIFORM MEASURE: | Conduct a well managed program in accordance with Agency implementing strategies. |
| 4SSP17 | The Space Shuttle Program Theme commits to execute its programs within +10% of the total cost shown on the following table. |
| 4SSP18 | The Space Shuttle Program Theme commits to execute programs within +10% of its baseline schedules. |

### INDEPENDENT REVIEWS

| Types of Review | Performer | Last Review | Next Review | Purpose |
|---|---|---|---|---|
| Business Review | RAND | 30-Sep-02 | N/A | Evaluate options for Shuttle program competitive sourcing. |

### BUDGET

| Budget Authority ($millions) | FY02 | FY03 | Change | FY04 | Comments |
|---|---|---|---|---|---|
| **Space Shuttle Program** | **3,270.0** | **3,208.0** | **+760.4** | **3,968.4** | |
| DEVELOPMENT | 177.4 | 148.6 | -51.8 | 96.8 | |
| Checkout & LaunchControl System (CLCS) | 61.0 | 52.1 | -52.1 | 0.0 | Cancelled 9/02 |
| Other Service Life Extension Projects | 116.4 | 96.5 | +0.3 | 96.8 | |
| SSME AHMS | 15.5 | 8.0 | -1.7 | 6.3 | |
| Cockpit Avionics Upgrade | 100.9 | 88.5 | +2.0 | 90.5 | Procurement funding only |
| OPERATIONS | 3,092.6 | 3,059.4 | +812.2 | 3,871.6 | *no scheduled |
| Program Integration | 395.7 | 402.7 | -70.6 | 332.1 | completion, |
| Ground Operations | 537.1 | 527.9 | +371.6 | 899.5 | ongoing activity. |
| Flight Operations | 238.0 | 264.6 | +110.8 | 375.4 | |
| Flight Hardware | 1,787.5 | 1,681.7 | +301.5 | 1,983.2 | |
| Shuttle Service Life Extension Program | 134.3 | 182.5 | +98.9 | 281.4 | *contains full costs delta for CAU |

Indicated budget numbers in Full Cost.

Indicates changes since the FY 2003 Presidents Budget Submit.

Note: For all formats, the FY 02 column reflects the FY 2002 Congressional Operating Plan dated 9/30/02. The FY 03 column reflects the FY 2003 Presidents Budget Submit (PBS) as Amended. The Change column includes both programmatic and full cost adjustments. FY 2004 column is in full cost.

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| THEME: | Space Shuttle Program (SSP) |
|---|---|
| **DEVELOPMENT:** | **Checkout and Launch Control System (CLCS)** |

## PURPOSE

| Objectives | Reference 2003 Strategic Plan | Performance Measures |
|---|---|---|
| This project has been cancelled and therefore no FY04 measure is provided. | | |

The overall objectives of the CLCS Project were to modernize the Space Shuttle launch processing system and to reduce inherent risks associated with Shuttle Processing at KSC.
This project was cancelled on September 16, 2002 due to cost growth.

## OVERVIEW

This project was cancelled on September 16, 2002 due to cost growth.

CLCS was to modify the firing rooms at KSC and Shuttle Avionics Integration Laboratory at JSC. The system was to use modern commercial products and standards (computers, system software, networks, user interfaces, software development tools, etc.) to replace legacy hardware and software systems.

## PROGRAM MANAGEMENT

CLCS was a single-project program with program responsibility delegated to the Johnson Space Center. Prime Contractor was United Space Alliance. The OSF Program and Institutional Management Council (OPIMC) had SSP governing responsibility. The Agency Program Management Council (PMC) had CLCS governing responsibility. Enterprise official was William F. Readdy, Associate Administrator for Office of Space Flight at HQ. The Point of Contact was General Michael C. Kostelnik, Deputy Associate Administrator for ISS and SSP at HQ. This project was cancelled on September 16, 2002 due to cost growth.

## TECHNICAL COMMITMENT

The baseline for this technical commitment was made in June, 1997

| Technical Specifications | Current Baseline | FY04 President's Budget | Change from Baseline |
|---|---|---|---|
| Throughput (peak) | -- | -- | -- |
| R/T Closed Loop Contr | -- | -- | -- |
| Redundancy Mgmt | | | |
| Availability | -- | -- | -- |
| *This project has been cancelled. | | | |

| Schedule | Current Baseline | FY04 President's Budget | Change from Baseline |
|---|---|---|---|
| SLWT Ready | -- | -- | -- |
| HMF FRCS | -- | -- | -- |
| OPF ORR | -- | -- | -- |
| Launch Capable | -- | -- | -- |
| Project Compl | -- | -- | -- |
| *This project has been cancelled. | | | |

| THEME: | Space Shuttle Program (SSP) |
|---|---|
| **DEVELOPMENT:** | **Checkout and Launch Control System (CLCS)** |

## ACQUISITION STRATEGY & PERFORMING ORGANIZATIONS

This project was cancelled on September 16, 2002 due to cost growth.

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

| Future Acquisitions - Major | Selection | Goals |
|---|---|---|
| This project was cancelled on September 16, 2002 due to cost growth. | | |

## AGREEMENTS

*None*

## INDEPENDENT REVIEWS

| Types of Review | Performer | Last Review | Next Review | Purpose |
|---|---|---|---|---|
| NASA Non-Advocacy Review | Agency/IPAO | Jun-97 | | Review project viability, cost/benefit. |
| SSP Indep. Assessment Team | SSP | Aug-00 | | Review management approach, organizational structure. |
| NASA Special Assessment Rev. | HQ | Aug-02 | | Review cost/benefit. |

## BUDGET / LIFE CYCLE COST

Total budget authority represents the Life Cycle Cost (LCC). These figures include budget years FY1997 through FY2003.

| Budget Authority ($ in millions) | Prior | FY02 | FY03 | FY04 | FY05 | FY06 | FY07 | FY08 | BTC | Total | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|
| FY 2004 President's Budget (LCC) | 212.9 | 61.0 | 52.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | 326.0 | |
| Development | 212.9 | 61.0 | 52.1 | | | | | | | 326.0 | |
| Operations | | | | | | | | | | 0.0 | |
| Data Analysis | | | | | | | | | | | |
| Changes since FY 03 Pres. Budget | - | - | - | -37.5 | -26.6 | -8.5 | - | - | | -72.6 | ***Reason for Change:*** |
| Development | - | - | - | -37.5 | -26.6 | -8.5 | - | - | | -72.6 | Project cancelled September 2002. |
| Operations | | | | | | | | | | | |
| Data Analysis | | | | | | | | | | | |
| FY 2003 President's Budget (LCC) | 212.9 | 61.0 | 52.1 | 37.5 | 26.6 | 8.5 | 0.0 | 0.0 | | 398.6 | Based on the recommendations of |
| Development | 212.9 | 61.0 | 52.1 | 37.5 | 26.6 | 8.5 | 0.0 | 0.0 | | 398.6 | an independent assessment team, |
| Operations | | | | | | | | | | 0.0 | the project was rebaselined and |
| Data Analysis | | | | | | | | | | 0.0 | restructured in November 2000. |
| Basis of Estimate (BOE) | 194.4 | 11.3 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | 205.7 | Baseline Budget Date: June 3, 1997 |
| Development | 194.4 | 11.3 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | 205.7 | |
| Operations | | | | | | | | | | | |
| Data Analysis | | | | | | | | | | | |

Indicates changes since the FY 2003 Presidents Budget Submit.

FY 2002, FY 2003, Prior and BTC are not in full cost.

**THEME:** Space Shuttle Program (SSP)

# DEVELOPMENT: SSME Advanced Health Management System (AHMS) Phase I

## PURPOSE

| Objectives | Reference 2003 Strategic Plan | Performance Measures |
|---|---|---|
| 8.3 | Improve the accessibility of space to better meet research, ISS assembly, and operations requirements by increasing Shuttle safety, reliability, and maintainability. | 4SSP15 |

AHMS project supports this objective by enabling safe Space Shuttle Main Engine shutdown during potentially catastrophic high pressure turbopump failures. Decreases ascent risk by approximately 10%.

## OVERVIEW

AHMS project for the Space Shuttle Main Engines (SSME) will provide improved real-time vibration monitoring of the SSME and will provide improved engine anomaly response capabilities. AHMS consists of modifications to the existing SSME flight controller. These modifications include: 1) adding a vibration redline monitor for high pressure turbopumps, 2) doubling memory capacity and utilizing radiation tolerant memory, 3) adding an external communication interface for a potential Phase 2 Health Management Computer, and 4) eliminating existing memory retention batteries and replacing them with non-volatile memory. This project funds these modifications and the testing necessary to validate their performance and safety benefits to the Space Shuttle program.

## PROGRAM MANAGEMENT

AHMS is a single-project program with program responsibility delegated to the Johnson Space Center. Marshall Space Flight Center, Stennis Space Center and Kennedy Space Center also have critical roles in the realization of this program. Prime Contractor is Boeing-Rocketdyne. The OSF Program and Institutional Management Council (OPIMC) has SSP governing responsibility. The Agency Program Management Council (PMC) has AHMS governing responsibility. Enterprise official is William F. Readdy, Associate Administrator for Office of Space Flight at HQ. The Point of Contact is General Michael C. Kostelnik, Deputy Associate Administrator for ISS and SSP at HQ. The Program Manager is Jeffrey Spencer at MSFC. Full compliance with NPG 7120.5B will be achieved in FY 03.

## TECHNICAL COMMITMENT

The baseline for this technical commitment was made in June, 1997.

| Technical Specifications | Current Baseline | FY04 President's Budget | Change from Baseline |
|---|---|---|---|
| Digital Computer Unit Memory | 64K | 128K | +64 |
| Controller Weight | +3lbs | +1lb | -2lbs |
| Time to initiate engine shutdown after vibration redline exceedance | 125 | 125 | -- |

| Schedule | Current Baseline | FY04 President's Budget | Change from Baseline |
|---|---|---|---|
| **Phase I** | | | |
| Critical Design Review | May-01 | May-01 | Complete |
| Design Certification Revie | Nov-03 | Feb-04 | + 3 months |
| Ready for First Flt. | Jun-04 | Jun-04 | + 1 month |

**THEME:** Space Shuttle Program (SSP)

# DEVELOPMENT: SSME Advanced Health Management System (AHMS) Phase I

## ACQUISITION STRATEGY & PERFORMING ORGANIZATIONS

Boeing-Rocketdyne has a cost plus award fee/incentive fee contract to develop this project.

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

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

| Future Acquisitions - Major | Selection | Goals |
|---|---|---|
| None | | |

## AGREEMENTS

Internal: The program is not dependent on other NASA activities outside of the control of the Associate Administrator of Space Flight.

External: None

Changes since FY03 Pres. Budget: None.

## INDEPENDENT REVIEWS

| Types of Review | Performer | Last Review | Next Review | Purpose |
|---|---|---|---|---|
| Independent Assessment | IPAO | 1-Jan-01 | None | Assess probability of meeting technical objectives on schedule and within cost. Assess mission risks and measures availabile to mitigate those risks. |

## BUDGET / LIFE CYCLE COST

These figures include budget years FY2000 through FY2007.

| Budget Authority ($ in millions) | Prior | FY02 | FY03 | FY04 | FY05 | FY06 | FY07 | FY08 | BTC | Total | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|
| FY 2004 President's Budget | 21.1 | 15.5 | 8.0 | 6.3 | 3.0 | 2.0 | 1.3 | 0.0 | | 57.2 | |
| Development | 21.1 | 15.5 | 8.0 | 6.3 | 3.0 | 2.0 | 1.3 | | | 57.2 | |
| Direct Civil Service (FTE) | 2 | 2 | 2 | 2 | 2 | 2 | 2 | | | | |
| Changes since FY 03 Pres. Budget | -0.9 | - | - | +3.3 | - | - | +0.3 | - | | +2.7 | ***Reason for Change:*** |
| Development | -0.9 | - | - | +3.3 | - | - | +0.3 | - | | +2.7 | Rephasing; no programmatic |
| Direct Civil Service (FTE) | - | - | - | - | - | - | - | - | | - | |
| G&A Rates | | | | | | | | | | | |
| FY 2003 President's Budget | 22.0 | 15.5 | 8.0 | 3.0 | 3.0 | 2.0 | 1.0 | 0.0 | | 54.5 | |
| Development | 22.0 | 15.5 | 8.0 | 3.0 | 3.0 | 2.0 | 1.0 | | | 54.5 | |
| Direct Civil Service (FTE) | 2 | 2 | 2 | 2 | 2 | 2 | 2 | | | | |
| G&A Rates | | | | | | | | | | | |
| Basis of Estimate (BOE) | 22.0 | 15.5 | 8.0 | 3.0 | 3.0 | 2.0 | 1.0 | 0.0 | | 54.5 | Baseline established July 2000 at Program Authorization to Proceed (ATP). |
| Development | 22.0 | 15.5 | 8.0 | 3.0 | 3.0 | 2.0 | 1.0 | | | 54.5 | |
| Direct Civil Service (FTE) | 2 | 2 | 2 | 2 | 2 | 2 | 2 | | | | |
| G&A Rates | | | | | | | | | | | |

Indicated budget numbers in Full Cost.

Indicates changes since the FY 2003 Presidents Budget Submit.

FY 2002, FY 2003, Prior and BTC are not in full cost.

| | |
|---|---|
| **THEME:** | Space Shuttle Program (SSP) |
| **DEVELOPMENT:** | Cockpit Avionics Upgrade |

## PURPOSE

| Objectives | | Reference 2003 Strategic Plan | Performance Measures |
|---|---|---|---|
| 8.3 | Improve the accessibility of space to better meet research, ISS assembly, and operations requirements. | | 4SSP15 |

The CAU will increase crew situational awareness and decrease crew workload in the cockpit to enable more timely and accurate crew decisions. Excessive crew workload adversely affects the crew's situational awareness and impairs crew ability to diagnose and isolate system failures. Improving the crew's ability to manage information during critical flight operations will significantly benefit the safety and reliability of the SSP. The CAU minimum success criteria for safety improvement is a 100% increase in trajectory monitoring, a 50% increase in critical system monitoring, and 20% increase in overall system monitoring.

## OVERVIEW

CAU will implement new Orbiter cockpit avionics hardware and software to meet the man-machine interface requirements identified by the Space Shuttle Cockpit Council to enhance overall crew safety. Orbiter cockpit displays and crew interface capabilities will be significantly improved by replacing the existing Integrated Display Processors (IDPs) with higher performance Command and Display Processors (CDPs). These units will provide expanded processing performance to enable dramatic improvements in information access and display capability as well as the implementation of the new Abort Flight Management software function.

## PROGRAM MANAGEMENT

CAU is a single-project program with program responsibility delegated to the Johnson Space Center. The Prime contractor is United Space Alliance. The Office of Space Flight Program and Institutional Management Council (PIMC) has SSP governing responsibility. The Agency Program Management Council (APMC) has CAU governing responsibility. Enterprise official is William F. Readdy, Associate Administrator for the Office of Space Flight at HQ. The Point of Contact is General Michael C. Kostelnik, Deputy Associate Administrator for ISS and SSP at HQ. The Program Manager is Michael Brieden at JSC. Full compliance with NPG 7120.5B will be achieved in FY 03.

## TECHNICAL COMMITMENT

The baseline for this technical commitment was made in September, 2000

| Technical Specifications | Current Baseline | FY04 President's Budget | Change from Baseline |
|---|---|---|---|
| Crew situational awareness | | | |
| - On-board trajectory monitoring | *100% increase | *100% increase | -- |
| - On board critical systems monitoring | *50% increase | *50% increase | -- |
| - On-board overall systems monitoring | *20% increase | *20% increase | -- |

* Increase is relatve to current on-board Shuttle cockpit avionics capability as measured using industry standard Situation Awareness Global Assessment Technique (SAGAT)

| Schedule | Current Baseline | FY04 President's Budget | Change from Baseline |
|---|---|---|---|
| **Phase I** | | | |
| Prliminary Design Review | Apr-02 | Apr-02 | Complete |
| Critical Design Review | Jul-03 | Jul-03 | -- |
| Ready for First Flt. | CY 2006 | CY 2006 | -- |

| THEME: | Space Shuttle Program (SSP) |
|---|---|
| **DEVELOPMENT:** | **Cockpit Avionics Upgrade** |

## ACQUISITION STRATEGY & PERFORMING ORGANIZATIONS

United Space Alliance has a cost plus award fee/incentive fee contract to develop this project.
Changes since FY03 Presidents Budget: None.

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

| Future Acquisitions - Major | Selection | Goals |
|---|---|---|
| None | | |

## AGREEMENTS

Internal: MOU between JSC and NASA Ames Research Center regarding common interests in Shuttle improvements and new aerospace technologies (human factors and information technology expertise).
External: None **Changes since FY03 Pres. Budget: None.**

## INDEPENDENT REVIEWS

| Types of Review | Performer | Last Review | Next Review | Purpose |
|---|---|---|---|---|
| Independent Cost Estimate | Aerospace | Sep-2002 | TBD | To perform an Independent Cost Estimate (ICE). |
| NAR | IPAO | Oct-2002 | N/A | To assess the probability of meeting project technical objectives onschedule and within cost. To assess the mission risks and measures availabile to mitigate those risks. |

## BUDGET/LIFE CYCLE COST

These figures include budget years FY2000 through FY2006. Transition & orbiter mod kit costs are excluded here but will be accomodated within the Flight Hardware budget. This project is not yet in full cost, however, full cost is included in the Service Life Extension Program (SLEP) figures. Individual projects will specify their full cost allocations during the POP-03 process.

| Budget Authority ($ in millions) | Prior | FY02 | FY03 | FY04 | FY05 | FY06 | FY07 | FY08 | BTC | Total | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|
| FY 2004 President's Budget | 71.0 | 100.9 | 88.5 | 90.5 | 76.9 | 14.2 | 0.0 | 0.0 | | 442.0 | |
| Development | 71.0 | 100.9 | 88.5 | 90.5 | 76.9 | 14.2 | 0.0 | | | 442.0 | |
| Direct Civil Service (FTE) | | 20 | 20 | 20 | 17 | 11 | | | | | |
| | | | | | | | | | | | *FY03 is the Initial Baseline year for this development. |
| Initial Baseline (LCC) | 71.0 | 100.9 | 88.5 | 90.5 | 76.9 | 14.2 | 0.0 | 0.0 | | 442.0 | |
| Development | 71.0 | 100.9 | 88.5 | 90.5 | 76.9 | 14.2 | 0.0 | | | 442.0 | |

| THEME: | Space Shuttle Program (SSP) |
|---|---|
| **OPERATIONS:** | **Program Integration** |

## PURPOSE

| Objectives | | Reference 2003 Strategic Plan | Performance Measures |
|---|---|---|---|
| 8.3 | Improve the accessibility of space to better meet research, ISS assembly, and operations requirements. | | 4SSP14 |

SSP Program Integration assures the successful technical integration of all Shuttle elements and payloads into each mission to efficiently and effectively meet our customer requirements in exploring the fundamental principles of physics, chemistry, and biology through research in the unique environment of space. Program Integration performs the analyses necessary to demonstrate our ability to safely and reliably conduct each Shuttle mission.

## OVERVIEW

The Program Integration budget includes funds for the analysis, management, and the Safety, Reliability, Maintainability & Quality Assurance function that is performed for the entire Space Shuttle Program. Program integration includes those elements managed by the Space Shuttle Program Office at the Johnson Space Center (JSC) and conducted primarily by United Space Alliance, including payload integration into the Space Shuttle and systems integration of the flight hardware elements through all phases of flight. Shuttle integration provides for the engineering analysis needed to ensure that payloads that are integrated to form a viable and safe cargo and meet Space Shuttle interface requirements. Shuttle integration includes the necessary mechanical, aerodynamic and avionics engineering tasks to ensure that the launch vehicle can be safely launched, fly a safe ascent trajectory, achieve planned performance and descend to a safe landing.

## PROGRAM MANAGEMENT

The Shuttle program integration responsibility is delegated to JSC. The OSF Program and Institutional Management Council (OPIMC) has SSP governing responsibility. Enterprise official is William F. Readdy, Associate Administrator for Space Flight at HQ. Theme Director and Point of Contact is General Michael C. Kostelnik, Deputy Associate Administrator for ISS and SSP at HQ. The Program Manager is Ronald D. Dittemore at JSC. Full compliance with NPG 7120.5B will be achieved in FY 03.

## TECHNICAL COMMITMENT

Flights are baselined approximately 12 to 13 months prior to targeted launch date.

| Technical Specifications | FY04 President's Budget | Change from Baseline |
|---|---|---|
| STS-117 | Integrate & Deliver S3/S4 Truss | -- |
| STS-118 | Integrate & Deliver S5 Truss | -- |
| STS-119 | Integrate & Deliver S6 Truss, Rotate Crew | -- |
| STS-120 | Integrate & Deliver Node 2 | -- |
| STS-121 | ULF2 -Integrate, Deliver, & Return MPLM, Rotate Crew | -- |

| Schedule | FY04 President's Budget | Change from Baseline |
|---|---|---|
| STS-117/Endeavour | 1st Qtr FY 04 | -- |
| STS-118/Columbia | 1st Qtr FY 04 | -- |
| STS-119/Atlantis | 2nd Qtr FY 04 | -- |
| STS-120/Endeavour | 2nd Qtr FY 04 | -- |
| STS-121/Discovery | 4th Qtr FY 04 | -- |

| | |
|---|---|
| **THEME:** | Space Shuttle Program (SSP) |
| **OPERATIONS:** | Program Integration |

## ACQUISITION STRATEGY & PERFORMING ORGANIZATIONS

The prime contractor for program integration is United Space Alliance under the Space Flight Operations Contract (SFOC). This contract covers operations through September 30, 2004. The SFOC contract was awarded in 1996 as a sole source contract on the determination that this acquisition strategy was in the best interest of the U. S. Government in reducing procurement costs, overall contract costs, and minimizing the disruption of on-going Shuttle operations. Changes since FY03 Pres. Budget: None.

| Current Acquisitions | Actual * | Selection Method | Actual * | Performer | Actual * |
|---|---|---|---|---|---|
| Cooperative Agreements | 0% | Full & Open Competition | 12.4% | Industry | 98.6% |
| Cost Reimbursable | 95.8% | Sole Source | 87.6% | Government | 1.2% |
| Fixed Price | 2.6% | | 100% | NASA Intramural | 0% |
| Grants | 0% | | | University | 0.1% |
| Other | 1.5% | Sci Peer Review | N/A | Non Profit | 0.1% |
| * as % of FY02 direct procurement | 100% | * as % of FY02 direct procurement | | * as % of FY02 direct procuren | 100% |

| Future Acquisitions - Major | Selection | Goals |
|---|---|---|
| SFOC | Full & Open | President's Mgt. Agenda on Competitive Sourcing |

## AGREEMENTS

Internal: Not dependent on other NASA activities outside of the control of the Associate Administrator of Space Flight.
External: None

## INDEPENDENT REVIEWS

| Types of Review | Performer | Last Review | Next Review | Purpose |
|---|---|---|---|---|
| None | | | | |

## BUDGET

| Budget Authority ($ in millions) | FY02 | FY03 | FY04 | Comments |
|---|---|---|---|---|
| FY 2004 President's Budget | 395.7 | 402.7 | 332.1 | |
| Program Integration | 395.7 | 402.7 | 332.1 | |
| Changes since FY 03 Pres. Budget | - | - | -205.6 | ***Reason for Change:*** Moved infrastructure to SLEP, Reallocated Privatization funds to other Ops, and Full Cost restructure. |

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

| THEME: | Space Shuttle Program (SSP) |
|---|---|
| **OPERATIONS:** | **Ground Operations** |

## PURPOSE

| Objectives | Reference 2003 Strategic Plan | Performance Measures |
|---|---|---|
| 8.3 | Improve the accessibility of space to better meet research, ISS assembly, and operations requirements. | 4SSP12 |

Ground Operations provides final integration and checkout of all hardware elements for launch. It also includes coordination with other government agencies and foreign entities for Shuttle landing capabilities. The major launch site operational facilities at KSC include three Orbiter Processing Facilities (OPFs), two launch pads, the Vehicle Assembly Building (VAB), the Launch Control Center (LCC) and three Mobile Launcher Platforms (MLPs).

## OVERVIEW

Ground operations support includes launch countdown and landing for six Shuttle missions in FY 2004. Ground support for Shuttle landing includes both the KSC and Edwards AFB runways and multiple contigency landing sites in the U.S. and other countries. Ground Operations also includes the maintenance and operations of ground infrastructure to support launch and landing. Three or four orbiters are normally in the hardware processing flow along with External Tanks, Space Shuttle Main Engines and Solid Rocket Booster components to support several missions.

## PROGRAM MANAGEMENT

The Shuttle ground operations responsibility is delegated to KSC. The OSF Program and Institutional Management Council (OPIMC) has SSP governing responsibility. Enterprise official is William F. Readdy, Associate Administrator for Space Flight at HQ. Theme Director and Point of Contact is General Michael C. Kostelnik, Deputy Associate Administrator for ISS and SSP at HQ. The Program Manager is Ronald D. Dittemore at JSC. Full compliance with NPG 7120.5B will be achieved in FY 03.

## TECHNICAL COMMITMENT

Flights are baselined approximately 12 to 13 months prior to targeted launch date.

| Technical Specifications | FY04 President's Budget | Change from Baseline |
|---|---|---|
| STS-117 | Integrate & Deliver S3/S4 Truss | -- |
| STS-118 | Integrate & Deliver S5 Truss | -- |
| STS-119 | Integrate & Deliver S6 Truss, Rotate Crew | -- |
| STS-120 | Integrate & Deliver Node 2 | -- |
| STS-121 | ULF2 -Integrate, Deliver, & Return MPLM, Rotate Crew | -- |

| Schedule | FY04 President's Budget | Change from Baseline |
|---|---|---|
| STS-117/Endeavour | 1st Qtr FY 04 | -- |
| STS-118/Columbia | 1st Qtr FY 04 | -- |
| STS-119/Atlantis | 2nd Qtr FY 04 | -- |
| STS-120/Endeavour | 2nd Qtr FY 04 | -- |
| STS-121/Discovery | 4th Qtr FY 04 | -- |

| THEME: | Space Shuttle Program (SSP) |
|---|---|
| **OPERATIONS:** | Ground Operations |

## ACQUISITION STRATEGY & PERFORMING ORGANIZATIONS

The prime contractor for ground operations is United Space Alliance under the Space Flight Operations Contract (SFOC). This contract covers operations through Sept. 30, 2004. The SFOC contract was awarded in 1996 as a sole source contract on the determination that this acquisition strategy was in the best interest of the U. S. Government in reducing procurement costs, overall contract costs, and minimizing the disruption of on-going Shuttle operations. Changes since FY03 Pres. Budget: None.

| Current Acquisitions | Actual * | Selection Method | Actual * | Performer | Actual * |
|---|---|---|---|---|---|
| Cooperative Agreement | 0% | Full & Open Competition | 12.4% | Industry | 98.6% |
| Cost Reimbursable | 95.8% | Sole Source | 87.6% | Government | 1.2% |
| Fixed Price | 2.6% | | 100% | NASA Intramural | 0% |
| Grants | 0% | | | University | 0.1% |
| Other | 1.5% | Sci Peer Review | N/A | Non Profit | 0.1% |
| * as % of FY02 direct procureme | 100% | * as % of FY02 direct procurement | | * as % of FY02 direct procureme | 100% |

| Future Acquisitions - Major | Selection | Goals |
|---|---|---|
| SFOC | Full & Open | President's Mgt. Agenda on Competitive Sourcing |

## AGREEMENTS

Internal: The program is not dependent on other NASA activities outside of the control of the Associate Administrator of Space Flight.

External:Department of Defense and Foreign Countries in support of all Emergency Landing Sites.

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

## INDEPENDENT REVIEWS

| Types of Review | Performer | Last Review | Next Review | Purpose |
|---|---|---|---|---|
| None | | | | |

## BUDGET

| Budget Authority ($ in millions) | FY02 | FY03 | FY04 | Comments |
|---|---|---|---|---|
| FY 2004 President's Budget | 537.1 | 527.9 | 899.5 | |
| Ground Operations | 537.1 | 527.9 | 899.5 | |
| Changes since FY 03 Pres. Budget | - | - | +290.5 | ***Reason for Change***: Full Cost in FY 04 . |
| (yellow) Indicated budget numbers in Full Cost. | | | | |
| (blue) Indicates changes since the FY 2003 Presidents Budget Submit. | | | | |

| THEME: | Space Shuttle Program (SSP) |
|---|---|
| **OPERATIONS:** | **Flight Operations** |

## PURPOSE

| Objectives | Reference 2003 Strategic Plan | Performance Measures |
|---|---|---|
| 8.3 Improve the accessibility of space to better meet research, ISS assembly, and operations requirements. | | 4SSP1, 4SSP2, 4SSP3, 4SSP12, 4SSP13, 4SSP14, 4SSP16 |

SSP Flight Operations assures the successful accomplishment of pre-flight planning, crew training, operations control activities, flight crew operations support, aircraft maintenance and operations, and life sciences operations support for each mission to efficiently and effectively meet our customer requirements in exploring the fundamental principles of physics, chemistry, and biology through research in the unique environment of space. Program Integration performs the analyses necessary to demonstrate our ability to safely and reliably conduct each Shuttle mission.

## OVERVIEW

The planning activities range from the development of operational concepts and techniques to the creation of detailed systems operational procedures and checklists. Flight operations funding also provides for the maintenance and operation of critical mission support facilities including the Mission Control Center (MCC), Integrated Training Facility (ITF), Integrated Planning System (IPS) and the Software Production Facility (SPF). The major operations facilities at Johnson Space Center (JSC) include flight design systems and the training of aircraft fleet.

For more status information go to http://spaceflight.nasa.gov

## PROGRAM MANAGEMENT

The Shuttle Flight operations responsibility is delegated to JSC. The OSF Program and Institutional Management Council (OPIMC) has SSP governing responsibility. Enterprise official is William F. Readdy, Associate Administrator for Space Flight at HQ. Theme Director and Point of Contact is General Michael C. Kostelnik, Deputy Associate Administrator for ISS and SSP at HQ. The Program Manager is Ronald D. Dittemore at JSC. Full compliance with NPG 7120.5B will be achieved in FY 03.

## TECHNICAL COMMITMENT

Flights are baselined approximately 12 to 13 months prior to targeted launch date.

| Technical Specifications | FY04 President's Budget | Change from Baseline |
|---|---|---|
| STS-117 | Integrate & Deliver S3/S4 Truss | -- |
| STS-118 | Integrate & Deliver S5 Truss | -- |
| STS-119 | Integrate & Deliver S6 Truss, Rotate Crew | -- |
| STS-120 | Integrate & Deliver Node 2 | -- |
| STS-121 | ULF2 -Integrate, Deliver, & Return MPLM, Rotate Crew | -- |

| Schedule | FY04 President's Budget | Change from Baseline |
|---|---|---|
| STS-117/Endeavour | 1st Qtr FY 04 | -- |
| STS-118/Columbia | 1st Qtr FY 04 | -- |
| STS-119/Atlantis | 2nd Qtr FY 04 | -- |
| STS-120/Endeavour | 2nd Qtr FY 04 | -- |
| STS-121/Discovery | 4th Qtr FY 04 | -- |

| | |
|---|---|
| **THEME:** | Space Shuttle Program (SSP) |
| **OPERATIONS:** | Flight Operations |

## ACQUISITION STRATEGY & PERFORMING ORGANIZATIONS

The prime contractor for flight operations is United Space Alliance under the Space Flight Operations Contract(SFOC). This contract covers 2 years of operations through September 30, 2004. The SFOC contract was awarded in 1996 as a sole source contract on the determination that this acquisition strategy was in the best interest of the U. S. Government in reducing procurement costs, overall contract costs, and minimizing the disruption of on-going Shuttle operations.
Changes since FY03 Pres. Budget: None.

| Current Acquisitions | Actual * | Selection Method | Actual * | Performer | Actual * |
|---|---|---|---|---|---|
| Cooperative Agreements | 0% | Full & Open Competition | 12.4% | Industry | 98.6% |
| Cost Reimbursable | 95.8% | Sole Source | 87.6% | Government | 1.2% |
| Fixed Price | 2.6% | | 100% | NASA Intramural | 0% |
| Grants | 0% | | | University | 0.1% |
| Other | 1.5% | Sci Peer Review | N/A | Non Profit | 0.1% |
| * as % of FY02 direct procurement | 100% | * as % of FY02 direct procurement | | * as % of FY02 direct procurement | 100% |

| Future Acquisitions - Major | Selection | Goals |
|---|---|---|
| SFOC | Full & Open | President's Management Agenda on Competitive Sourcing. |

## AGREEMENTS

Internal: The program is not dependent on other NASA activities outside of the control of the Associate Administrator of Space Flight.
External: None
Changes since FY03 Pres. Budget: None.

## INDEPENDENT REVIEWS

| Types of Review | Performer | Last Review | Next Review | Purpose |
|---|---|---|---|---|
| None | | | | |

## BUDGET

| Budget Authority ($ in millions) | FY02 | FY03 | FY04 | Comments |
|---|---|---|---|---|
| FY 2004 President's Budget | 238.0 | 264.6 | 375.4 | |
| Flight Operations | 238.0 | 264.6 | 375.4 | |
| Changes since FY 03 Pres. Budget | - | - | +88.2 | ***Reason for Change:*** Full Cost in FY 04. |

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

| | |
|---|---|
| **THEME:** | Space Shuttle Program (SSP) |
| **OPERATIONS:** | Flight Hardware |

## PURPOSE

| Objectives | Reference 2003 Strategic Plan | Performance Measures |
|---|---|---|
| 8.3 | Improve the accessibility of space to better meet research, ISS assembly, and operations requirements. | 4SSP13, 4SSP14 |

SSP Flight Hardware assures the vehicle hardware and software are designed, developed, manufactured, and tested sufficiently to enable the safe and reliable transportation that meets our customers' requirements for research in the unique environment of space. Shuttle Flight Hardware and software assures the success of each Shuttle mission.

## OVERVIEW

The Flight Hardware program produces space components to support Shuttle mission requirements and ensures core skills and capabilities required for maintaining the Orbiter as a safe and effective transportation and science platform. Other support requirements are also provided for in this budget, including tasks, that support flight software development and verification. The software activities include development, formulation and verification of the guidance, targeting and navigation systems software in the Orbiter.

## PROGRAM MANAGEMENT

The Shuttle flight hardware responsibility is delegated to JSC for Orbiter and EVA, MSFC for ET, RSRM, SRB, and SSME, and SSC for SSME test support. The OSF Program and Institutional Management Council (OPIMC) has SSP governing responsibility. Enterprise official is William F. Readdy, Associate Administrator for Space Flight at HQ. Theme Director and Point of Contact is General Michael C. Kostelnik, Deputy Associate Administrator for ISS and SSP at HQ. The Program Manager is Ronald D. Dittemore at JSC. Full compliance with NPG 7120.5B will be achieved in FY 03.

## TECHNICAL COMMITMENT

Flights are baselined approximately 12 to 13 months prior to targeted launch date.

| Technical Specifications | FY04 President's Budget | Change from Baseline |
|---|---|---|
| STS-117 | Integrate & Deliver S3/S4 Truss | -- |
| STS-118 | Integrate & Deliver S5 Truss | -- |
| STS-119 | Integrate & Deliver S6 Truss, Rotate Crew | -- |
| STS-120 | Integrate & Deliver Node 2 | -- |
| STS-121 | ULF2 -Integrate, Deliver, & Return MPLM, Rotate Crew | -- |

| Schedule | FY04 President's Budget | Change from Baseline |
|---|---|---|
| STS-117/Endeavour | 1st Qtr FY 04 | -- |
| STS-118/Columbia | 1st Qtr FY 04 | -- |
| STS-119/Atlantis | 2nd Qtr FY 04 | -- |
| STS-120/Endeavour | 2nd Qtr FY 04 | -- |
| STS-121/Discovery | 4th Qtr FY 04 | -- |

| THEME: | Space Shuttle Program (SSP) |
|---|---|
| **OPERATIONS:** | Flight Hardware |

## ACQUISITION STRATEGY & PERFORMING ORGANIZATIONS

The prime contractor for the external tank is Lockheed Martin Corporation. This contract expires December 1, 2008. The prime contractor for the Space Shuttle Main Engine is Boeing-Rocketdyne Propulsion & Power Systems. This contract expires December 31, 2006. The prime contractor for the Vehicle & Solid Rocket Booster is United Space Alliance. This contract ends September 30, 2004. The prime contractor for the Reusable Solid Rocket Motor is ATK Thiokol Propulsion. This contract covers 2 years of operations, renewable in FY04. The prime contractors for the Extravehicular Mobility Unit are United Space Alliance for hardware processing and Hamilton Sundstrand for development and sustaining engineering. This USA contract ends September 30, 2004. **Changes since FY03 Pres. Budget: None.**

| Current Acquisitions | Actual * | Selection Method | Actual * | Performer | Actual * |
|---|---|---|---|---|---|
| Cooperative Agreements | 0% | Full & Open Competition | 12.4% | Industry | 98.6% |
| Cost Reimbursable | 95.8% | Sole Source | 87.6% | Government | 1.2% |
| Fixed Price | 2.6% | | 100% | NASA Intramural | 0% |
| Grants | 0% | | | University | 0.1% |
| Other | 1.5% | Sci Peer Review | N/A | Non Profit | 0.1% |
| * as % of FY02 direct procurement | 100% | * as % of FY02 direct procurement | | * as % of FY02 direct procurement | 100% |

| Future Acquisitions - Major | Selection | Goals |
|---|---|---|
| SFOC | Full & Open | President's Mgt. Agenda on Competitive Sourcing |

## AGREEMENTS

*Internal:* The program is not dependent on other NASA activities outside of the control of the Associate Administrator of Space Flight.
*External:* None
**Changes since FY03 Pres. Budget: None.**

## INDEPENDENT REVIEWS

| Types of Review | Performer | Last Review | Next Review | Purpose |
|---|---|---|---|---|
| Audit | GAO | 1-Jan-01 | 3-Mar-03 | Orbiter Maintenance Modification decision |

## BUDGET

| Budget Authority ($ in millions) | FY02 | FY03 | FY04 | Comments |
|---|---|---|---|---|
| FY 2004 President's Budget | 1787.5 | 1,681.7 | 1,983.2 | |
| Flight Hardware | 1787.5 | 1,681.7 | 1,983.2 | |
| Changes since FY 03 Pres. Budget | - | - | +28.0 | ***Reason for Change:*** Full Cost balanced by reprogramming funds to SLEP. |

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

| THEME: | Space Shuttle Program (SSP) |
|---|---|
| **OPERATIONS:** | Shuttle Service Life Extension Program |

## PURPOSE

| Objectives | Reference 2003 Strategic Plan | Performance Measures |
|---|---|---|
| 8.3 Improve the accessibility of space to better meet research, ISS assembly, and operations requirements. | | 4SSP15 |

The Space Shuttle Service Life Extension Program (SLEP) is a strategic and proactive program designed to keep the Space Shuttle flying safely and efficiently in order to meet agency commitments and goals for access to space. The Shuttle Service Life Extension Program (SLEP) addresses the ability of the Shuttle to maintain the existing safety posture of the flight and ground support/facilities systems while operating the Shuttle well into the next decade. NASA is reformulating (through the SLEP Summit Process) its approach to prioritizing, selecting and managing these investments to ensure Shuttle operability into the next decade within schedule and budget guidelines.

## OVERVIEW

Includes high priority projects for safety, supportability, and infrastructure. These projects provide revitalization of the Shuttle infrastructure and combat obsolescence of vehicle, ground systems, and facilities to maintain the program's safety and viability into the next decade. Service life extension projects include the design, manufacturing, and process changes that elminate, reduce, or mitigate significant hazards and critical failure modes. Investments made to research and development infrastructure ensure the continued safe operations of the Shuttle ground support equipment, tooling and special test equipment required for Shuttle processing. Construction of Facilities (CoF) funding for Shuttle projects is provided to refurbish, modify, reclaim, replace and restore facilities at Office of Space Flight (OSF) Centers to improve performance, address environmental concerns of the older facilities and to ensure their readiness to support Shuttle operations.

## PROGRAM MANAGEMENT

The Shuttle Service Life Extension Program responsibility is delegated to the Space Shuttle Program Office. The OSF Program and Institutional Management Council (OPIMC) has SSP governing responsibility. Enterprise official is William F. Readdy, Associate Administrator for Space Flight at HQ. Theme Director and Point of Contact is General Michael C. Kostelnik, Deputy Associate Administrator for ISS and SSP at HQ. The Program Manager is Ronald D. Dittemore at JSC. Full compliance with NPG 7120.5B will be achieved in FY 03.

## TECHNICAL COMMITMENT

Flights are baselined approximately 12 to 13 months prior to targeted launch date.

| Technical Specifications | FY04 President's Budget | Change from Baseline |
|---|---|---|
| TBD - Shuttle Service Life Extension Program Summit in FY 03 to determine program priorities and investment strategy. | | |

| Schedule | FY04 President's Budget | Change from Baseline |
|---|---|---|
| Conduct annual SLEP Summit | Mar-04 | New Baseline |

| THEME: | Space Shuttle Program (SSP) |
|---|---|
| **OPERATIONS:** | **Shuttle Service Life Extension Program** |

## ACQUISITION STRATEGY & PERFORMING ORGANIZATIONS

The acquisition strategy for the ground facilities procurements will be full and open competition. Procurement activities for flight and ground support systems will be a combination of full and open competition where applicable hardware or software development experience is not necessary to conduct the procurement. Where applicable hardware and software development experience is deemed necessary to meet NASA's requirements, existing contracts may be augmented without competition to fulfill the overall government interests.
Changes since FY03 Pres. Budget: None.

| Current Acquisitions | Actual * | Selection Method | Actual * | Performer | Actual * |
|---|---|---|---|---|---|
| Cooperative Agreements | TBD | Full & Open Competition | TBD | Industry | TBD |
| Cost Reimbursable | TBD | Sole Source | TBD | Government | TBD |
| Fixed Price | TBD | | 100% | NASA Intramural | TBD |
| Grants | TBD | | | University | TBD |
| Other | TBD | Sci Peer Review | TBD | Non Profit | TBD |
| * as % of FY02 direct procurement | 100% | * as % of FY02 direct procurement | | * as % of FY02 direct procurem | 100% |

| Future Acquisitions - Major | Selection | Goals |
|---|---|---|
| None | | |

## AGREEMENTS

Internal: The program is not dependent on other NASA activities outside of the control of the Associate Administrator of Space Flight.
External: None.
**Changes since FY03 Pres. Budget: None.**

## INDEPENDENT REVIEWS

| Types of Review | Performer | Last Review | Next Review | Purpose |
|---|---|---|---|---|
| Fact Finding | IG | Under Way | | To evaluate NASA's planning & management of Space Shuttle Infrastructure. |

## BUDGET

| Budget Authority ($ in millions) | FY02 | FY03 | FY04 | Comments |
|---|---|---|---|---|
| FY 2004 President's Budget | | | | |
| Shuttle Service Life Extension | 134.3 | 182.5 | 281.4 | |
| Infrastructure (CofF) | 39.5 | 91.4 | 53.9 | For FY 2003, $56.5M is for CofF. For FY 2004, total amount is for CofF. |
| Future Projects | 94.8 | 91.1 | 227.5 | See note |
| Changes since FY 03 Pres. Budget | * | * | * | ***Reason for Change:*** *Consolidated funding Shuttle Service Life Extension Program, from other Shuttle funding lines. |

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

Note: Future Projects definition to be determined through the SLEP Summit Process. This is an ongoing process using a comprehensive total systems perspective to determine the highest priority program content. Future projects may include safety, supportability, infrastructure, process improvement, personnel, etc.

Space and Flight Support is comprised of separate Agency-level "enabling capabilities" program services including environmental support, space communications, Space Shuttle payloads processing, expendable launch vehicles, and rocket propulsion systems testing.

# SPACE AND FLIGHT SUPPORT

## MAJOR EVENTS IN FY 2004

- Commence Plum Brook reactor building demolition and disposal.
- Award of the Space Mission Communication and Data Service Procurement, the follow-on to the Consolidated Space Operations Contract (CSOC).

## THEME: Space and Flight Support

### OVERVIEW

Space and Flight Support, managed by the Office of Space Flight is comprised of several distinct Agency-level services in support of NASA research. These services includes space communications, Space Shuttle payloads processing, expendable launch vehicles, rocket propulsion systems testing, and environmental (Plum Brook nuclear facility dismantling and Environmental Compliance and Restoration). The services are critical for conducting space exploration, aeronautical research, material sciences research, biological and physical research. These services are provided to a wide range of customers including NASA scientists and engineers, other U.S. federal agencies, universities, foreign governments and industry interests. Space and Flight Support also includes the Advanced Systems program, which conducts advanced research and technology development to enable future NASA capabilities.

| Missions | Goals supported by this theme | Objectives supporting those goals Reference 2003 Strategic Plan |
|---|---|---|
| Understand & Protect Earth | Goal 1: Understand the Earth system and apply Earth system science to improve prediction of climate, weather and natural hazards. | 1.1 Understand how the Earth is changing, better predict change, and understand the consequences for life on Earth. (Supporting Role) |
| | Goal 3: Create a more secure world and improve the quality of life by investing in technologies and collaborating with other agencies, industry and academia. | 3.1 Enhance the Nation's security by developing and demonstrating critical access-to-space technologies that benefit NASA, DOD, and other government agencies. (Supporting Role) |
| Explore | Goal 5: Explore the solar system and the universe beyond, understand the origin and evolution of life and search for evidence of life elsewhere. | 5.6 Develop an understanding of Mars in support of possible future human exploration. (Supporting Role) |
| Inspire | Goal 6: Inspire students to pursue careers in science, math and engineering. | 6.1, 6.2, 6.3, 6.4 (Supporting Role) - See Education Programs Theme. |
| | Goal 7: Engage the public in shaping and sharing the experience of exploration and discovery. | 7.2 - Improve science literacy by engaging the public in NASA missions and discoveries, and their benefits, through such avenues as public programs, community outreach, mass media, and the internet. |
| Enabling Capabilities | Goal 8: Ensure the provision of space access, and improve it by increasing safety, reliability, and affordability. | 8.5 - Provide services for space communications,rocket propulsion testing, and launch in support of NASA, other government agencies and industry. |
| | | 8.6 - Create concepts, technologies and capabilities for transportation beyond LEO, and define plans to enable affordable future infrastructures. |
| | Goal 9: Extend the duration and boundaries of human space flight to create new opportunities for exploration and discovery. | 9.5 - Create innovative approaches and concepts to inform future decisions concerning systems, infrastructures and missions for human and robotic exploration of space. |
| | Goal 10: Enable revolutionary capabilities through new technology. | 10.4 - Create novel aerospace concepts in support of future human and robotic exploration and development of space. |

### RELEVANCE

Space and Flight Support includes the enabling capabilities required to conduct space exploration, expand scientific knowledge of our universe, enable the development of space and to conduct Microgravity research. Each of these capabilities play a critical support role in the success of NASA missions and goals. Without these capabilities NASA could not perform many of its missions and the American public would not receive many benefits of the nation's space program. In addition to these capabilities, the Space and Flight Support Theme includes funding for the decommissioning of the Plum Brook nuclear reactor and environmental remediation activities for the agency. These two initiatives address environmental legacy liabilities of decades of space explorations and demonstrate NASA's commitment to providing a safe and clean natural environment for future generations of Americans.

## THEME: Space & Flight Support

### RELEVANCE (continued)

**Education and Public Benefits**

Benefits of Space and Flight Support include the relay of scientific data from space to Earth, the safe launching of Space Shuttles and expendable launch vehicles necessary for research, assurance that rocket systems have been adequately tested, and provision of a blue print for future capabilities to enable pursuit of future exploration and discovery. These activities benefit both the general public and the education community. A space program properly supported by this Theme will be successful and will generate a broad array of research data that can be used to generate new scientific knowledge through the study of the physical sciences, biological sciences, Earth sciences, planetary science and beyond.

### IMPLEMENTATION

This theme is composed of multiple programs that provide capabilities across a customer base that includes internal NASA customers, other federal agencies, foreign governments and commercial customers. These programs, while serving separate and distinct roles, serve a common role of continuous customer service. They work together to achieve the aforementioned goals and objectives. Those elements are summarized below.

Space and Flight Support is a multiple-program theme with program responsibility in the Office of Space Flight, at NASA HQ. The Agency Program Institutional Management Council (PIMC) has governing responsibility. Enterprise official is William Readdy, Associate Administrator for Space Flight at HQ. The Headquarters Program Directors are: Space Communications - Robert Spearing, Payload Carriers and Expendable Launch Vehicles - Karen Poniatowski, Miscellaneous (Crew Health and Safety) - Dr. Jeffrey Davis, Advanced Systems - John Mankins, and Plum Brook Decommissioning and the Environmental Compliance and Restoration programs - Olga Dominguez.

| Strategy | Schedule by Fiscal Year<br>96 97 98 99 00 01 02 03 04 05 06 07 08 09 10 | Purpose |
|---|---|---|
| Space Communications | | Provides space comm. services to STS, ISS, Low Earth Orbiting (LEO) satellites, and launch vehicles, and telecomm. services among facilities such as NASA flight support networks, mission control centers and science facilities, and admin. comm. among NASA Centers. |
| Payload Carriers | | Provides expertise and facilities necessary to perform payload buildup; test and checkout; integration and servicing of; transportation to the launch vehicle; and integration and installation into the launch vehicle. |
| Expendable Launch Vehicles | | Provides oversight of launch services across all launch vehicle classes for NASA unique one of a kind science, earth observing and technology payloads. Provides launch site maintenance and sustaining operations at Vandenberg AFB and Cape Canaveral Air Station. |
| Rocket Propulsion Testing | | Provides development of space transportation propulsion systems by sustaining "world-class" core capabilities required by NASA rocket engine development and testing programs for space transportation. |
| Miscellaneous | | Provides astronaut crew health monitoring services, delivery of on-orbit medical services, longitudinal studies and development of life support technologies. |

## THEME: Space & Flight Support

### IMPLEMENTATION (continued)

| Strategy (continued) | Schedule by Fiscal Year (96 97 98 99 00 01 02 03 04 05 06 07 08 09 10) | Purpose |
|---|---|---|
| Advanced Systems | | Supports the creation and enabling of a long-term Agency capabilities for human and robotic exploration and development of space. |
| Plum Brook Reactor Facility Decommissioning | | Supports the decontamination, demolition and disposal of NASA's Plum Brook Nuclear Reactor Facility. |
| Environmental Compliance and Restoration | | Supports activities necessary for compliance with environmental statutory and regulatory requirements and standards, orders, regulatory and cooperative agreements, and support of environmental program initiatives. |

Tech. & Adv. Concept  Development  Operations

| Tailoring |
|---|
| No exceptions to NPG 7120.5B have been taken. |

### STATUS

Over the past year, the Space and Flight Support theme continued to provide critical support in all areas under its domain. Each program provided customer support as measured by their individual annual performance goals. In the area of environmental interests, NASA continues to demonstrate its dedication to environmental stewardship and regulatory assurance as demonstrated by closing 90+ percent of compliance findings, and reducing unfunded environmental liabilities. Space Communications successfully provided support for all Shuttle flights and deep space expedition probes. Payloads processing met all customer requirements schedules and deadlines in preparing and integrating payloads into the Shuttle cargo bays and delivering to low Earth orbit. The four Space Shuttle launches included five Hitchhiker experiments, six Get-Away Special Payloads and six Secondary payloads. Expendable Launch Vehicles met all customer requirements and deadlines that resulted in the successful launch of six vehicles. The Rocket Propulsion Test program provided 24 test cells and associated facilities to meet customer demands.

Go to Program homepages for more detailed status information.

**Plum Brook:** http://www.lerc.nasa.gov/WWW/pbrf/
**Environmental Compliance & Restoration:**
http://www.hq.nasa.gov/office/codej/codeje/je_site/about_us/about_us.html

**Advanced Systems:** http://hedsadvsystems.nasa.gov/SpaceExploration.html
**Expendable Launch Systems** http://www.ksc.nasa.gov/elvnew/elv.htm
**Rocket Propulsion Test Program** https://rockettest.ssc.nasa.gov/
**Payloads Carriers/Small Paylaods Office** http://sspp.gsfc.nasa.gov

## THEME: Space & Flight Support

### PERFORMANCE MEASURES

| Annual Performance Goals | |
|---|---|
| OUTCOME: | 1.1.4 - Enhance Earth Science research through definition of future opportunities for utilizationof unique human capabilities in space. |
| 4SFS1 | Identify 2-3 innovative system and infrastructure concepts (and associated technologies) driven by the requirements of ambitious future Earth system science missions. |
| 4SFS2 | Develop and review technology maturation road maps and investment strategies necessary to realize these transformational capabilities for Earth system science. |
| OUTCOME: | 3.1.2 - Advance goals of a more secure world and a higher quality of life by providing and defining more capable and affordable future in space operations infrastructure. |
| 4SFS3 | Identify 2-3 innovative systems and infrastructure concepts (and associated technologies) that can support prospective requirements of ambitious future space systems that contribute materially to security and the quality of life. |
| 4SFS4 | Develop and review technology maturation road maps and investment strategies necessary to realize these transformational capabilities. |
| OUTCOME: | 5.6.2 - Enable safer, more affordable and more effective future human and robotic exploration missions by defining science-driven, innovative approaches and concepts to inform future decisions concerning systems infrastructures. |
| 4SFS5 | Identify 4-6 innovative system and infrastructure concepts (and associated technologies) that can support the requirements of ambitious future space science missions. |
| 4SFS6 | Develop and independently review technology maturation road maps and investment strategies necessary to realize these transformational capabilities for Space Science. |
| OUTCOME: | 6.1.1 - Kindergarten through graduate students will be more proficient in science, technology, engineering, and mathematics (STEM). |
| 4SFS7 | Ensure the development and distribution of OSF content for curricular use in NASA Explorer Schools and in the Educator Mission Specialist Program. |
| OUTCOME: | 6.2.1 - More students from diverse communities motivated to pursue careers in STEM |
| 4SFS8 | Increase by 10%, students participating in OSF research and development opportunities that enhances their academic experience, strengthens their professional skills, and supports their successful transition into the scientific and technical workforce. |
| OUTCOME: | 6.3.1 - Improve quality of STEM instruction. |
| 4SFS9 | Reach and expose, through both formal and informal educations venues, 800 in-service and pre-service teachers, university teacher education faculty and students to mathematics and science careers and to OSF's unique educational resources. |
| 4SFS10 | During academic year 2003-2004, increase by 2 the number of pre-college programs for students participation in OSF center sponsored education enrichment activities that promotes their interest in and knowledge of mathematics, science, engineering and technology career fields. |
| OUTCOME: | 6.4.1 - More students prepared to enter the STEM workforce |
| 4SFS11 | During academic year 2003-2004, increase by 4% the number of undergraduate and graduate students and faculty researchers exposed and gaining hand-on experience in OSF's state-of-the art research instrumentation and methodologies. |
| 4SFS12 | Host 2 forums to strengthen OSF partnership with the minority university community and to more fully engage faculty and students from this community in OSF's mission. |
| OUTCOME: | 7.2.3 - Use OSF unique facilities, education resources, formal and informal venues(conferences, workshops, science centers, museums) and print, web and TV media, to share with the public our human space activities. |
| 4SFS13 | Increase by 10% OSF venues (educational, commercial, and political) that provide "hands-on" opportunities for the public to experience and become more knowledgeable of OSF benefits and contributions, particularly ISS. |
| 4SFS14 | Increase the number of visits to the Space Flight websites. |
| OUTCOME: | 8.5.1 - Provide reliable launch services on Expendable Launch Vehicles to meet agency requirements. |
| 4SFS15 | Maintain NASA success rate at or above a running average of 95% for missions noted on the Expendable Launch Vehicle (ELV) manifest. |
| OUTCOME: | 8.5.2 - Provide reliable communications and mission control systems for every flight mission. |
| 4SFS16 | Achieve at least 95% of planned data delivery for the International Space Station, each Space Shuttle mission, and low-Earth orbiting missions in FY04. |

## THEME: Space & Flight Support

### PERFORMANCE MEASURES (continued)

Annual Performance Goals (continued)

| | |
|---|---|
| OUTCOME: | 8.5.3 - Minimize technical, cost, and schedule risk to NASA, DoD and Commercial test customers by ensuring safe and efficient operations of NASA test facilities. |
| 4SFS17 | Achieve zero mishaps that constitute a major breach of safety. |
| 4SFS18 | Achieve positive feedback from a minimum of 95% of all test customers. |
| OUTCOME: | 8.6.1 - Advance future human and robotic exploration and development of space objectives. |
| 4SFS19 | Define and provide Level 1 OSF requirements related to future human and robotic exploration and development of space to NASA programs pursuing improvements in access to space. |
| 4SFS20 | Identify key concepts (near term to far term) and technology road maps for space transportation capabilities, focusing on future human & robotic space exploration and development. |
| OUTCOME: | 9.5.1 - Enable safer, more affordable and more effective future human activities beyond LEO. |
| 4SFS21 | Identify 4-7 innovative system and infrastructure concepts (and associated technologies) in support of ambitious future human activities beyond LEO. |
| 4SFS22 | Identify 5-9 alternative human exploration mission options based on these innovative concepts. |
| 4SFS23 | Develop and review technology maturation road maps and investment strategies necessary to realize these transformational capabilities. |
| OUTCOME: | 10.4 - Accelerate the development of new revolutionary technologies by enabling better investment decisions. |
| 4SFS24 | Define and provide Level 1 OSF requirements related to future human and robotic exploration and development of space to NASA and other Agency programs pursuing improvements in future revolutionary space capabilities. |
| 4SFS25 | Identify 8-10 concepts for transformational space capabilities, focusing on future human & robotic space exploration and development, in areas including space assembly, maintenance and servicing, space utilities and power, and self-sufficient space systems. |
| 4SFS26 | Develop technology road maps and formulation of investment options to enable these capabilities. |
| UNIFORM MEASURE: | Conduct a well managed program in accordance with Agency implementing strategies. |
| 4SFS27 | The Space & Flight Support Theme commits to execute its programs within +10% of the total cost shown on the following table. |
| 4SFS28 | The Space & Flight Support Theme commits to execute programs within +10% of the of its baseline schedules. |

### INDEPENDENT REVIEWS

Reviews are conducted at the Project level. Please refer to the Development, page 2, Operations, page 2 and Technology & Advanced Systems, page 2.

### BUDGET

| Budget Authority ($millions) | FY02 | FY03 | Chng | FY04 | Comments |
|---|---|---|---|---|---|
| **Space & Flight Support** | **600.9** | **238.7** | **+195.6** | **434.3** | |
| Development: | 0.0 | 0.0 | +84.7 | 84.7 | Not subject to Full Cost. |
| Plum Brook | [16] | [64] | -20.3 | 43.7 | [ ] Budgeted in institutional support for FY 2002 and FY 2003. Non-add. |
| Env Compli & Restor. | [41] | [41] | - | 41.0 | |
| Operations | 600.9 | 238.7 | +104.9 | 343.6 | |
| Space Communications | 481.8 | 117.5 | +7.3 | 124.8 | |
| Payloads | 57.0 | 51.7 | +24.5 | 76.2 | |
| ELV | 34.3 | 35.8 | +30.0 | 65.8 | |
| Rocket Test | 27.8 | 27.9 | +34.4 | 62.3 | |
| Miscellaneous | 0.0 | 5.8 | +8.7 | 14.5 | |
| Technology and Advanced Concepts (Full Cost) | | | +6.0 | 6.0 | New for FY 2004 |

Indicated budget numbers in Full Cost.

Indicates changes since the FY 2003 Presidents Budget Submit.

Note: For all formats, the FY 02 column reflects the FY 2002 Congressional Operating Plan dated 9/30/02. The FY 03 column reflects the FY 2003 Presidents Budget Submit (PBS) as Amended. The Change column includes both programmatic and full cost adjustments. FY2004 is in full cost.

| THEME: | Space & Flight Support |
|---|---|
| **DEVELOPMENT:** | **Plum Brook Reactor Facility Decommissioning (PBRF)** |

## PURPOSE

| Objectives | Reference 2003 Strategic Plan | Performance Measures |
|---|---|---|
| # IS4.2 | Ensure operations and mission environmental compliance and stewardship over resources entrusted to NASA | 4SFS29-30 |

1) Decontaminate NASA's Plum Brook Reactor Facility (PBRF) to levels to allow for unrestricted release required under 10 Code of Federal Regulations (CFR) 20 Subpart E "Radiological Criteria for License Termination".
2) Demolish and dispose of contaminated and uncontaminated buildings and structures.
3) Terminate the Nuclear Regulatory Commission (NRC) licenses for PBRF as required by the NRC, under 10 CFR 20.1402

## OVERVIEW

The PBRF is an area of about 27 acres located within NASA's Plum Brook Station, a federal reservation of 6,400 acres, near Sandusky, OH. The PBRF includes a 60-megawatt (thermal) materials testing and research reactor (NRC license number TR-3), a 100-kilowatt mock-up reactor (NRC license number R-93), and other facilities that support the reactors. The PBRF was built for nuclear irradiation testing of nuclear fueled and unfueled experiments for space applications. PBRF was operating from 1961 to 1973. The NRC has required, through its license process and regulations, that NASA decommission PBRF by 2007. Moreover, the decommissioning schedule is driven by the one commercially available disposal facility (Barnwell, SC) for Class B and C radioactive wastes. Barnwell is accepting less waste each year and will stop accepting wastes in 2007.

Go to Plum Brook Reactor Decommissioning Project: http://www.grc.nasa.gov/WWW.PBRF/

## PROGRAM MANAGEMENT

PBRF is a single-project program with program responsibility delegated to the Glenn Research Center. The Glenn Research Center Program Management Council (PMC) has governing responsibility for the PBRF. This is not an aerospace program and as such is not subject to the requirements of NPG 7120. The responsible office at NASA Headquarters is Code JE, Ms. Olga Dominguez.

## TECHNICAL COMMITMENT

Decontaminate the site to meet NRC's unrestricted release levels for License Termination per 10 CFR 20.1402

| Technical Specifications | Current Baseline | FY04 President's Budget | Change from Baseline |
|---|---|---|---|
| Continue reactor building demolition | Oct 03 thru Sept 04 | Oct 03 thru Sept 04 | - |
| Continue reactor quadrants demolition | Oct 03 thru Sept 05 | Oct 03 thru Sept 05 | - |
| Complete reactor vessel removal/cleanup | Nov 03 | Nov 03 | - |
| Commence environmental cleanup | Feb 04 | Feb 04 | - |
| Complete reactor fan house/hot lab demo | Aug 04 | Aug 04 | - |
| | No change in the technical approach.<br>Rebaselining necessary to move appropriate surveying closer to the front end of the project (scheduled to occur in FY03). | | |

| Schedule | Current Baseline | FY04 President's Budget | Change from Baseline |
|---|---|---|---|
| NRC notifies NASA of 2007 deadline | Nov-97 | Nov-97 | - |
| Decommissioning Plan submitted to NRC | Dec-99 | Dec-99 | - |
| NRC approves decommissioning plan | Nov-01 | Mar-02 | + 4 months |
| Begin removing reactor internals | Oct-02 | Feb-03 | + 4 months |
| Begine Demolition/Disposal efforts | Jan-04 | Aug-04 | + 7 months |
| Commence reactor building demo/disp | Aug-04 | Jul-05 | + 11 months |
| Site-wide demo/disposal completed | Apr-05 | Mar-06 | + 11 months |
| NRC Validation - termination of licenses | Jul-06 | Jun-07 | + 11 months |

| | |
|---|---|
| **THEME:** | Space & Flight Support |
| **DEVELOPMENT:** | Plum Brook Reactor Facility Decommissioning (PBRF) |

## ACQUISITION STRATEGY & PERFORMING ORGANIZATIONS

NASA signed a Space Act Agreement with the U.S. Army Corps (USACE) of Engineers. USACE is using a cost reimbursable type contract primarily because of the flexibility and continuous "cradle to grave" involvement. Moreover, USACE claims that its cost reimbursable contract was selected because of: 1) ability to provide incentives to contractors, 2) small business goals, 3) use of local contractors, 4) competitively awarded.
**Changes since FY03 Pres. Budget: None.**

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

| Future Acquisitions - Major | Selection | Goals |
|---|---|---|
| None | n/a | n/a |

## AGREEMENTS

INTERNAL AGREEMENTS: None EXTERNAL AGREEMENTS: 1) Nuclear Regulatory Agency license TR-3 for 60 megawatt research test reactor – possess but not operate 2) Nuclear Regulatory Agency license R-93 for 100 kilowatt swimming pool mock-up reactor – possess but not operate, 3) Space Act Agreement signed on September 13, 1999, and SAA Modification #1 signed on August 3, 2000, provide the scope that allowed USACE to be a partner for PBRF decommissioning. ("Reimbursable Interagency Agreement between National Aeronautics and Space Administration and the Department of the Army for Activities Leading to the Decommissioning of the Plum Brook Station Nuclear Reactor Facility"), 4) USACE contract with Montgomery Watson 5) Montgomery Watson's contract and agreements with subcontractors (Duke Engineering & Services, and MOTA, Inc.) 6) NASA's agreements and contracts with support contractors: U.S. Department of Energy's Argonne National Laboratory, Plum Brook Operations and Support Group, Focus Group, and others. 7) NRC Letter of Indemnification dated July 8, 2000, indemnifying NASA, USACE, and contractors and subcontractors up to $500 million for radiological incidents during decommissioning. **Changes since FY03 Pres. Budget: None.**

## INDEPENDENT REVIEWS

| Types of Review | Performer | Last Review | Next Review | Purpose |
|---|---|---|---|---|
| NASA Non-Advocate Review | IPAO | 30-Oct-01 | N/A | No further non-advocate reviews planned |

## BUDGET/LIFE CYCLE COST

Total budget authority represents the Life Cycle Cost (LCC). These figures exclude preliminary studies completed prior to project commencement.

| Budget Authority ($ in millions) | Prior | FY02 | FY03 | FY04 | FY05 | FY06 | FY07 | FY08 | *BTC | Total | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|
| FY 2004 President's Budget (LCC) | 13.0 | 16.0 | 64.0 | 43.7 | 30.5 | 9.2 | 0.6 | 0.0 | -12.0 | 165.0 | |
| Development | 13.0 | 16.0 | 64.0 | 43.7 | 30.5 | 9.2 | 0.6 | | -12.0 | 165.0 | |
| Changes since FY 03 Pres. Budget | - | - | - | -12.3 | +14.5 | +9.2 | +0.6 | - | -12.0 | - | ***Reason for Change:*** |
| Development | | | - | -12.3 | +14.5 | +9.2 | +0.6 | | -12.0 | - | *Negative value in BTC reflects rephasing of project, no increase in cost. |
| FY 2003 President's Budget (LCC) | 13.0 | 16.0 | 64.0 | 56.0 | 16.0 | 0.0 | 0.0 | 0.0 | | 165.0 | NOTE: Per issued guidance, environmental projects are not subject to full-cost requirements. |
| Development | 13.0 | 16.0 | 64.0 | 56.0 | 16.0 | | | | | 165.0 | |
| Initial Baseline (LCC) | 13.0 | 16.0 | 64.0 | 56.0 | 16.0 | 0.0 | 0.0 | 0.0 | | 165.0 | |
| Development (Feb '97) | 13.0 | 16.0 | 64.0 | 56.0 | 16.0 | | | | | 165.0 | |

Indicates changes since the FY 2003 Presidents Budget Submit.
FY 2002, FY 2003, Prior and BTC are not in full cost.

| THEME: | Space & Flight Support |
|---|---|
| **DEVELOPMENT:** | **Environmental Compliance and Restoration (ECR)** |

## PURPOSE

| Objectives | Reference 2003 Strategic Plan | Performance Measures |
|---|---|---|
| # IS4.2 | Ensure operations and mission environmental compliance and stewardship over resources entrusted to NASA | 4SFS29-30 |

Compliance with environmental requirements including environmental management system initiatives as outlined in Executive Order 13148. Activities necessary for NASA to comply with environmental statutory and regulatory requirements, standards, orders, cooperative agreements and environmental management system initiatives. Program is focused in areas of compliance, remediation, conservation, pollution prevention and closures and includes projects, studies, assessments, investigations, plans, designs, engineering, support, sampling, monitoring, and operation of remedial treatment sites as part of remediation and cleanup measures. Also includes regulatory oversight costs and acquisition of land if necessary to implement compliance and remediation measures. Activities will be performed at NASA installations, NASA-owned industrial plants supporting NASA activities, and other current or former NASA sites where NASA operations have contributed to environmental problems and is obligated to contribute to cleanup costs.

## OVERVIEW

The Program represents this year's request on a phased approach prioritizing Agency requirements for environmental remediation measures that must be implemented within the next several years, as well as needed requirements for other environmental compliance measures and management system initiatives. Based on relative urgency and potential health hazards and safety, these activities are the highest priority requirements currently planned for accomplishment in FY 2004. Deferral of these necessary compliance and remediation measures would preclude NASA from complying with environmental requirements and regulatory agreements, and could jeopardize NASA operations. As studies, assessments, investigations, plans, regulatory approvals, and designs progress and as new discoveries or regulatory requirements change, it is expected that priorities may change and revisions to these activities may become necessary.

Go to NASA's Environmental Compliance and Restoration Program
http://www.hq.nasa.gov/office/codej/codeje/je_site/about_us/about_us.html

## PROGRAM MANAGEMENT

The Environmental Compliance and Restoration (ECR) Program is managed from NASA Headquarters under the Office of Management Systems and involves all NASA facilities. Annual budget requirements are presented to the Institutional Review Board for concurrence. This is not an aerospace program and as such is not subject to the requirements of NPG 7120. The responsible office at NASA Headquarters is Code JE, Ms. Olga Dominguez.

## TECHNICAL COMMITMENT

A comprehensive environmental program as directed under Executive Order 13148 and a host of federal, state, and local environmental regulations.

| Technical Specifications | Current Baseline | FY04 President's Budget | Change from Baseline |
|---|---|---|---|
| Environmental Remediation Activities under the Resource Conservation and Recovery Act (RCRA), the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA or Superfund), and State equivalent Statutes. | | | -- |
| Environmental Compliance Requirements under 40 CFR and State and Local laws and regulations. | | | -- |
| Environmental Management System Initiatives as required under Executive Order 13148. | | | -- |
| Environmental functional reviews as required under Executive Order 13148. | | | -- |
| Environmental resource stewardship requirements under federal, state, and local laws & regulations. | | | -- |

| Schedule | Current Baseline | FY04 President's Budget | Change from Baseline |
|---|---|---|---|
| No set schedule/milestones exist for this ongoing program - instead, worst-first prioritization methods employed. | Oct 03 thru Sept 04 | Oct 03 thru Sept 04 | -- |

**THEME:** Space & Flight Support

# DEVELOPMENT: Environmental Compliance and Restoration (ECR)

## ACQUISITION STRATEGY & PERFORMING ORGANIZATIONS

Environmental Compliance and Restoration requirements are prevalent at all NASA locations and are contracted for through a variety of means at NASA's centers. This may include all of the different types of contracts and performers noted below. **Changes since FY03 Pres. Budget: None.**

| Current Acquisitions | Actual * | Selection Method | Actual * | Performer | Actual * |
|---|---|---|---|---|---|
| Cooperative Agreements | 0% | Full & Open Competitior | 55% | Industry | 78% |
| Cost Reimbursable | 63% | Sole Source | 45% | Government | 15% |
| Fixed Price | 37% | | 100% | NASA Intramural | 1% |
| Grants | 0% | | | University | 6% |
| Other | 0% | Sci Peer Review | % | Non Profit | 0% |
| * as % of FY02 direct procurement | 100% | * as % of FY02 direct procurement | | * as % of FY02 direct procureme | 100% |

| Future Acquisitions - Major | Selection | Goals |
|---|---|---|
| no major acquisitions planned | n/a | n/a |

## AGREEMENTS

Most NASA centers perform environmental remediation under one or more regulatory agreements. These agreements range from very formal (as in the case of Consent Orders issued by courts or Federal Facility Agreements signed by NASA and the Environmental Protection Agency or the States) to less formal (outlines of project plans sent between Center environmental offices and State Regulatory Agencies). **Changes since FY03 Pres. Budget: None.**

## INDEPENDENT REVIEWS

| Types of Review | Performer | Last Review | Next Review | Purpose |
|---|---|---|---|---|
| Institutional Committee Reviews | IRC | May-03 | May-04 | Agency review of FY04 budget requirements for budget build. |

## BUDGET/LIFE CYCLE COST

*Total budget authority does not represent life cycle costs as this is an ongoing incrementally funded program.

| Budget Authority ($ in millions) | Prior | FY02 | FY03 | FY04 | FY05 | FY06 | FY07 | FY08 | BTC | Total | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|
| FY 2004 President's Budget (LCC) | * | 41.0 | 41.0 | 41.0 | 41.0 | 41.0 | 41.0 | 41.0 | * | * | |
| Development | * | 41.0 | 41.0 | 41.0 | 41.0 | 41.0 | 41.0 | 41.0 | * | * | |
| Changes since FY 03 Pres. Budget | * | - | - | - | - | - | - | +41.0 | * | * | ***Reason for Change:*** |
| Development | | | | | | | | +41.0 | * | * | Continution of ECR program, as new sites are identified. |
| FY 2003 President's Budget (LCC) | * | 41.0 | 41.0 | 41.0 | 41.0 | 41.0 | 41.0 | 0.0 | * | * | NOTE: Per issued guidance, |
| Development | * | 41.0 | 41.0 | 41.0 | 41.0 | 41.0 | 41.0 | | * | * | environmental projects are not subject to full-cost requirements. |
| Initial Baseline (LCC) | * | 41.0 | 41.0 | 41.0 | 41.0 | 41.0 | 41.0 | 0.0 | * | * | |
| Development (Feb '97) | * | 41.0 | 41.0 | 41.0 | 41.0 | 41.0 | 41.0 | | * | * | |

Indicates changes since the FY 2003 Presidents Budget Submit.

* BTC was not calculated for this program.

NOTE: Per issued guidance, environmental projects are not subject to full-cost requirements.

| THEME: | Space and Flight Support |
|---|---|
| **OPERATIONS:** | Space Comm., Payload Carriers & Spt, Exp. Launch Vehicle Msn Spt, Prop. Test and Adv. Systems |

## PURPOSE

| Objectives — Reference 2003 Strategic Plan | Performance Measures |
|---|---|
| 8.5 Provide services for space communications, launch operations, rocket propulsion testing, and astronaut crew health and safety in support of NASA, other governments, and commercial interests. | 4SFS17-20, 4SFS29-30 |

SPACE COMMUNICATION PROGRAM: Provide space communications services to STS, ISS, other low-Earth orbiting (LEO) satellites, and launch vehicles. PAYLOADS CARRIERS & SUPPORT PROGRAM: Provide access to space, via the Space Shuttle. EXPENDABLE LAUNCH VEHICLE (ELV) MISSION SUPPORT PROGRAM: (1) Provide mission success driven and cost effective launch services for NASA missions; (2) Provide mission analysis and feasibility assessments for NASA payload customers; (3) Increase efficiency in launch site operations; (4) Provide low cost secondary payload opportunities. PROPULSION TEST PROGRAM: Provide rocket propulsion test facilities in support of NASA programs, commercial partners and DoD. Space and Flight Support budget also provides for astronaut crew health and safety issues.

## OVERVIEW

Space and Flight Support, managed by the Office of Space Flight, is comprised of four separate Agency-level services: SPACE COMMUNICATION PROGRAM: Comprised of two elements: (1) Space Network supporting space shuttle, ELVs and research aircraft; and (2) the NASA Integrated Services Network (NISN), providing telecommunications services among facilities. PAYLOADS CARRIERS & SUPPORT PROGRAM: Provides expertise, facilities and capabilities necessary to perform payload buildup, test and checkout, integration and servicing of multiple payloads, and integration and installation into the launch vehicle. ELV MISSION SUPPORT PROGRAM: Provides launch services across all launch vehicle classes (Small, Med-Lite, Medium, Intermediate, and NLS) for NASA unique missions. Supports launch site maintenance and sustaining operations at Vandenberg AFB and Cape Canaveral Air Station. PROPULSION TEST PROGRAM: Develop low-cost, safe, and reliable space transportation propulsion systems and testing of operational rockets. Program includes staff support at test facilties at SSC, MSFC, GRC and JSC-White Sands Test Faciltiy.

For more information, go to: Payload Carriers: Small Payloads Office - http://sspp.gsfc.nasa.gov
RPT: https://rockettest.ssc.nasa.gov/ ELV: http://www.ksc.nasa.gov/elvnew/elv.htm

## PROGRAM MANAGEMENT

Enterprise official is Mr. William F. Readdy, Associate Administrator for Space Flight at HQ. The OSF Program Management Council (PMC) has governing responsibility for the programs below.

SPACE COMMUNICATIONS: The Program Office Director is Robert Spearing, Assistant Associate Administrator for Space Communications, Office of Space Flight at HQ.

PAYLOADS CARRIERS / ELV PROGRAMS: The Program Office Director is Karen S. Poniatowski, Assistant Associate Administrator for Launch Services at HQ. KSC is responsible for the execution of both programs.

ROCKET PROPULSION TEST: The Program Office Director is Michael Dawson of Stennis Space Center.

## TECHNICAL COMMITMENT

Data current as of 12/6/2002

The definition of the baseline is the FY 2003 Budget.

| Technical Specifications | FY04 President's Budget | Change from Baseline |
|---|---|---|
| Space Network | Manage/operate 8 satellites. | - |
| NASA Integrated Services Network (NISN) | Manage NASA Integrated Services Network. | - |
| Expendable Launch Vehicle | Manage processing and launch facilities at KSC, Cape Canaveral Air Force Station and Vandenberg AFB. | - |
| Payloads | Manage processing facilities at KSC. | - |
| Rocket Propulsion Testing | Manage 24 test cells and the supporting facilities. | - |

| Schedule | FY04 President's Budget | Change from Baseline |
|---|---|---|
| Space Network | Provide system operational readiness. | - |
| NASA Integrated Services Network (NISN) | Provide 24/7 operational readiness of network. | - |
| Expendable Launch Vehicle | Support ELV manifest. | - |
| Payloads | Support Shuttle manifest. | - |
| Rocket Propulsion Testing | Maintain facilities in state of readiness. | - |

| THEME: | Space and Flight Support |
|---|---|
| **OPERATIONS:** | Space Communications, Payload Carriers & Spt, Expendable Launch Vehicle Msn Spt, Rocket Propulsion Test, and Advanced Systems |

## ACQUISITION STRATEGY & PERFORMING ORGANIZATIONS

The prime contractor for space communications/data services is Lockheed Martin under the Consolidated Space Operations Contract (CSOC), which covers 5 years of operations. This contract will not be renewed because a new procurement strategy is being developed to support a newly establsihed cross-Enterprise management approach. The prime contractor for TDRS Replenishment is Boeing. The contract term is 5 years and ends December 2003. It will not be renewed because the requirement for development and launching of three new satellites has been completed. Changes since FY03 Pres. Budget: None. The Expendable Launch Vehicle Integrated Support (ELVIS) contractor is the Analex Corporation. This contract covers 3 years of operations, renewable in FY2005. Changes since FY03 Pres. Budget: Contract Awarded May 2002. The Checkout and Payload Processing Services (CAPPS) contractor is the Boeing Space Operations Company. This contract covers 4 years of operations, renewable in FY2006. Changes since FY03 Pres. Budget: Contract Awarded August 2002. The primary Rocket Test contractor at each test site are as follows: SSC: Lockheed Martin and Mississippi Space Services; MSFC: LB&B; JSC/WSTF: Honeywell; GRC/PB: Plum Brook Operations Support Group (PBOSG).

| Current Acquisitions | Actual * | Selection Method | Actual * | Performer | Actual * |
|---|---|---|---|---|---|
| Cooperative Agreements | 0% | Full & Open Competition | 100% | Industry | 100% |
| Cost Reimbursable | 77% | Sole Source | 0 | Government | 0% |
| Fixed Price | 23% | | 100% | NASA Intramural | 0% |
| Grants | 0% | | | University | 0% |
| Other | 0% | Sci Peer Review | 0% | Non Profit | 0% |
| * as % of FY02 direct procurement | 100% | * as % of FY02 direct procurement | | * as % of FY02 direct procur | 100% |

| Future Acquisitions - Major | Selection | Goals |
|---|---|---|
| 1. Space Comm. Operations | Dec '03 | 100% Full & Open comp., 15% Small business |
| 2. RPT Consolidated Test Operations Contract (TOC). | July '03 | 100% Full & Open comp., 15% Small business |

## AGREEMENTS

*Internal: Rocket Propulsion Test Management (RPT) Board (Intra-Center).* **Changes since FY03 Pres. Budget: None.**
*External: Three NASA & DoD Memorandums of Agreement for increased efficiencies between agencies.*

## INDEPENDENT REVIEWS

| Types of Review | Performer | Last Review | Next Revie | Purpose |
|---|---|---|---|---|
| (RPT) Program Review | PIMC | Sep '02 | Dec '02 | Rocket Propulsion Testing quarterly review |
| (Space Comm) Assessment | Msn Ass. Off. | 2002 | - | Assess TDRS-J spacecraft readiness |
| (Space Comm) Audit | Insp. Gen. | 2002 | - | Review program management |

## BUDGET

| Budget Authority ($ in millions) | FY02 | FY03 | FY04 | Comments |
|---|---|---|---|---|
| FY 2004 President's Budget | 600.9 | 238.7 | 343.6 | |
| Space Communications | 481.8 | 117.5 | 124.8 | |
| TDRS Continuation [non-add] | | [16.5] | [6.2] | |
| Payloads | 57.0 | 51.7 | 76.2 | |
| ELV | 34.3 | 35.8 | 65.8 | |
| Rocket Test | 27.8 | 27.9 | 62.3 | |
| Miscellaneous | 0.0 | 5.8 | 14.5 | |
| Changes since FY 03 Pres. Budget | - | +5.8 | +23.7 | ***Reason for Change:*** |
| Space Communications | | | +18.0 | Operations, Technology & Standards Program |
| *TDRS Continuation [non-add]* | | *[2.5]* | *[6.2]* | Formulation phase of new TDRS spacecraft |
| Payloads | | | | Delta II Pad (Readjust Payload Carriers and |
| ELV | | | | Realign to ELV (Delta II Pad) |
| Rocket test | | | | |
| Miscellaneous | - | +5.8 | +5.7 | Realign Crew Health & Safety to Space Flt |

| | |
|---|---|
| (yellow) | Indicates budget numbers in Full Cost. |
| (blue) | Indicates changes since the FY 2003 Presidents Budget Submit. |

| THEME: | Space and Flight Support |
|---|---|

## TECHNOLOGY AND ADVANCED CONCEPTS: Advanced Systems Office

### PURPOSE

Data current as of 12/6/2002

| Objectives | | Performance Measures |
|---|---|---|
| 9.5 | Develop innovative approaches and concepts to inform future decisions concerning systems, infrastructures and missions for human and robotic exploration of space. | 4SFS23-25, 4SFS29-30 |
| 10.4 | Define and implement technology investment strategies, including architecture definition, technology maturation and validation, and advanced systems development in support of future human and robotic exploration and development of space. | 4SFS26-30 |

Define and implement investment strategies, including architecture definition, technology maturation and validation and advanced systems development in support of future human and robotic exploration and development of space in collaboration with other Enterprises, the Office of the NASA Space Architect, other Agencies, and other organizations. Define and provide Level 1 requirements related to future human and robotic exploration and development of space to NASA and others pursuing new space capabilities.

### OVERVIEW

The Advanced Systems Office (ASO) is an organization within the Office of Space Flight. Working with other Enterprises and the recently-created NASA Space Architect's Office, the ASO supports the creation and enabling of a multi-Enterprise long-term vision for human and robotic exploration and development of space. The ASO (1) promotes alignment of Enterprise strategic plans. (2) Collects scientific requirements and generates technical and programmatic requirements to assess strategic technology investments and ongoing NASA Programs relevant to the office. (3) Conducts and coordinates advanced concepts analyses and develops new innovative approaches for space exploration. (4) Assesses technology programs and pursues alignment of relevant programs with the NASA Vision and Mission. (5) Identifies and promotes space development opportunities that are consistent with the Vision. (6) Identifies resources and requirements that could be added to an existing activity to yield benefits for more strategic purposes. (7) Serves as the source of studies for incubating the Agency's space exploration technology efforts and decision tools. (8) Manages a small portfolio ofspecific advanced concepts and technologies to cultivate ideas and concepts that could lead to future building blocks of critical capabilities. These activities are conducted wherever possible in collaboration with other organizations.

Go to Project Homepage for more information. NEXT.nasa.gov HEDSAdvSystems.nasa.gov

### PROGRAM MANAGEMENT

Enterprise official is William Readdy, Associate Administrator for Space Flight at HQ. The Headquarters Program Director is John Mankins. The Advanced Systems Office is a newly-created organization. It will operate as a broadly-based cadre of innovators and engineers, lead by a focused team at NASA Headquarters in the Office of Space Flight. The ASO will work in close collaboration with various external organizations, including in particular the NASA Space Architect.

### TECHNICAL COMMITMENT

Data current as of 12/6/2002

This program was formed in early FY03. The baseline is the FY2004 budget.

| Technical Specifications | FY04 President's Budget | Change from Baseline |
|---|---|---|
| Develop studies | Identify concepts & technologies to be developed. | N/A |
| ASO will provide support to the recently created NASA Space Architect's office. | | |

| Schedule | FY04 President's Budget | Change from Baseline |
|---|---|---|
| A schedule is being developed to identify projects. | | N/A |

| THEME: | Space and Flight Support |
|---|---|

# TECHNOLOGY AND ADVANCED CONCEPTS: Advanced Systems Office

## ACQUISITION STRATEGY & PERFORMING ORGANIZATIONS

No major acquisitions are planned. There were no procurements in FY02, and no budget authority.
**Changes since FY03 Pres. Budget: New program.**

| Current Acquisitions | Actual * | Selection Method | Actual * | Performer | Actual * |
|---|---|---|---|---|---|
| Cooperative Agreements | N/A | Full & Open Competition | N/A | Industry | N/A |
| Cost Reimbursable | N/A | Sole Source | N/A | Government | N/A |
| Fixed Price | N/A | | | NASA Intramural | N/A |
| Grants | N/A | | | University | N/A |
| Other | N/A | Sci Peer Review | N/A | Non Profit | N/A |
| * as % of FY02 direct procurement | | * as % of FY02 direct procurement | | * as % of FY02 direct procurement | |

| Future Acquisitions - Major | Selection | Goals |
|---|---|---|
| Annual NASA Research Announcements (NRA) | TBD | 100% of NRA competitive activities will be peer reviewed. |

## AGREEMENTS

*Internal:* Memorandum of Agreement among the Office of Space Science, the Office of Biological and Physical Research, and the Office of Space Flight. establishing the NASA Exploration Team (NEXT).
*External:* None yet created.

## INDEPENDENT REVIEWS

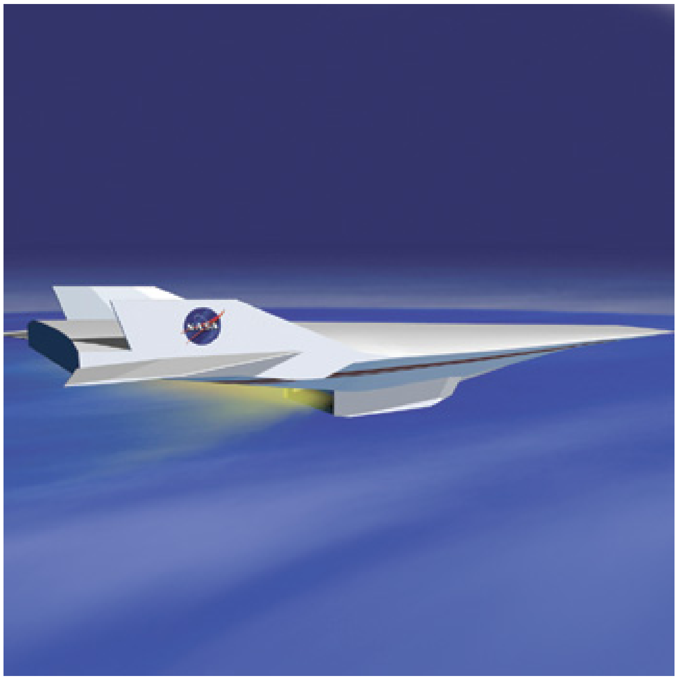
| Types of Review | | Performer | Last Review | Next Review | Purpose |
|---|---|---|---|---|---|
| Technology | | | | | |
| TBD | | | | | |
| Advanced Concepts | | | | | |
| None to date | | | | | |

## BUDGET

| Budget Authority ($ in millions-Full Cost) | FY02 | FY03 | FY04 | Comments |
|---|---|---|---|---|
| FY 2004 President's Budget(Adv. Conc.) | 0.0 | 0.0 | 6.0 | |
| Advanced Systems | 0.0 | 0.0 | 6.0 | |
| Changes since FY 03 Pres. Budget | - | - | +6.0 | ***Reason for Change:*** |
| Advanced Systems | | | +6.0 | New Program |

| | |
|---|---|
| (yellow) | Indicates budget numbers in Full Cost. |
| (blue) | Indicates changes since the FY 2003 Presidents Budget Submit. |

## ENTERPRISE: Aerospace Technology



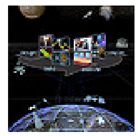
The 12-foot long X-43A hypersonic demonstrator is a scramjet-powered test. Powered by a supersonic combustion ram-jet engine and at a speed of Mach-5, this technology could enable travel to any point on Earth in two-hours, if the ultra high-speed flight proves successful in September 2003 as planned.

**THEMES** (Aeronautics)

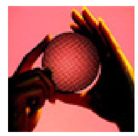
**Aeronautics Technology**

**THEMES** (Crosscutting Technologies)

**Space Launch Initiative**



**Mission and Science Measurement Technology**



**Innovative Technology Transfer Partnerships**

Note: The four Themes of the Aerospace Technology Enterprise are split across the two appropriations. The Crosscutting Technologies can be found here in the Space Flight Capabilities appropriation.

# AEROSPACE TECHNOLOGY

### (CROSSCUTTING TECHNOLOGIES)

## PURPOSE

NASA's Integrated Space Transportation Plan (ISTP) has been formulated by the Agency to ensure safe, affordable, capable, and reliable space transportation systems are provided to support NASA's missions. The Space Launch Initiative (SLI) began as a key component of the ISTP, with a goal to provide the necessary technology development, risk reduction, and systems analysis to enable a NASA decision whether to proceed into full-scale development of a Reusable Launch Vehicle (RLV). The ISTP has been updated based on recent systems analyses, resulting in reprogramming some of the planned SLI funding to help achieve the Agency's International Space Station (ISS), Space Shuttle and science objectives. The SLI is focused on the highest agency space transportation priorities: investing in an Orbital Space Plan (OSP) for assured access to the ISS and maintaining technology investments in space transportation launch technologies through the Next Generation Launch Technology (NGLT) Program in support of a future implementation decision.

The Mission and Science Measurement Technology (MSM) Theme enables revolutionary capabilities through new technology. MSM objectives are to develop science-driven architectures and technology, to create knowledge from scientific data, and to develop capabilities for assessing and managing mission risk. The advanced system concepts, fundamental technologies, and engineering tools developed by MSM are unique to NASA requirements, and are applicable across many classes of missions in multiple Enterprises. These products may require many years to progress from initial concept definition to mission infusion. Three programs have been formulated to accomplish MSM objectives. The Computing, Information, and Communications Technologies (CICT) Program develops breakthrough information and communication systems to increase our understanding of scientific data and phenomena. The Engineering for Complex Systems (ECS) Program develops the capabilities to assess and manage risk in the synthesis of complex systems. The Enabling Concepts and Technologies (ECT) Program defines new system concepts and develops new technologies to enable new science measurements.

Innovative Technology Transfer Partnerships Theme consists of the Technology Transfer Activity and the Small Business Innovation Research (SBIR) / Small Business Technology Transfer (STTR) programs. NASA's strategy is to make technology transfer a normal part of doing business whenever it is developing new technologies and leverage existing mechanisms for technology transfer. In addition the budget provides for a new approach, known as the Enterprise Engine, to partner with venture capital firms and U.S. industry for the development of technologies that can directly contribute to the agency's core research activities, while benefiting private industry. The Technology Transfer Activity contributes to support the Enterprise mission requirements, as well as contributes to improve the Nation's economic strength and quality of life by facilitating innovative use of NASA technology.

## FY 2002 ACCOMPLISHMENTS

Risk reduction and technology development activities conducted by the Second Generation Reusable Launch Vehicle (RLV) program culminated in the analysis and evaluation of competing second-generation reusable launch vehicle architectures and technologies against NASA safety and cost goals. The architecture definition studies focused the available trade space from over 100 candidate architectures to the 15 most promising candidates, identified the key technology drivers for a 2nd Generation RLV, and prioritized the technology development needs. Propulsion system requirements definition and conceptual design studies were performed in support of these architectures. These studies focused the selection of the thrust class and fuel for the booster stage, second stage, and on-orbit auxiliary rocket engines and led to the decision to prioritize further rocket engine work on reusable kerosene engines to support a booster stage of an RLV. Airframe design evaluations included assessments of hot aeroshell/integral tank structures and a demonstration of a self-reacting friction stir welding process for metallic cryogenic tanks. Additional technology development activities were conducted in integrated vehicle health management, flight mechanics, operations, and power systems.

The results of these efforts were evaluated against the Program cost and safety goals. This research indicated that although significant improvements in RLV safety, reliability and cost are possible, large uncertainties surrounding acquisition and operations costs remain, and development of a second generation RLV lacks economic justification for the foreseeable future. As a result, NASA determined that pursuit of a multipurpose Orbital Space Plane that could provide both crew transport and crew return capability would be the best use of agency resources, providing a vehicle of more robust capability and a wider range of potential applications. Investments in space transportation launch technologies will be continued in the Next Generation Launch Technology Program with decision points outlined in the future on whether to implement a new launch vehicle.

A suite of autonomy and collaborative workspace technologies for planetary rovers has been developed and demonstrated in both simulations and field tests. Many of these technologies will be utilized in the upcoming Mars Exploration Rover (MER) mission, and several of the technologies represent key enablers for future planetary exploration missions such as the 2009 Mars Science Laboratory (MSL).

Integrated autonomy software components, including a ground-based task and resources planner, an on-board rover executive for contingency planning, imaging for target acquisition and assessment, and a visual interface for scientists and engineers have demonstrated short traverse instrument placement in a single command cycle. The baseline capabilities of previous rovers required up to three command cycles to perform this type of task. This advance in rover autonomy can significantly reduce the time and resources required, and increase the science return of planetary exploration missions.

An autonomy-architecture has also been demonstrated for the purposes of long-range traverses, which are generally beyond the current capabilities of planetary rovers. This architecture includes a decision layer, which is responsible for robust, dynamic replanning, path-planning, and overall execution, and a functional layer for low-level autonomy capabilities such as locomotion, manipulation, and vision-based navigation. The application of this technology would enable rapid response and replanning based on unexpected events or opportunistic (unplanned) science, which are often inherent in long-range traverse scenarios. Elements of these high-level autonomy capabilities will be tested and evaluated in the upcoming MER mission, with full infusion anticipated for the MSL mission.

Another advanced information technology to be demonstrated on the MER mission is a collaborative workspace to streamline mission operations. The workspace, called MERBoard, allows dispersed scientists, engineers, and mission operators to interactively develop mission plans and monitor mission status. The workspace functions as an electronic bulletin board where the science team can make requests for data and targets to be acquired by the rover. The MERBoard provides a common framework for naming targets and communicating science intentions so that the mission team can work together more efficiently.

Collaborative engineering environments can substantially reduce the time needed to conduct tests and plan mission operations. Instead of the transparencies that were often used during the planning phase of the Pathfinder mission, scientists and engineers can now display images on a 50-inch plasma monitor with touch-screen capabilities. Individuals can mark up images on the screen, which can be viewed in real time on other MERBoards connected to a network.

## THEME DISTRIBUTIONS

| Budget Authority ($ in millions) | FY 2002 | FY 2003 President's Budget, As Amended | FY 2004 President's Budget |
|---|---|---|---|
| Space Launch Initiative | 535.1 | 879.4 | 1,064.6 |
| Mission and Science Measurement Technology | 276.1 | 274.9 | 438.4 |
| Innovative Technology Transfer Partnerships | 163.8 | 146.9 | 169.3 |
| Institutional | 543.1 | 528.2 | -- |
| Total | 1,518.1 | 1,829.4 | 1,672.3 |

Note: For all formats, the FY 2002 column reflects the FY 2002 Congressional Operating Plan dated 9/30/02. The FY 2003 column reflects the FY 2003 Presidents Budget Submit (PBS) as Amended. FY2004 is in full cost.

Indicates budget numbers in Full Cost.

## Space Launch Initiative

This theme ensures safe, affordable, and reliable access to space. New space transportation capabilities are needed to ensure that America continues its leadership in space. The theme gives special emphasis to NASA's unique needs, including crew escape and survival systems. It helps create a more secure world by collaborating with the DOD on critical access to space and hypersonics technologies that support future civil and military aerospace missions. Highlights for FY 2004 include:

**Overall budget**
FY 2004 request is $1,065 million, a $85 million or 7.4 percent decrease from FY 2003 President's Request (full cost):

- $550 million for Orbital Space Plane program to develop a crew return capability from Space Station by 2010 and crew transfer capability atop an expendable launch vehicle by 2012. Funding supports technology demonstrators such as X-37 and advanced design studies.

- $515 million for Next Generation Launch Technology program to meet NASA's future space launch needs. Funding includes advanced kerosene engine development and hypersonic propulsion research and testing.

## Mission and Science Measurement Technologies

This theme is responsible for developing crosscutting technology for a variety of aviation and space applications, such as communications, power and propulsion systems, micro-devices and instruments, information technology, nanotechnology, and biotechnology. These technology advances will have the potential to open a new era in aviation and allow space missions to expand our knowledge of Earth and the Universe. Our technologies are unique to NASA because we focus on space mission applications. Highlights for FY 2004 include:

**Overall budget**
FY 2004 request is $438 million, a $4 million or 0.9 percent increase over FY 2003 President's Request (full cost):

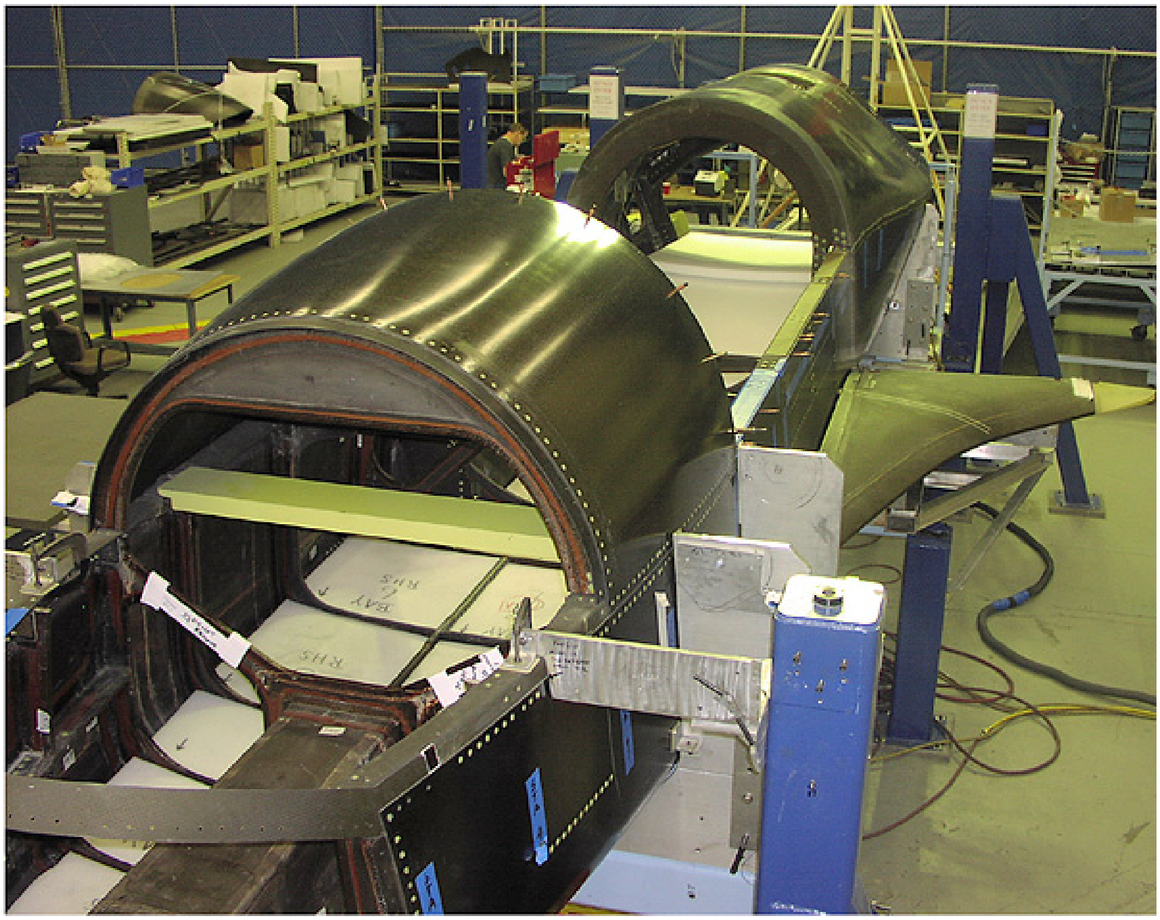
- $233 million for Computing, Information, and Communications Technologies program including intelligent and autonomous systems for science exploration missions.
- $44 for Engineering for Complex Systems program including develop of engineering tools to improve safety and mission success.
- $161 million for Enabling Concepts and Technologies program including development of revolutionary technologies in support of NASA's other enterprises.

## Innovative Technology Transfer Partnerships

Under this theme, we will work to develop partnerships with industry and academia to develop new technology that supports Enterprise programs; commercialize and transfer NASA technology to U.S. industry; and enhance NASA technology and commercial objectives through the Small Business Innovation Research and Small Business Technology Transfer (SBIR/STTR) programs. Highlights for FY 2004 include:

**Overall budget**
FY 2004 request is $169 million, a $14 million or 7.6 percent decrease from FY 2003 President's Request (full cost):

- $5 million for Enterprise Engine being introduced to create partnerships with innovators to sponsor dual use technologies to further NASA's mission and meet our future technology needs.
- $29 million for discontinuing the existing commercial technology promotion efforts and, instead, recompeting and refocusing our technology transfer programs to maximize benefits to the taxpayer.
- $135 million for SBIR/STTR programs.



As a flight demonstration project for the Orbital Space Plane, the X-37 Approach and Landing Test Vehicle (ATLV) is being assembled for flight demonstrations in 2004. This autonomous flight vehicle will incorporate a wide variety of technologies and experiments, generating data for the Orbital Space Plane and future space transportation launch vehicle systems.

# SPACE LAUNCH INITIATIVE

## MAJOR EVENTS IN FY 2004

- Test flight of DART vehicle to demonstrate autonomous rendezvous technology between a chase vehicle and an on-orbit satellite.
- Drop test of X-37 vehicle from carrier aircraft to demonstrate autonomous landing capability as a precursor to a planned orbital demonstration.
- Conceptual design review of Orbital Space Plane with sufficient cost, schedule, technical and risk definition to enable a full-scale development decision.

## THEME: Space Launch Initiative (SLI)

### OVERVIEW

NASA's Integrated Space Transportation Plan (ISTP) has been formulated by the Agency to ensure safe, affordable, capable, and reliable space transportation systems are provided to support NASA's missions. The Space Launch Initiative (SLI) began in 2001as a key component of the ISTP, with a goal to provide the necessary technology development, risk reduction, and systems analysis to enable a NASA decision whether to proceed into full scale development of a 2nd Generation Reusable Launch Vehicle (RLV). The ISTP has been updated based on recent systems analyses, resulting in reprogramming some of the planned SLI funding to help achieve the Agency's International Space Station (ISS), Space Shuttle and science objectives.

The SLI budget is focused on the highest agency space transportation priorities: investing in an Orbital Space Plane (OSP) for assured access to the ISS and maintaining technology investments in space transportation launch technologies through the Next Generation Launch Technology (NGLT) Program in support of a future implementation decision. The OSP Program will develop a new human-crewed vehicle with multi-purpose utility for the Agency. It will initially serve as an ISS Crew Return Vehicle (CRV) launched on an Expendable Launch Vehicle (ELV). It will then evolve into a complement and backup to the Shuttle for taking crew to and from space, and will enable a transition path to future space launch vehicle systems under development in NGLT.

The NGLT Program combines the remaining technology development activities from the former Second Generation RLV with the Space Transfer and Launch Technology Program (3rd Generation Hypersonics) to ensure a coordinated technology development effort. With the FY03 budget amendment, NASA has begun formulation of the OSP and NGLT Programs, transitioning ongoing activities into those programs. NASA will establish the OSP Level 1 requirements in FY03 and initiate concept studies; ongoing flight demonstrators will continue while new flight demonstrators will begin formulation. The NGLT Program will focus on the most critical technology development activities, integrating with the Department of Defense (DoD) through the National Aerospace Initiative (NAI).

| Missions | Goals supported by this theme | Objectives supporting those goals | Reference 2003 Strategic Plan |
|---|---|---|---|
| Understand and Protect Our Home Planet | 3. Create a more secure world and improve the quality of life by investing in technologies and collaborating with other agencies, industry, and academia. | 3.1 | Enhance the nation's security by developing and demonstrating critical access-to-space technologies that benefit NASA, DOD, and other government agencies. |
| Inspire the Next Generation of Explorers | 6. Inspire and motivate students to pursue careers in science, technology, engineering, and mathematics. | 6.1 | Improve student proficiency in science, technology, engineering and mathematics by creating a culture of achievement using educational programs, products and services based on NASA's unique missions, discoveries, and innovations. |
| | 7. Engage the public in shaping and sharing the experience of exploration and discovery. | 7.3 | Increase public awareness and understanding on how research and innovation in aerospace affect and improve the quality of life. |
| Space Flight Capabilities | 8. Ensure the provision of space access and improve it by increasing safety, reliability, and affordability. | 8.1 | Assure safe, affordable, and reliable U.S.-based crew access and return from the International Space Station. |
| | | 8.2 | Improve the safety, affordability and reliability of future space transportation systems. |
| | 9. Extend the duration and boundaries of human space flight to create new opportunities for exploration and discovery. | 9.5 | Create innovative approaches and concepts to inform future decisions concerning systems, infrastructures and missions for human and robotic exploration of space. |

### RELEVANCE

New space transportation capabilities are needed to ensure America continues its important leadership role in space, for education, science, defense, and commercial competitiveness. SLI supports NASA's vision by ensuring safe, affordable, and reliable access to space. The United States is currently the only country with reusable launch vehicle capabilities and has a large investment in the International Space Station. The Space Shuttle is the nation's 1st Generation RLV. Based on 25-year-old technology, the Shuttle fleet is expensive to operate and maintain. New U.S. based access to ISS is needed to meet our commitments and assure the full capabilities of the ISS can be realized and its mission objectives are reached. Future space transportation systems are needed to efficiently serve the long term needs of the Agency for safe, reliable, and affordable access to space and to extend the boundaries of human space flight. SLI helps create a more secure world by collaborating with the Department of Defense on critical access to space and hypersonics technologies that support future civil and military aerospace missions.

# THEME: Space Launch Initiative (SLI)

## RELEVANCE - CONTINUED

### Education and Public Benefits

SLI will benefit the Public by dramatically improving access to space for current and future missions and by assuring access to ISS. Improved access to space will enable NASA's vision to improve life here, to extend life there, and to find life beyond. SLI ensures America's superiority on the space frontier in both conventional rocket and air-breathing hypersonics technology fields.

SLI participates in the Student Launch Initiative to inspire students to pursue careers in science and engineering. SLI also provides research funding to several Universities in support of the SLI goals, including two recently established University Research, Engineering, and Technology Institutes (URETIs) at the University of Maryland and the University of Florida.

SLI gives special emphasis to NASA's unique needs, including crew escape and survival systems, which will not be developed by the private sector without Government funding. Therefore, SLI is an investment in the nation's scientific and technological progress, as well as the U.S. aerospace infrastructure.

## IMPLEMENTATION

This theme is composed of many integrated parts which work together to achieve the SLI goal of providing safe, affordable, capable, and reliable space transportation systems. Those elements are summarized below. The OSP and NGLT Programs have Technology and Advanced Concept information sheets. Separate Development information sheets are provided for the X-37 Approach and Landing Test Vehicle (ALTV) and the Demonstration of Autonomous Rendezvous Technology (DART) Flight Demonstration projects.

SLI is a two-program (OSP and NGLT) theme, with each program comprised of multiple projects. Theme and program responsibility is in the Office of Aerospace Technology (OAT) at NASA Headquarters. The Enterprise Program Management Council (EPMC) has SLI governing responsibility. The Enterprise official is Dr. Jeremiah F. Creedon, Associate Administrator of Aerospace Technology. The Theme Director and Point of Contact is Dr. John R. (Row) Rogacki, Division Director for Space Transportation Technology. The Acting Program Manager for the OSP Program is Mr. Dennis Smith and the Acting Deputy Program Manager is Mr. Dan Dumbacher. The Acting Program Manager for the NGLT Program is Mr. Garry Lyles and the Acting Deputy Program Manager is Mr. Stephen Cook. Both Program Offices and Program Managers are located at NASA's Marshall Space Flight Center (MSFC). Multiple NASA Centers support SLI by providing project management and technical expertise.

| Strategy | Schedule by Fiscal Year<br>01 02 03 04 05 06 07 08 09 10 | Purpose |
|---|---|---|
| 2nd Generations Reusable Launch Vehicle (RLV) Program | | *Note: 2nd Gen RLV was restructured into OSP & NGLT Programs in the FY 2003 NASA Budget Amendment.* |
| Space Transfer & Launch Technology (STLT) *[Hypersonics]* Program | | *Note: SLTL was restructured into OSP & NGLT Programs in the FY 2003 NASA Budget Amendment.* |
| Orbital Space Plane (OSP) Program | FSD | Provide both early Crew Return Vehicle (CRV, FY 2010) and subsequent Crew Transfer Vehicle (CTV, FY 2012) capabilities to support ISS by providing crew rescue, crew transfer, and limited cargo capability. |
| Next Generation Launch Technology (NGLT) Program | FSD Decision | Advance the state-of-the-art in critical and high payoff technologies to enable low-cost, reliable and safe future generations of space transportation systems. |

Tech. & Adv. Concept | Development | Operations

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

## THEME: Space Launch Initiative (SLI)

### STATUS

The FY2002 accomplishments of the Space Launch Initiative provided the space transportation technology information needed to contibute to the update of the Integrated Space Transportation Plan and establish the joint NASA/DOD National Aerospace Initiative plan and roadmap. The activities conducted within the Second Generation Reusable Launch Vehicle Program and the Space Transfer and Launch Technology Programs have been refocused into the Orbital Space Plane and Next Generation Launch Technology Programs beginning in FY2003. Specific FY2002 accomplishments of the Second Generation Reusable Launch Vehicle Program and the Space Transfer and Launch Technology Programs are listed below:

Integrated Space Transportation Plan (ISTP)
- Contributed to an update of the ISTP to better align the space transportation investments with the Agency priorities.
- Conducted a Crew Transfer Vehicle/Crew Rescue Vehicle study, concluding that a multi-purpose Orbital Space Plane that can perform both the crew transfer and crew return functions for the Station is feasible.

Second Generation Reusable Launch Vehicle Program (2GRLV)
- Completed the initial architecture assessments for a 2GRLV, providing risk reduction results and technology readiness assessments that enabled the update of the ISTP.
  - Focused over 100 candidate 2GRLV architecture designs to the 15 most promising candidates.
  - Identified the key technology drivers and prioritized technology development needs.
- Established the Advanced Engineering Environment (AEE) as a state-of-the-art engineering analysis and modeling tool that provides the capability to conduct high fidelity mission analyses with integrated participation across NASA Center offices, collaborative engineering centers, and contractor offices.
- Completed the joint NASA/U.S. Air Force 120-Day Study and follow-on assessments, identifying complementary areas of access-to-space technology development needs.
- Reached sufficient completion of the Demonstration of Autonomous Rendezvous Technology (DART) design to begin its final design review, establishing the design for a critical technology required to support the OSP.
- Completed the X-37 Approach and Landing Test Vehicle (ALTV) systems verification assessment and began the manufacturing and test of the ALTV, preparing for the 2004 flight demonstrations.
- Progressed toward development of booster, second stage, and on-orbit auxiliary rocket engines in support of the 2GRLV, including baselining the Propulsion Systems Requirements and completing a variety of test article design reviews and component tests.
- Progressed toward development of the 2GRLV Vehicle, with various Airframe, Integrated Vehicle Health Management, Operations, and Vehicle Systems activities. This includes investigations of hot aeroshell/integral tank structures, a self-reacting friction stir welding process for metallic tanks, and a demonstration of flight control software.

Space Transfer and Launch Technology Program (STLT)
- Established a joint NASA/DOD National Aerospace Initiative Hypersonic Science and Technology Plan and Roadmap to guide investments in this field. Continued implementing NASA's responsibilities for this plan.
- Officially established the Rocket Based Combined Cycle (RBCC), X-43C, and Turbine Based Combined Cycle (TBCC) projects.
- Baselined the RBCC Requirements Specification for the Integrated System Test of an Air Breathing Rocket (ISTAR).
- Demonstrated advanced adhesives for non-autoclave composite processing, resulting in potentially significant manufacturing cost reduction and design improvements for space transportation systems.
- Established the requirements for the X-43C Flight Demonstrator, allocating requirements down to the component level, and began the preliminary design of the Ground Test Engine.
- Conducted an independent cost evaluation of the three Hypersonic propulsion technology system demonstrations, including an RBCC engine, a TBCC engine, and a scramjet engine integrated with a flight vehicle.
- Established two University Research, Engineering and Technology Institutes (consortia led by the University of Maryland and the University of Florida) to provide research funding in support of space transportation goals.

## THEME: Space Launch Initiative (SLI)

### PERFORMANCE MEASURES

| Annual Performance Goals | |
|---|---|
| | **OUTCOME:** A well managed program in accordance with Agency implementing strategies. (NGLT and OSP) |
| 4SLI1 | Each Development project will complete its current phase within 10% of total life-cycle cost. |
| 4SLI2 | The Theme will distribute at least 80% of its allocated procurement funding to competitively awarded contracts, |
| 4SLI3 | The Theme will complete all of its milestones within 10% of its baseline schedules. |
| **8.1.1** | **OUTCOME:** An Orbital Space Plane that provides safe, affordable and reliable access to and from the International Space Station (ISS). (OSP) |
| 4SLI4 | The OSP Program Plan will be approved and the OSP Level 2 Requirements will be established and approved. |
| 4SLI5 | A conceptual design of the Orbital Space Plane will be completed with sufficient cost, schedule, technical, and risk definition to enable a full-scale development decision. |
| 4SLI6 | The X-37 Approach and Landing Test Vehicle will be certified for flight demonstration, establishing it as a test platform for technology demonstrations supporting the OSP. |
| 4SLI7 | The Demonstration of Autonomous Rendezvous Technology flight article will be certified for flight demonstration, establishing it as a test platform for demonstrating key technologies required to enable an autonomous (no pilot in the loop) approach of an OSP to the International Space Station. |
| **8.2.1** | **OUTCOME:** Technology development and risk reduction results that open up the Nation's access to space by demonstrating substantial improvements in safety, reliability, and cost as compared to current space transportation systems. (NGLT) |
| 4SLI8 | The Next Generation Launch Technology (NGLT) Program Plan will be approved, aligning the Program implementation approach with the Space Transportation strategic objectives. |
| 4SLI9 | The preliminary design of a reusable hydrocarbon prototype rocket engine will be completed, demonstrating the design's applicability to a reusable launch vehicle. |
| 4SLI10 | A LOx/LH2 full flow staged combustion engine cycle will be operationally demonstrated to determine its applicability to a reusable launch vehicle. |
| 4SLI11 | The preliminary design of a Rocket Based Combined Cycle (RBCC) ground testbed will be completed, paving the way toward ground demonstration of a hypersonic air-breathing propulsion system. |
| 4SLI12 | The preliminary design of a Mach 4 ground turbine testbed will be completed, leading to the development of the primary element of a turbine-based combined-cycle hypersonic air-breathing propulsion system. |
| 4SLI13 | The fabrication of the X-43C Mach 5 Multi-Module Flowpath Propulsion Demonstrator will be completed, enabling the ground demonstration of a hydrocarbon dual-mode scramjet powered vehicle applicable for a reusable launch vehicle. |
| 4SLI14 | The testing and analysis of a light-weight ceramic composite cooled panel in a scramjet test article will be completed, demonstrating a critical propulsion technology needed for development of an air-breathing reusable launch vehicle. |
| 4SLI15 | The design and fabrication of a Mach 15 hypersonic scramjet model platform will be completed, leading to the demonstration of a scramjet engine at high Mach number. |
| **9.5.3** | **OUTCOME:** An established space transportation investment strategy that is responsive to the Agency's science-driven missions. (NGLT) |
| 4SLI16 | The systems assessment of the Next Generation Launch Technology needs, priorities, and technical performance metrics will be completed, providing an integrated roadmap for space launch technology investments. |
| **3.1.2** | **OUTCOME:** An established partnership between NASA and DoD to ensure space technology investments are fully leveraged. (NGLT) |
| 4SLI17 | The DoD responsive space lift requirements as defined by the Analysis of Alternatives process will be assessed to determine the potential and priorities for leveraged technology investments that support both NASA and DoD needs. |
| **6.1.1** | **OUTCOME:** Kindergarten through graduate students will be more proficient in science, technology, engineering, and mathematics (STEM). (NGLT and OSP) |
| 4SLI18 | An instructional video program and standards-based lesson guide highlighting applications of science, technology, engineering and mathematics will be produced for the 'NASA CONNECT" series to help student proficiency in these technical fields. |
| **7.3.1** | **OUTCOME:** Increase public awareness and appreciation of the benefits made possible by NASA research and innovation in aerospace technology. (NGLT and OSP) |
| 4SLI19 | Space transportation technical exhibits will be sponsored for at least five events reaching over 50,000 participants to improve public appreciation of the ongoing activities and benefits of NASA's space transportation research and technology development efforts. |

### INDEPENDENT REVIEWS

| Types of Review | Performer | Last Review | Next Review | Purpose |
|---|---|---|---|---|
| Relevance | ATAC | Nov-02 | Feb-03 | Serve as an independent panel for the Office of Aerospace Technology Review programs/projects, reporting to the NAC and the Adminstrator. |
| Quality Review | National Academy | -- | 2004/2007 | Assess the technical quality of research & technology work being performed. |

## THEME: Space Launch Initiative (SLI)

### BUDGET

| Budget Authority ($millions) | FY02 | FY03 | Chng * | FY04 | Comments |
|---|---|---|---|---|---|
| **Space Launch Initiative (Technology)** | **535.1** | **879.4** | **185.3** | **1,064.7** | |
| 2nd Generation Reusable Launch Vehicle | 465.4 | 0.0 | 0.0 | 0.0 | SLI refocused from 2nd Gen RLV and STLT in FY03 NASA Budget Amendment to OSP & NGLT Programs contained in FY03 NASA Budget Amendment. |
| Space Transfer & Lanuch Technology | 69.7 | 0.0 | 0.0 | 0.0 | |
| Orbital Space Plane (OSP) Program | 0.0 | 295.7 | 254.5 | 550.2 | |
| Next Generation Launch Technology (NGLT) Program | 0.0 | 583.7 | -69.2 | 514.5 | |

Indicates budget numbers in Full Cost.

Indicates changes since the FY 2003 Presidents Budget Submit.

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

**THEME:** Space Launch Initiative

## TECHNOLOGY AND ADVANCED CONCEPTS: Orbital Space Plane (OSP) Program

### PURPOSE

| Objectives | Reference 2003 Strategic Plan | Performance Measures |
|---|---|---|
| 6.1 | Improve student proficiency in science, technology, engineering and mathematics by creating a culture of achievement using educational programs, products and services based on NASA's unique missions, discoveries and innovations. | 4SLI18 |
| 7.3 | Increase public awareness and understanding of how research and innovations in aerospace technology affect and improve the qualiy of life. | 4SLI19 |
| 8.1 | Assure safe, affordable, and reliable U.S.-based crew access and return from the ISS. | 4SLI1 - 4SLI7 |

The OSP Program Goal is to provide both early Crew Return Vehicle (CRV, FY 2010) and subsequent Crew Transfer Vehicle (CTV, FY 2012) capabilities to support ISS by providing crew rescue, crew transfer, and limited cargo capability. The Orbital Space Plane (OSP) Program will develop a new vehicle that will provide a multi-purpose utility for the Agency. It will start as a crew return vehicle, launched on an Expendable Launch Vehicle (ELV). Its initial role will be to provide a crew return capability from the ISS by approximately 2010. It will evolve into a complement and backup to the Shuttle for taking crew into space, and will enable a transition path to future reusable launch vehicle systems. The OSP Program will preserve the opportunity to support crew transport to and from space by 2012.

### OVERVIEW

The OSP Program of the SLI Theme contains two elements: (1) Technology and Demonstrations, and (2) Design, Development, and Production. The Design, Development, and Production element of the OSP Program began the formulation phase in FY03. Per NPG 7120.5A Guidelines, the Formulation Phase will be utilized to establish the Program schedule and budget plans. The current budget planning is based on formulation concept studies being conducted in FY03 and FY04, preliminary design activities conducted in FY04 and FY05, a System Design Review (SDR) in FY04, and a Preliminary Design Review in FY05. A decision whether to enter into implementation (proceed with the Full Scale Development) of the OSP is scheduled to be made at the end of FY04 following the SDR, completion of the Non-Advocate Review (NAR), and completion of an Independent Cost Review including a Cost Analysis Requirements Document (CARD). At that point, a decision to proceed will result in the OSP Program transitioning from Formulation to Implementation.

The objective of the Technology and Demonstrations program element is to provide the necessary flight demonstrations and technology development activities to enable the OSP development. There are four flight demonstrators currently planned:

1. X-37 Approach and Landing Test Vehicle (ALTV). The purpose is to validate thermal effects during approach & landing (40,000 ft and below) and autonomous approach (no pilot) technology incorporating advanced thermal protection systems and design/ manufacturing techniques. The X-37 ALTV Project is imbedded as a vital portion of the formulation phase OSP.

2. Demonstration of Autonomous Rendezvous Technology (DART). The purpose is to develop and demonstrate autonomous rendezvous and proximity operations (no pilot) between a chase vehicle (DART) and an on-orbit satellite. The DART Project is is imbedded as a vital portion of the formulation phase OSP.

3. Pad Abort Demonstrator (PAD). The purpose is to develop the fundamental capability to test crew escape technologies in a pad abort situation. This full-scale demonstrator is a re-usable flexible testbed that provides a basis for understanding the environments of crew escape. This testbed will include fully instrumented mannequins to provide data on crew environments during demonstration of propulsion systems, parachute systems, orientation and landing techniques, and external aeroshell configurations. The PAD vehicle will be adaptable to test additional maturing crew escape technologies to meet the program goals for crew safety. The PAD Project began the formulation phase in FY03. The current budget planning is based on three demonstration tests in CY2005 and four demonstration tests in CY2006.

*Continued on Next Page*

## OVERVIEW (Continued)

**Continued from Prior Page**

4. X-37 Orbital Vehicle. The purpose is to provide a versatile technology demonstrator platform on which to mature, through demonstration, critical technologies required by future space transportation systems. It will validate ascent, on-orbit, and re-entry environments incorporating a broad range of technologies including autonomous (no pilot) approach and landing, advanced guidance and navigation, advanced thermal protection systems and power distribution systems, and streamlined flight operations. The Project began the formulation phase in FY03. The current budget planning is based on a Preliminary Design Review (PDR) in CY 2004, a Critical Design Review (CDR) in early 2005, and an orbital flight test in CY 2006.

## PROGRAM MANAGEMENT

The Aerospace Technology Enterprise Program Management Council (EPMC) has NGLT governing responsibility. The NASA Enterprise official is Dr. Jeremiah Creedon, Associate Administrator (AA) for Aerospace Technology. The Theme Director is Dr. John Rogacki, Division Director for Space Transportation Technology. The acting OSP Program Manager is Mr. Dennis Smith and the acting OSP Deputy Program Manager is Mr. Dan Dumbacher.

## TECHNICAL COMMITMENT

The baseline for this technical commitment is the FY03 budget amendment.

| Technical Specifications | FY04 President's Budget | Change from Baseline |
|---|---|---|
| Specific Technical Specifications are TBD for OSP Program: they will be established during the early part of the Program Formulation Phase. X-37 and DART Technical Specifications are provided on their Development sheets. | | |

| Schedule | FY04 President's Budget | Change from Baseline |
|---|---|---|
| **OSP Development:** | | |
| Conduct Mission Baseline Review | Jan-03 | New |
| Complete System Requirements Review | Dec-03 | New |
| Complete OSP Phase A Concept Studies - System Design Review **(1)** | Jul-04 | New |
| OSP Full Scale Development Decision **(1)** | Sep-04 | New |
| Complete Preliminary Design Review **(1)** | May-05 | New |
| **X-37 ATLV:** | | |
| ALTV Structural Proof Test | Jul-03 | -- |
| ALTV Roll-out | Jan-04 | -- |
| Complete Captive Carry Tests | Jun-04 | -- |
| Conduct Drop Test | Aug-04 | -- |
| **DART Demonstrator:** | | |
| System Pre-ship Review | Oct-03 | -- |
| Launch | Apr-04 | -- |
| Post-Flight Report Complete | May-04 | -- |
| **X-37 Orbital Vehicle:** | | |
| Conduct System Definition Review | Jul-03 | New |
| Conduct Preliminary Design Review | FY 2004 Q2 | New |
| Conduct Critical Design Review **(1)** | 2005 | New |
| Perform Orbital Flight Test **(1)** | 2006 | New |
| **Pad Abort Demonstrator (1):** | | |
| Conduct initial demonstration tests | 2005 | New |
| Conduct second stage of demonstration tests | 2006 | New |
| **(1) Schedule is preliminary pending results of formulation activities** | | |

## ACQUISITION STRATEGY & PERFORMING ORGANIZATIONS

The current acquisition strategy uses the existing SLI architecture contractors to conduct OSP concept studies. Free and open competitive procurements are planned for the follow-on design, development, and procurement of the OSP. Free and open procurements were used for the flight demonstration projects. The X-37 Orbital Vehicle and PAD contracts were awarded as a result of the NRA 8-30 Cycle II NRA competitive announcement that occurred during 2002.

**THEME:** Space Launch Initiative

## TECHNOLOGY AND ADVANCED CONCEPTS: Orbital Space Plane (OSP) Program

### ACQUISITION STRATEGY & PERFORMING ORGANIZATIONS - CONTINUED

**Changes since FY03 Pres. Budget:**

- The acquisition strategy for OSP development is a revision to the acquisition strategy resulting from the change in program direction to focus development on the Orbital Space Plane.
- The DART Project has no acquisition strategy changes since the FY03 President's Budget.
- The X-37 Project baseline was changed to incorporate the selection of the X-37 Orbital Vehicle as part of NRA 8-30 Cycle II NRA selections. The cooperative agreement that had been in effect is being closed out with a new cost plus award fee/incentive fee contract to execute the entire X-37 project, including both the ALTV and Orbital Vehicle.
- The PAD contract has been awarded as a result of NRA 8-30 Cycle II selections in FY02.

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

| Future Acquisitions - Major | Selection | Goals |
|---|---|---|
| 1. Restructure SLI architecture contracts (1) | FY 2003 Q1 | |
| 2. Award new Flight Demonstrator contracts (1) | FY 2003 Q1 | 100% Full & Open Competition - NRA 8-30 Cycle II |
| 3. Conduct OSP Preliminary Design (2) | FY 2004 | 100% Full & Open Competition |

### AGREEMENTS

***Internal:*** The Program is not dependent on other NASA activities outside of the control of the Associate Administrator of the Office of Aerospace Technology (Code R).

***External:*** The X-37 Project is dependent on the Air Force for range activities - Technical Task Agreements (TTA).

**Changes since FY03 Pres. Budget:** No changes in internal/external agreements.

### INDEPENDENT REVIEWS

| Types of Review | Performer | Last Review | Next Review | Purpose |
|---|---|---|---|---|
| Relevance | ATAC | Nov-02 | Feb-03 | Independent panel reporting to the NAC and the Adminstrator. |
| Performance | ERAT | Mar-02 | Nov-02 | Independent expert, assessments, and studies for intent. |
| Performance | IPAO IRT | -- | 2004 | Conduct NAR to review the analysis, definition, development, and operations for Full Scale Development decision. |
| Performance | TBD | -- | 2004 | Independent cost assessment of the OSP including an emphasis on the X-37. |
| Performane | IPAO IRT | -- | 2006 & on | Independent annual review and assessment of program technical objectives within cost. |

## BUDGET

| Budget Authority ($millions) | FY02 | FY03 | FY04 | Comments |
|---|---|---|---|---|
| FY 2004 President's Budget (Technology) | **0.0** | **295.7** | **550.2** | SLI refocused from 2nd Gen RLV and STLT in FY03 NASA Budget Amendment to OSP & NGLT Programs contained in FY03 NASA Budget Amendment. |
| Design & Integration | 0.0 | 75.4 | 324.2 | |
| Technology & Demonstations | 0.0 | 220.3 | 226.0 | |
| *X-37 Approach & Landing Test Vechicle (ALTV)* | *0.0* | *177.6* | *178.0* | |
| *Demonstration of Autonomous Rendezvous Technology (DART)* | *0.0* | *19.7* | *18.0* | |
| *PAD - Launch Pad, Crew Excape Demonstration* | | *23.0* | *30.0* | |
| **Changes since FY 03 Pres. Budget** | **+0.0** | **+0.0** | **+108.2** | ***Reason for Changes:*** *increase for full cost implications.* |
| **Undefined Orbital Space Plan (in FY03 Budget Amendment)** | **+0.0** | **-295.7** | **-442.0** | **Define Projects within OSP (off-set to show detail below).** |
| Design & Integration | +0.0 | +75.4 | +324.2 | *1st Time to show this level of detail within Orbital Space Plane.* |
| Technology & Demonstrations | | | | *1st Time to show this level of detail within Orbital Space Plane.* |
| * *X-37 Approach & Landing Test Vechicle (ALTV)* | *+0.0* | *+177.6* | *+178.0* | *FY02 Budget was reflected in 2nd Generation RLV Project. FY03 is 1st time to show this level of detail within OSP Technology & Demonstrations.* |
| *Demonstration of Autonomous Rendezvous Technology (DART)* | *+0.0* | *+19.7* | *+18.0* | *1st Time to show this level of detail within OSP Technology & Demonstrations.* |
| *PAD - Launch Pad, Crew Excape Demonstration* | | *+23.0* | *+30.0* | *1st Time to show this level of detail within OSP Technology & Demonstrations.* |

Indicates budget numbers in Full Cost. (yellow)
Indicates changes since the FY 2003 President's Budget Submit. (blue)

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

* The X-37 reflected in FY2003 President's Budget was an X-37 Orbital Vehicle, this X-37 is a Approach & Landing Technology Vehicle (not the same project).

| THEME: | Space Launch Initiative (SLI) |
|---|---|
| **TECHNOLOGY AND ADVANCED CONCEPTS:** | Next Generation Launch Technology (NGLT) Program |

## PURPOSE

| Objectives | | Reference 2003 Strategic Plan / Performance Measures |
|---|---|---|
| 3.1 | Enhance the nation's security by developing and demonstrating critical access-to-space technologies that benefit NASA, DOD, and other government agencies. | 4SLI17 |
| 6.1 | Improve student proficiency in science, technology, engineering and mathematics by creating a culture of achievement using educational programs, products and services based on NASA's unique missions, discoveries and innovations. | 4SLI18 |
| 7.3 | Increase public awareness and understanding of how research and innovations in aerospace technology affect and improve the qualiy of life. | 4SLI19 |
| 8.2 | Improve the safety, affordability and reliability of future space transportation systems. | 4SLI1-3, 4SLI8-15 |
| 9.5 | Create innovative approaches and concepts to inform future decisions concerning systems, infrastructures and missions for human and robotic exploration of space. | 4SLI16 |

The Next Generation Launch Technology Program will advance the state-of-the-art in critical and high payoff technologies to enable low-cost, reliable and safe future generations of space transportation systems. All elements within NGLT seek to advance enabling technologies that are currently not technically or economically feasible. The missions include safe, routine, earth-to-orbit transportation to enable NASA's exploration and development of space, enable new commercial space markets, and enhance the Nation's security through aerospace technology development.

## OVERVIEW

The Next Generation Launch Technology (NGLT) program of the SLI theme contains three elements: (1) Propulsion Technology, (2) Launch Systems Technology and (3) Systems Engineering and Analysis. The NGLT has resulted from the consolidation of the remaining technology development activities from the former Second Generation RLV with the Space Transfer and Launch Technology Program (3rd Generation Hypersonics) to ensure a coordinated technology effort. The goal of the Next Generation Launch Technology program is to develop technology to make next generations of launch systems safer, more affordable and more reliable, in support of the Agency's Integrated Space Transportation Plan RLV decision points.

The *Propulsion Technology* element reduces the most critical, highest payoff technology risks associated with future launch propulsion systems. The core projects in the Propulsion Technology program element will be the development of a LOX/Kerosene rocket booster engine to prototype testing, a Rocket Based Combined Cycle (RBCC) ground engine testbed and a Turbine Based Combined Cycle ground engine testbed. In addition, cross-cutting propulsion component and subsystem technologies will be developed which support these testbeds and operational engine needs.

The *Launch Systems Technology* element reduces the most critical, highest payoff technology risks associated with future launch vehicle systems. This includes aerosciences, propulsion/airframe integration, structures and materials, vehicle subsystems, integrated vehicle health management and operations. The current core project in the Launch Systems Technology program element is the flight demonstration of dual-mode scramjet propulsion system integrated with an airframe (X-43C). The remaining technology investments are being reevaluated during the formulation phase to determine the balance of priorities.

The *Systems Engineering and Analysis* element will provide systems analyses to integrate the activities both within the NGLT and within the SLI Programs. These analyses will focus and guide the technology investments.

## PROGRAM MANAGEMENT

The Office of Aerospace Technology (OAT) Enterprise Program Management Council (EPMC) has NGLT governing responsibility. The NASA Enterprise official is Dr. Jeremiah Creedon, Associate Administrator (AA) for Aerospace Technology. The Theme Director is Dr. John Rogacki, Division Director for Space Transportation Technology. The acting OSP Program Manager is Mr. Garry Lyles and the acting OSP Deputy Program Manager is Mr. Stephen Cook.

## TECHNICAL COMMITMENT

The baseline for this technical commitment is the FY03 budget amendment. The formulation phase of the NGLT Program will be used to assess the long-term technology funding priorities. The baseline technical commitments below may change based on this assessment.

| Technical Specifications | | FY04 Budget Submit FY02 | FY03 | FY04 | | Change from Baseline |
|---|---|---|---|---|---|---|
| LOX/RP Prototype Engine Development. Deliver a prototype test engine and database | TRL | 4 | 4 | 4 | 5 | -- |
| | $M | | 171.0 | 97.5 | | -- |
| Current TRL status relative to FY03 plan (R/Y/G/B) | | | | | Planned TRL status to FY03 plan | |

## TECHNICAL COMMITMENT - CONTINUED

| Technical Specifications | | FY04 President's Budget FY02 | FY03 | FY04 | | Change from Baseline |
|---|---|---|---|---|---|---|
| LOX/H2 Integrated Powerhead Demo. | TRL | 4 | 4 | 5 | | -- |
| | $M | | 8.1 | 2.5 | | -- |
| RBCC: Deliver a test database that verifies operability of a reusable rocket based combined cycle engine in Air-augmented rocket, Ramjet and Scramjet modes in wind tunnel conditions equivalent to Mach 0-7 flight vehicle operation. | TRL | 3 | 3 | 3 | 4 | -- |
| | $M | | 28.5 | 31.9 | | -- |
| TBCC: Deliver a test database that verifies operability, performance, and durability of a turbine based combined cycle engine in wind tunnel conditions equivalent to Mach 4 flight vehicle operation. | TRL | 3 | 3 | 3 | 3 | -- |
| | $M | | 19.9 | 24.6 | | -- |
| X-43C: Deliver a test database and validated design tools for Mach 5 - 7 scramjet powered vehicle in flight. | TRL | 3 | 3 | 3 | 4 | -- |
| | $M | | 25.4 | 34.5 | | -- |
| System Engineering and Analysis: Deliver an annual update of technology priorities, technical performance metrics, and progress towards program objectives. | TRL | N/A | N/A | N/A | N/A | -- |
| | $M | | 34.9 | 30.3 | | -- |

Current TRL status relative to FY03 plan (R/Y/G/B) Planned TRL status to FY03 plan

| Schedule | FY04 Budget | Chng Base | Schedule | FY04 Budget | Chng Base |
|---|---|---|---|---|---|
| **RBCC:** | | | **TBCC:** | | |
| Complete Concept Design | 2003 | -- | Define Systems Requirements | 2003 | -- |
| Complete Preliminary Design | 2004 | -- | Complete High Speed Fan Design | 2004 | -- |
| Complete Direct Connector Combustor Rig Test | 2004 | -- | Complete Preliminary Design | 2004 | -- |
| Complete Design | 2005 | -- | Complete Augmentor Rig Test | 2005 | -- |
| Conduct ground test of Air-Augmented Rocket | 2007 | -- | Complete Design | 2006 | -- |
| Conduct ground tests of Ramjet and Scramjet Engines | 2008 | -- | Complete Engine #1 Test | 2008 | -- |
| **X-43C:** | | | **LOX/RP Engine:** | | |
| Define Systems Requirements | 2003 | -- | Complete Concept Design | 2003 | -- |
| Complete Mach 5 Multi-Module Flowpath Propulsion Demonstrator Test Design | 2004 | -- | Complete Preliminary Design | 2003 | -- |
| Complete Preliminary Design | 2005 | -- | Conduct Interim Design Review | 2004 | -- |
| Conduct Mach-5 Multi-Module Flowpath Propulsion Demonstrator Ground Test | 2005 | -- | Complete Final Prototype Design | 2005 | -- |
| Complete Design | 2006 | -- | Complete Powerhead Test | 2006 | -- |
| Accept Delivery of Demo. Vehicle | 2007 | -- | Complete Breadboard Thrust Chamber | 2007 | -- |
| Conduct X-43C Flight Test | 2008 | -- | Complete Prototype Engine Test | 2007 | -- |

## ACQUISITION STRATEGY & PERFORMING ORGANIZATIONS

Due to the broad nature of the Next Generation Launch Technology Program, a variety of acquisition instruments will be employed. Procurements will be in accordance with approved procedures at the implementing Centers. Free and open competitive procurements will be used to the maximum extent possible. The NGLT acquisition strategy employs both NASA in-house and contracted activities. Because of the experimental nature of the NGLT program, emphasis will be placed on streamlined procurement approaches. The program will use existing contracts, NRA's, Cooperative Agreements, Space Act Agreements, purchase orders, and support agreements to the greatest extent possible. Multiple procurements are anticipated annually. The acquisition process will allow for government-only, industry/university-only, and government-industry/university teams to bid for NGLT technology tasks. Government-only tasks will use a separate, internal, government selection process. Innovative means of data sharing will be encouraged in order to ensure the fastest possible transition of technology to the end users. The U. S. Government will retain all data rights from Government funded activities.

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

**THEME:** Space Launch Initiative (SLI)

**TECHNOLOGY AND ADVANCED CONCEPTS:** Next Generation Launch Technology (NGLT) Program

## ACQUISITION STRATEGY & PERFORMING ORGANIZATIONS

| Current Acquisitions | Actual * | Selection Method | Actual * | Performer | Actual * |
|---|---|---|---|---|---|
| Cooperative Agreements | --% | Full & Open Competition | --% | Industry | --% |
| Cost Reimbursable | --% | Sole Source | --% | Government | --% |
| Fixed Price | --% | | --% | NASA Intramural | --% |
| Grants | --% | | | University | --% |
| Other | --% | Sci Peer Review | --% | Other | --% |
| * as % of FY02 direct procurement | --% | * as % of FY02 direct procurement | | * as % of FY02 direct procurement | --% |

| Future Acquisitions - Major | Selection | Goals |
|---|---|---|
| 1. X-43C Flight Demonstrator Vehicle | Summer 03 | Full and open Competition. |
| 2. Propulsion R&T | Summer 03 | Fully competed. 2 competitions - internal and external (NRA). |
| 3. Prototype Engine | Summer 04 | Full and open competition for the LOx/RP engine prototype. |

Note: Other acquisitions are likely as a result of the systems analyses to be conducted during NGLT formulation.

## AGREEMENTS

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

*External:* The programs within NGLT will pursue cooperation with the DoD, Air Force Research Laboratory (AFRL), and the Department of Energy laboratories, where appropriate. A Memorandum of Understanding currently exists between NASA and the AFRL for the development and delivery of the USAF HyTech engine to NASA for integration into the X-43C Hypersonic Flight Demonstrator. Also, there is an Memorandum of Agreement between the Office of Aerospace Technology (OAT) and the Office of the Director, Defense Research and Engineering (DDR&E) regarding the University of Maryland University Research, Engineering and Technology Institute.

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

## INDEPENDENT REVIEWS

| Types of Review | Performer | Last Review | Next Review | Purpose |
|---|---|---|---|---|
| Relevance | ATAC | Nov-02 | Feb-03 | Serve as an independent panel to the Office of Aerospace Technology. Review programs/projects, reporting to the NASA Advisory Council and Administrator. |
| Performance | IPAO | -- | 2003 | Validate the NGLT's ability to achieve the objectives within cost and schedule through IIR. |
| Performance | IPAO | -- | 2004 | Validate the NGLT's ability to achieve the objectives within cost and schedule through IIR. |
| Quality Review | National Academy | -- | 2004 / 2007 | Assess the technical quality of research & technology work being performed. |

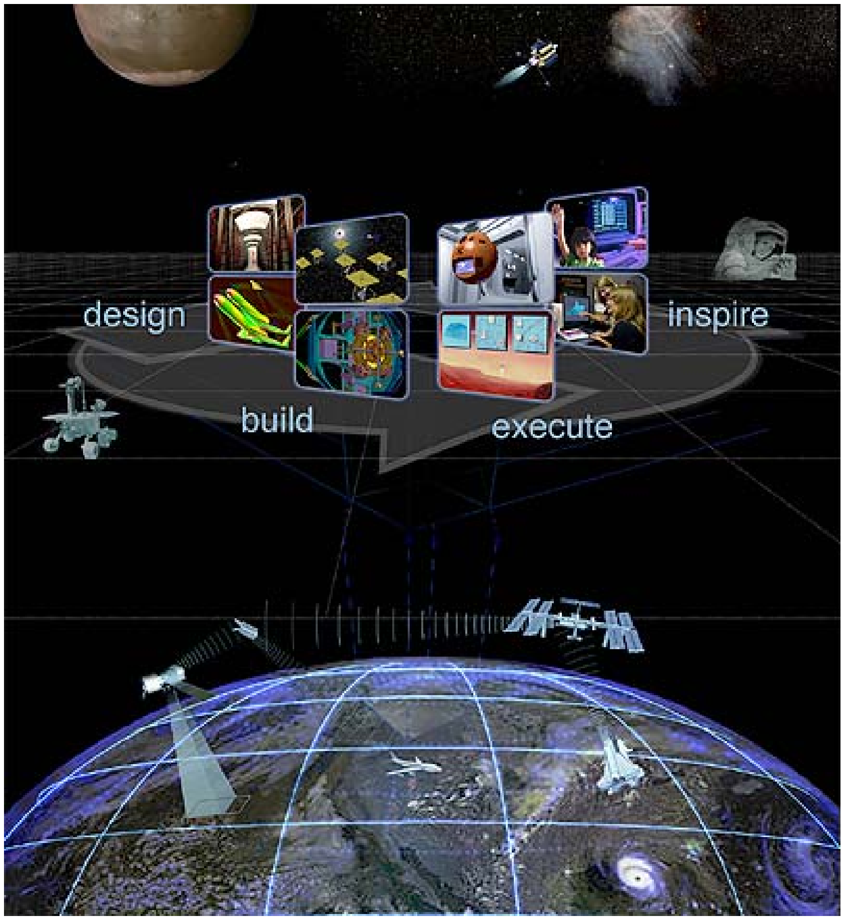
## BUDGET

| Budget Authority ($ in millions) | FY02 | FY03 | FY04 | Comments |
|---|---|---|---|---|
| FY 2004 President's Budget (Technology) | **0.0** | **583.7** | **514.5** | |
| **Changes since FY03 Pres. Budget** | **+0.0** | **+30.7** | **+37.5** | ***Reason for Change:*** |
| Next Generation Lanuch Technology | +0.0 | +30.7 | +37.5 | Agency Offsets & Full Cost Implications |

Indicates budget numbers in Full Cost.

Indicates changes since the FY 2003 Presidents Budget Submit.

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




Mission and Science Measurement Technologies will enable new mission and science discoveries. Research in emerging new fields of study, multi-disciplinary approaches, and the development of powerful new engineering tools will one day change the definition of what is possible.

# MISSION AND SCIENCE MEASUREMENT TECHNOLOGY

## MAJOR EVENTS IN FY 2004

- Demonstrate technologies for millimeter precision formation flying.
- Demonstrate spacecraft communications technologies achieving 1Gbps or greater for near Earth, and 1Mbps or greater for deep space applications.
- Demonstrate lightweight, sub-kilowatt ion engine for small spacecraft.
- Develop prototype workstation that provides capability to identify, track, and trade-off risk.

## THEME: Mission and Science Measurement Technology (MSM)

### OVERVIEW

The Mission and Science Measurement (MSM) Technology Theme enables revolutionary capabilities through new technology. MSM objectives are to develop science-driven architectures and technology, to create knowledge from scientific data, and to develop capabilities for assessing and managing mission risk. The primary customers for MSM technologies are the NASA Enterprises. The advanced system concepts, fundamental technologies, and engineering tools developed by MSM are unique to NASA needs, and are applicable across many classes of missions in multiple Enterprises. These products may require many years to progress from initial concept definition to mission infusion.

Three programs have been formulated to accomplish MSM objectives. The **Computing, Information, and Communications Technologies (CICT) Program** develops breakthrough information and communication systems to increase our understanding of scientific data and phenomena. The **Engineering for Complex Systems (ECS) Program** develops the capabilities to assess and manage risk in the synthesis of complex systems. The **Enabling Concepts and Technologies (ECT) Program** defines new system concepts and develops new technologies to enable new science measurements.

The MSM Theme uses systems analysis to identify high-payoff technologies, and to guide investment decisions across the three MSM programs. Broadly competed peer-reviewed solicitations are used to capture innovative ideas from the research community, to leverage emerging technologies, and to complement NASA capabilities in critical areas. The Technology Executive Board (TEB), which consists of Enterprise technology representatives, advises the MSM Theme on strategic mission needs, relevance of technology development activities, and opportunities for transitioning technology products.

With the FY04 Budget request, MSM will reduce set-up times for collaborative engineering and science simulations; demonstrate autonomy components for space exploration vehicles; develop risk-based design engineering tools for concept development; demonstrate high data rate spacecraft communications technologies for deep space applications; develop miniature *in-situ* sensors for detecting organic materials on planetary surfaces; and demonstrate precision formation flying in a simulation testbed to enable distributed science collection.

| Missions | Goals supported by this theme | Objectives supporting those goals | Reference 2003 Strategic Plan |
|---|---|---|---|
| Inspire the Next Generation of Explorers | 6 - Inspire and motivate students to pursue careers in science, technology, engineering, and mathematics. | 6.1 | Improve student proficiency in science, technology, engineering and mathematics by creating a culture of achievement using educational programs, products and services based on NASA's unique missions, discoveries and innovations. |
| | 7 - Engage the public in shaping and sharing the experience of exploration and discovery. | 7.3 | Increase public awareness and understanding of how research and innovations in aerospace technology affect and improve the qualiy of life. |
| Space Flight Capabilities | 9 - Extend the duration and boundaries of human space flight to create new opportunities for exploration and discovery. | 9.2 | Develop knowledge and technologies to make life support systems self-sufficient and improve human performance in space. |
| | 10 - Enable revolutionary capabilities through new technology. | 10.1 | Improve the capability to assess and manage risk in the synthesis of complex systems. |
| | | 10.2 | Create new system concepts and demonstrate new technologies that enable new science measurements. |
| | | 10.3 | Create breakthrough information and communication systems to increase our understanding of scientific data and phenomena. |

## THEME: Mission and Science Measurement Technology (MSM)

### RELEVANCE

By identifying, developing, and transferring breakthrough technologies that have broad potential to enable new capabilities across many types of systems, the MSM Theme directly addresses NASA's Mission. The MSM Theme contributes to NASA's mission to understand and protect our home planet by developing advanced Earth Science instrument, sensor, communications, autonomy, and data analysis technologies. The MSM Theme contributes to NASA's mission to explore the Universe and search for life by developing advanced power, propulsion, communications, and other spacecraft systems technologies; by developing advanced sensors and instruments with increased sensitivity, spectral coverage, and reliability to enable new scientific measurement capabilities; and by developing intelligent, autonomous, and adaptive technologies for remote exploration. The MSM Theme inspires the next generation of explorers by developing exciting concepts for far-term exploration missions and systems, and by directly supporting educational outreach plans in its visionary technology programs. The MSM Theme develops fundamental technologies as only NASA can, because technologies focus on first-of-a-kind and few-of-a-kind NASA space mission applications; quality and performance requirements usually exceed those of all other potential users; and end-use applications may have no known customer outside NASA.

#### Education and Public Benefits

Public benefits from MSM include new technologies for use in industry, and by the general public through new generations of consumer products. The research will lead to new capabilities lowering the cost of transporting goods and people, as well as increased safety in transportation. Although this research is oriented to helping NASA achieve its objectives, portions of the research are also expected to be used by the Department of Defense, Federal Aviation Administration, Environmental Protection Agency, National Oceanic and Atmospheric Administration, and others.

NASA heavily uses the expertise of academia in this research. This provides educational opportunities to undergraduate and graduate students in our colleges and universities that teach far beyond the methodology of research to encompass exciting new areas of research.

### IMPLEMENTATION

MSM program responsibility is in the Office of Aerospace Technology at NASA HQ. The Agency Program Management Council (PMC) has MSMT governing responsibility. Enterprise official is Jeremiah F. Creedon, Associate Administrator for Aerospace Technology at HQ. Theme Director is Dennis Andrucyk at HQ.

| Strategy | Schedule by Fiscal Year FY02 | FY03 | FY04 | FY05 | Purpose |
|---|---|---|---|---|---|
| Resilient Systems & Operations **(ECS)** | | | | | Enable mission systems that can analyze unexpected events and adjust plans and adapt systems accordingly with minimal human participation. |
| System Reasoning & Risk Management **(ECS)** | | | | | System-wide life-cycle analysis and reasoning to identify and eliminate risks. |
| Knowledge Engineering for Safe Systems **(ECS)** | | | | | Ensure knowledge is captured, integrated, and utilized continuously to improve safety. |
| Advanced Engineering Environments **(ECS)** | | | | | A state-of-the-art engineering capability to dramatically improve business practices and the quality of services and products. |
| IT Strategic Research **(CICT)** | | | | | Research, develop, and evaluate a broad portfolio of fundamental information and bio/nano technologies for computing. |
| Computing, Networking, & Information Systems **(CICT)** | | | | | Provide seamless access to ground-, air- and space-based distributed computing, information, and knowledge to enable NASA missions. |

***Chart Continued on Next Page***

Tech. & Adv. Development Operations

## THEME: Mission and Science Measurement Technology (MSM)

### IMPLEMENTATION (Continued)

| Strategy | Schedule by Fiscal Year (02 03 04) | Purpose |
|---|---|---|
| Space Communications **(CICT)** | Tech. & Adv. 02–04 | Develop space communication technologies required to give NASA scientists pervasive, high data rate access to space assets and the data they acquire. |
| Intelligent Systems **(CICT)** | Tech. & Adv. 02–04 | Enable smarter, more adaptive systems and tools that work collaboratively with humans in a goal-directed manner to achieve the mission/science goals. |
| Energetics **(ECT)** | Tech. & Adv. 02–04 | Develop advanced power and propulsion technologies to enable lower-cost missions with increased capability, and to extend mission reach. |
| Advanced Measurement & Detection **(ECT)** | Tech. & Adv. 02–04 | Develop miniaturized, highly-integrated, and efficient instruments and sensors to provide increased scientific return. |
| Revolutionary Spacecraft Systems **(ECT)** | Tech. & Adv. 02–04 | Develop revolutionary spacecraft systems and architectures to enable distributed science data collection, explore extreme environments, and lower mission costs. |
| Large Space Systems **(ECT)** | Tech. & Adv. 02–04 | Develop concepts for large, ultra-lightweight space structures and apertures to expand mission capabilities, and enable new visions of the Earth and the Universe. |
| Advanced Systems Concepts **(ECT)** | Tech. & Adv. 02–04 | Conceptual studies and systems analysis of revolutionary aerospace system concepts that have the potential to enable new visions for NASA's strategic plans. |
| Space NRAs **(ECT)** | Tech. & Adv. 02–04 | Broadly announced peer-reviewed solicitations to capture innovative ideas from external organizations, to leverage high-payoff emerging technologies, and to complement NASA capabilities in critical areas. |

Tech. & Adv. Development Operations

| Tailoring |
|---|
| No exceptions to NPG 7120.5A have been taken. |

### STATUS

The MSM Theme accomplished the following in the past year:

**Computing, Information, and Communications Technology**

- Demonstrated pilot-in-the-loop redesign of a CRV vehicle during a flight simulation entry.
- Simulated near real time adaptive neural flight and propulsion controls for transport class aircraft.
- Automated the use of geographically-distributed heterogeneous computing resources to generate over 1100 high-fidelity runs for an aerodynamics database for the Liquid Glide-Back Booster concept.
- Delivered a web-based knowledge management system designed to provide insight into mission status and operations during Mars Exploration Rover surface operations.
- Demonstrated an autonomy architecture for planetary exploration rovers.
- Demonstrated space communication link technology operating at 622 Mbps for direct distribution of data to users
- Developed a reliable and reproducible technique to grow a carbon nanotube based inverter logic circuit.
- Demonstrated DNA-based computations on a 20-variable (exponential) problem representing one of the largest problems solved to-date by molecular computers, which have the inherent potential of vast parallelism, exceptional energy efficiency, and extraordinary information density.

**Engineering for Complex Systems**

- Identified software errors in the Space Station Biological Research Project.
- Developed a collaborative, web-based analysis tool supporting the CONTOUR mission mishap investigation Enabling Concepts and Technologies.
- Demonstrated Cryobot Ice Explorer for subsurface sampling of planetary bodies.
- Developed uncooled thermopile IR detectors selected for 2005 Mars Reconnaissance Orbiter atmospheric sounder.

## THEME: Mission and Science Measurement Technology (MSM)

### STATUS (Continued)

**Enabling Concepts and Technologies**

- Demonstrated Cryobot Ice Explorer for subsurface sampling of planetary bodies.
- Developed uncooled thermopile IR detectors selected for 2005 Mars Reconnaissance Orbiter atmospheric sounder.
- Developed prototype MEMS-based microshutter array that was selected for Next Generation Space Telescope Multi-Object Spectrometer.
- Developed 10kW Next Generation Ion Engine that was selected for further development by Code S.
- Developed pulsed plasma thruster that was demonstrated on the Earth Observing-1.
- Demonstrated record 30% efficiency solar array with thin film Fresnel lens concentrators.
- Developed membrane antenna for synthetic aperture radar that was selected for further development by Code Y.
- Demonstrated imaging at 40 microns for proof-of-concept membrane mirror telescope.
- Characterized structural dynamics of a solar sail engineering model in vacuum.
- Developed carbon-nanotube doped polymer film to mitigate spacecraft charging.

### PERFORMANCE MEASURES

| Annual Performance Goals | |
|---|---|
| **6.1.1** | **OUTCOME:** Kindergarten through graduate students will be more proficient in science, technology, engineering, and mathematics (STEM). |
| 4MSM15 | Provide at least 4 products that deliver or facilitate the delivery of NASA science and engineering content into formal and informal educational institutions. Disseminate educational products to at least 1,000 schools, educators, or students. Provide remote access of educational materials into the classroom via advanced information technologies. Support NASA presence at educational workshops, conferences or symposiums. Support development of academic course material in Aerospace Technology. Progress will be validated in FY04 through external evaluation conducted according to accepted professional standards. (CICT, RMCS & ECT) |
| **7.3.1** | **OUTCOME:** Increase public awareness and appreciation of the benefits made possible by NASA research and innovation in aerospace technology. |
| 4MSM16 | Maintain publicly-available websites at the Program and Project levels. Publish at least 10 articles or papers on key innovations. Support at least 2 conferences or exhibits highlighting research in Aerospace Technology. (CICT, RMCS & ECT) |
| **9.2.2** | **OUTCOME:** Develop knowledge and technologies to make life support systems self-sufficient and improve human performance in space. |
| 4MSM1 | Demonstrate ground test of a Mobile Intelligent Vehicle Health Management (IVHM) system for internal spacecraft operations that will provide environmental sensing capabilities and knowledge management services. The Mobile IVHM will perform independent calibration checks for environmental sensors; autonomously replace or substitute for failed environmental sensors; hunt down and isolate gas leaks and temperature problems; and provide a range of crew personal data assistant functions. (RMCS) |
| **10.1.1** | **OUTCOME:** Enable new technologies to identify and reduce mission risk. |
| 4MSM2 | Develop a Prototype Concept Design Risk Workstation that provides the capability to identify, track, and trade-off risk in the conceptual design phase of missions. The workstation will integrate databases, visualization modules, solicitation routines, system simulations, and analysis programs that support an interactive system design process. (RMCS) |
| **10.2.1** | **OUTCOME:** Identify high-payoff mission enabling technologies to guide program investment decisions. |
| 4MSM3 | Develop a process for assessing the system-level benefits of new technologies, and complete technology assessments on 3 representative mission classes selected by the Technology Executive Board. A mission class is a set of missions with similar scientific objectives, such as large space-based astronomical observatories. The technology assessment will be concluded when the mission enabling technologies have been identified, and system-level performance goals for these technologies have been established. (ECT) |
| **10.2.2** | **OUTCOME:** Reduce trip time for interplanetary missions. |
| 4MSM4 | Demonstrate lightweight, sub-kilowatt ion engine for small spacecraft to reduce interplanetary trip time by 30%. (ECT) |
| **10.2.3** | **OUTCOME:** Enable new science measurements. |
| 4MSM5 | Develop bio-molecular probe to detect specific biomarker signature in-vitro for disease detection and astronaut health monitoring. Demonstrate a molecular probe that detects at least one specific biomarker in cells. (CICT) |
| 4MSM6 | Demonstrate > 5% efficiency for 2-micron laser transmitter. State-of-the-art laser transmitters have about 3% efficiency. Higher efficiency will enable smaller, lighter space-based lidar instruments for active sensing of the Earth's atmosphere. (ECT) |
| 4MSM7 | Develop 1,000-element array of superconducting transition edge sensors to enable astronomical imaging in the unexplored submillimeter region of the spectrum. (ECT) |

***Chart Continued on Next Page***

# THEME: Mission and Science Measurement Technology (MSM)

## PERFORMANCE MEASURES

**Annual Performance Goals (Continued)**

4MSM8 Develop miniature chromatography system for separation and detection of organic materials to enable the search for life on other planets. (ECT)

**10.2.4 OUTCOME:** Enable revolutionary spacecraft systems for distributed science collection and lower mission cost.

4MSM9 Demonstrate by simulation millimeter precision formation flying. The simulation will validate sensors and control algorithms needed to enable constellations of spacecraft for distributed science measurements. (ECT)

4MSM10 Develop microspacecraft ground testbed that incorporates micro navigation subsystem, micro thrusters, and multifunctional structure. By integrating miniaturized spacecraft subsystems, the testbed will demonstrate a factor of 2 to 3 reduction in spacecraft mass, which will result in lower mission costs. (ECT)

**10.2.5 OUTCOME:** Increased capabilities to acquire and return scientific data.

4MSM11 Develop critical spacecraft networking technologies. Demonstrate spacecraft communications technologies achieving 1Gbps or greater for near Earth, and 1Mbps or greater for deep space applications. Develop related protocols and software for Internet-like space computing and communications. High bandwidth communications and networking technologies will increase scientific return. (CICT)

4MSM12 Demonstrate in a laboratory environment deployment and rigidization of a jointed inflatable truss to enable modular assembly of large apertures. In-space assembly will enable a factor of 10 increase in aperture size to increase scientific return. (ECT)

**10.2.6 OUTCOME:** Enable intelligent and autonomous systems for science exploration missions.

4MSM13 Complete simulated autonomous science exploration mission - Demonstrate a successful analogue science mission (terrestrial rover or simulated spacecraft) with key autonomy technologies in planning/scheduling, science data priority assignment, system executives, and diagnostic systems, enabling goal-directed systems for science exploration missions. (CICT)

**10.3.1 OUTCOME**: Reduce the time required to design and operate future missions.

4MSM14 Develop collaborative science and engineering technologies for integrated simulation and information management, enabling reductions in set-up and management times for aerospace engineering, science simulations, and mission status awareness of remote exploration missions. Demonstrate standardized protocols and specifications for interoperability of simulation components and heterogeneous data sources; provide visual assembly of workflow components and tools; provide applications-oriented process management; and demonstrate heterogeneous database access technology that can automatically access distributed, heterogeneous data sources. (CICT)

## INDEPENDENT REVIEWS

| Types of Review | Performer | Last Review | Next Review | Purpose |
|---|---|---|---|---|
| Quality | NRC | 6-Jun-02 | 1-Jun-05 | Peer review of technical quality and program content. |
| Relevance | ATAC MSM subcommittee | 4-Sep-02 | 1-Mar-03 | External community reviews program status and plans. |

## COST

| Budget Authority ($millions) | FY02 | FY03 | Chng | FY04 | Comments |
|---|---|---|---|---|---|
| **Mission and Science Measurement (MSM) Technology** | **276.1** | **274.9** | **+163.5** | **438.4** | |
| Enabling Concepts & Technologies (ECT) | 92.8 | 92.9 | +68.1 | 161.2 | Full cost implications |
| Computing, Information & Communications Technology (CICT) | 155.5 | 154.0 | +79.2 | 233.2 | Full cost implications |
| Engineering for Complex Systems (ECS) | 27.8 | 28.0 | +13.0 | 44.0 | Full cost implications |

Indicates budget numbers in Full Cost.

Indicates changes since the FY 2003 Presidents Budget Submit.

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

| | |
|---|---|
| **THEME:** | Mission and Science Measurement Technology |
| **TECHNOLOGY AND ADVANCED CONCEPTS:** | Computing, Information, and Communications Technology (CICT) Program |

## PURPOSE

| Objective | Reference FY 2004 Strategic Plan | Performance Measures |
|---|---|---|
| 6.1 | Improve student proficiency in science, technology, engineering and mathematics by creating a culture of achievement using educational programs, products and services based on NASA's unique missions, discoveries and innovations. | 4MSM15 |
| 7.3 | Increase public awareness and understanding of how research and innovations in aerospace technology affect and improve the qualiy of life. | 4MSM16 |
| 10.2 | Create new system concepts and demonstrate new technologies that enable new science measurements. | 4MSM5, 4MSM11, 4MSM13 |
| 10.3 | Create breakthrough information and communication systems to increase our understanding of scientific data and phenomena. | 4MSM14 |

The CICT Program will research, develop, demonstrate, and infuse advanced computing, information, and communications technologies to allow NASA to accomplish its commitments to the United States taxpayers with greater mission assurance, for less cost, and with increased science return. CICT research and development, as an integral element of the federal information technology investment, will also act as a catalyst for continued national excellence in computing, communications, and the information technologies.

Specifically CICT Program will **1)** enable smarter, more adaptive systems and tools that work collaboratively with humans in a goal-directed manner to achieve the mission/science goals; **2)** enable seamless access to ground-, air-, and space-based distributed computing, information, and knowledge to enable NASA missions in aerospace, Earth science, and space science; **3)** enable broad, continuous presence and coverage for high rate data delivery from ground-, air-, and space-based assets directly to the users; and **4)** research, develop, and evaluate a broad portfolio of fundamental information and bio/nano-technologies for infusion into NASA missions.

## OVERVIEW

Building upon previous investments in a loose array of information science and technology programs, the Aerospace Technology Enterprise initiated the CICT Program in the beginning of fiscal year 2002 and established a tightly coupled and coordinated research and development program. By integrating and applying coordinated management to the Agency's information technology investments, the CICT Program makes strategic investments to enable fundamental computing, information and communication technology advancements that will enable and enhance a broad class of future NASA missions. In addition, CICT will work closely with other NASA programs to enable infusion of these technologies into NASA missions. The CICT Program has been organized into four projects, each with a unique technical focus. The **Intelligent Systems Project** goal is to enable smarter, more adaptive systems and tools that work collaboratively with humans in a goal-directed manner to achieve NASA mission/science goals and will focus on technologies for automated reasoning, human-centered computing, and intelligent data understanding. The **Computing, Networking, and Information Systems Project** goal is to enable seamless access to ground-, air-, and space-based information technology resources in support of NASA mission/science goals. The **Space Communications Project** goal is to develop the space communication technologies required to give NASA scientists pervasive, high-data rate access to space assets and the data they acquire. Finally, the **Information Technology Strategic Research Project** goal is to research, develop, and evaluate emerging information, biologically-inspired, and nanoscale technologies for infusion into NASA missions.

## PROGRAM MANAGEMENT

The CICT research program is managed at NASA HQ. The Office of Aerospace Technology Enterprise Program Management Council (EPMC) has CICT governing responsibility. Enterprise official is Jerry Creedon, Associate Administrator for Aerospace Technology at HQ. Theme Director is Dennis Andrucyk, Acting Director for Mission and Science Measurement Technology (MSMT) at HQ. The Program Manager and POC for CICT is Eugene Tu. This program is in full compliance with NPG7120.5B.

| | |
|---|---|
| **THEME:** | Mission and Science Measurement Technology |
| **TECHNOLOGY AND ADVANCED CONCEPTS:** | Computing, Information, and Communications Technology (CICT) Program |

## TECHNICAL COMMITMENT

The baseline for this technical commitment is the FY03 budget.

| | Technical Specifications | | FY04 President's Budget FY02 | FY03 | FY04 | FY05 | Change from Baseline |
|---|---|---|---|---|---|---|---|
| IS - Intelligent Systems | **Goal-Directed Systems:** Develop and demonstrate 1) automated reasoning technologies that support the need to significantly increase the level of autonomy within NASA's future missions, 2) intelligent data understanding technologies that support NASA mission needs to automatically discover new information from large databases, 3) human-centered computing technologies that optimize the combined performance of human experts and the supporting information system. | TRL<br>$M | 2<br>63.8 | 2-3<br>76.5 | 3-4<br>66.2 | 3-4 | --<br>-- |
| | Conclusion of a successful analogue science mission (terrestrial rover or simulated spacecraft) demonstrating key autonomy technologies enabling goal-directed systems for science exploration missions. Demonstrate technologies enabling contact instrument placement and vehicle positioning in **one command cycle** (at least 3X improvement over baseline capabilities). (4MSM13) | TRL<br>$M | 2<br>4.0 | 3<br>4.0 | 4<br>4.0 | | --<br>-- |
| | Demonstrate capability to **automatically** discover a feature, and its underlying mathematical causal structure. | TRL<br>$M | 2<br>6.6 | 2<br>10.4 | 3<br>8.5 | 3 | --<br>-- |
| | Successfully demonstrate in a Mission Operations Facility or similar testbed the **use of agent-based integrated tools** for routine operations, as well as anticipated and unanticipated off-nominal operations. | TRL<br>$M | 2<br>4.5 | 2<br>7.0 | 3<br>6.0 | 3 | --<br>-- |
| | Engage the Computational Sciences community with NASA problems by providing Challenge Problems and conducting periodic solicitations for basic research, resulting in the awarding of **over 50 excellent quality research tasks** (as rated by peer-review panels) over the life of the program. | TRL<br>$M | 2<br>9.3 | 2<br>10.0 | 2<br>8.5 | 2 | --<br>-- |
| | Develop **at least 11 key technologies** in the areas of Automated Reasoning, Human-Centered Computing, and Intelligent Data Understanding. | TRL<br>$M | 2<br>38.5 | 2<br>41.6 | 3<br>38.3 | 3 | --<br>-- |
| | University Research and Engineering Technology Institute (URETI). | TRL<br>$M | | 2<br>3.0 | | | --<br>-- |
| CNIS - Computing, Networking, & Information Systems | **Seamless access to NASA information technology resource:** Research, develop, test, integrate, demonstrate, and transfer testbed, grid common services, and information environments technologies for seamless and collaborative access to distributed ground-based hardware, software, and information resources. | TRL<br>$M | 4<br>44.2 | 5<br>33.5 | 5<br>38.9 | 6 | --<br>-- |
| | Exploratory grid environment: Demonstrate at least one Enterprise-relevant application operating on an exploratory grid environment. | TRL<br>$M | 5<br>2.9 | | | | --<br>-- |
| | Complete the development of at least 3 sets of technologies in the areas of:<br>**A)** Combinations of advances in Grid technologies (applications, information environments, grid common services, and high-end computing and networking).<br>**B)** Integrated toolsets for creating and managing collaborative science and engineering environments for integrated simulation, information management and data analysis in a Grid environment.<br>**C)** Technologies and services that enable: **(1)** Heterogeneous, geographically-extensible, ground-based Grid; **(2)** Efficient access to and use of Grid resources; **(3)** Integration of high-end computing resources into the Grid; **(4)** Interaction among mobile and communications elements. (4MSM14) | TRL<br>$M | 4<br>41.3 | 5<br>33.5 | 5<br>38.9 | 6 | --<br>-- |

Current TRL status relative to FY03 plan (R/Y/G/B) Planned TRL status to FY03 plan

| | |
|---|---|
| **THEME:** | Mission and Science Measurement Technology |
| **TECHNOLOGY AND ADVANCED CONCEPTS:** | Computing, Information, and Communications Technology (CICT) Program |

## TECHNICAL COMMITMENT

| | Technical Specifications | | FY02 | FY03 | FY04 | FY05 | Change from Baseline |
|---|---|---|---|---|---|---|---|
| SC - Space Communications | **High rate data delivery:** Develop innovative component technologies for on-demand space data delivery enabling high data rates, broad coverage, internet-like data access. | TRL | 1-2 | 1-2 | 2-3 | 2-3 | -- |
| | | $M | 7.6 | 7.5 | 7.4 | | -- |
| | Ground-based demonstration of spacecraft communications technologies, to achieve at least 1Gbps for near Earth and 1Mbps for deep space applications (representing 10X improvements over current baseline). Develop related protocols and software for Internet-like space computing and communications. (4MSM11) | TRL | 2 | 3 | **3** | | -- |
| | | $M | 3.6 | 3.5 | 3.4 | | -- |
| | Provide detailed analysis for next generation architectures to enable NASA Enterprises to make timely and cost effective investment decisions in operational systems. Demonstrate emulation environment to verify space architectural designs for implementation. Demonstrate high rate communications for space to space systems and low loss energy efficient technologies for inter-spacecraft and proximity links. | TRL | 1-2 | 1-2 | 2 | 2 | -- |
| | | $M | 4.0 | 4.0 | 4.0 | | -- |
| ITSR - Info. Tech. Strategy Research | **Strategic Research:** Demonstrate nano-scale component development and assembly; intelligent, adaptive, immersive, multi-modal control of aerospace vehicles; high confidence automated software development and verification; adaptive and fault-tolerant systems; and new models of computing for emerging and anticipated platforms. | TRL | 1 | 1 | 2 | 3 | -- |
| | | $M | 29.1 | 29.3 | 26.4 | | -- |
| | Evaluate and promote at least 5 new bio, nano, or information technologies impacting at least 2 NASA Enterprises to a status appropriate for transfer to another NASA program or project, or insertion into a NASA mission. The current research portfolio includes nano-scale component development and assembly; intelligent, adaptive, immersive, multi-modal control of aerospace vehicles; high confidence automated software development and verification; adaptive and fault-tolerant systems; and new models of computing for emerging and anticipated platforms. (4MSM5) | TRL | 1 | 1 | 2 | 3 | -- |
| | | $M | 29.1 | 29.3 | 26.4 | | -- |

Current TRL status relative to FY03 plan (R/Y/G/B) | Planned TRL status to FY03 plan

| Schedule | FY04 President's Budget | Change from Baseline |
|---|---|---|
| CICT Consolidation Initiated per OMB Guidance | Feb-01 | -- |
| CICT Program Execution Initiated | Oct-01 | -- |
| NRC Technical Quality Review | Jun-02 | -- |
| Independent Implementation (IIR) Review | Nov-03 | -- |
| Non Advocate (NAR) Review of CICT Phase I Follow-On | Jun-04 | |
| CICT Phase I Follow-On Project(s) Execution Initiated | Oct-04 | -- |
| NRC Technical Quality Review | Jun-05 | -- |
| Non Advocate (NAR) Review of CICT Phase II Follow-On Projects | Jun-06 | -- |
| CICT Phase II Follow-On Project(s) Execution Initiated | Oct-06 | -- |
| Independent Implementation (IIR) Review | Nov-06 | -- |

## ACQUISITION STRATEGY & PERFORMING ORGANIZATIONS

Data current as of 1/19/2003

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

| Current Acquisitions | Actual * | Selection Method | Actual * | Performer | Actual * |
|---|---|---|---|---|---|
| Cooperative Agreements | 15.5% | Full & Open Competition | 96.3% | Industry | 51.5% |
| Cost Reimbursable | 64.0% | Sole Source | 3.7% | Government | 0.4% |
| Fixed Price | 5.0% | | 100% | NASA Intramural | 27.1% |
| Grants | 5.5% | | | University | 21.0% |
| Other | 10.0% | Sci Peer Review ( full & open) | 23.7% | Non Profit | 0.0% |
| * as % of FY02 direct procurement | 100% | * as % of FY02 direct procurement | | * as % of FY02 direct procurement | 100% |

| | |
|---|---|
| **THEME:** | Mission and Science Measurement Technology |
| **TECHNOLOGY AND ADVANCED CONCEPTS:** | Computing, Information, and Communications Technology (CICT) Program |

## ACQUISITION STRATEGY & PERFORMING ORGANIZATIONS

Data current as of 1/19/2003

| Future Acquisitions - Major | Selection | Goals |
|---|---|---|
| CICT NASA Research Announcements (NRA) 2003-2004 | | Award of excellent rated academic, industry and NASA proposals in support of objectives. |
| CICT upgrades of computational research testbeds 2004-2006 | | Upgraded computing testbed capabilities to support research objectives. |

## AGREEMENTS

**Internal:** Agreement between CICT, ECS, and VST on the demonstrate of neural-based flight control systems for transport aircraft; Agreement with the Mars Exploration Rover (MER) Project on delivery of CICT products in support of the MER mission; Agreement with the Mars Communication Project Office and SOMO on the Transfer of Electronics and High-Power Transmitter Technologies.

**External:** MOU between NSF and NASA on Research in Distributed Heterogeneous Computing; Space Act Agreement between NASA and Silicon Graphics Inc. (SGI) on research of shared memory high-end computing architectures.

## INDEPENDENT REVIEWS

Data current as of 1/19/2003

| Types of Review | Performer | Last Review | Next Review | Purpose |
|---|---|---|---|---|
| Performance | IPAO | None | Nov-03 | Non-Advocate Review, followed by annual Independent Implementation Reviews. |
| Quality | NRC / ASEB | Jun-02 | Jun-05 | Technical quality and relevance. |
| Relevance | ATAC MSM SC | 4-Sep-02 | 1-Mar-03 | External community reviews status and plans. |
| Relevance | TEB | 29-Oct-02 | monthly | Enterprises review the relevance of program activities to their strategic needs, and identify transition opportunities for program products. |

## COST

| Budget Authority ($M) | FY02 | FY03 | FY04 | Comments |
|---|---|---|---|---|
| **FY 2004 President's Budget (Technology)** | **155.5** | **154.0** | **233.2** | |
| Information Technology Strategy Research (ITSR) | 38.6 | 29.8 | 54.7 | |
| Intelligent Systems (IS) | 63.8 | 79.6 | 82.2 | |
| Computing, Networking, & Information Systems (CNIS) | 44.1 | 37.0 | 80.7 | |
| Space Communications (SC) | 9.0 | 7.6 | 15.6 | |
| **Changes since FY 03 Pres. Budget** | **-0.4** | **+0.0** | **+78.9** | ***Reason for Change:*** |
| Information Technology Strategy Research (ITSR) | -1.7 | | +24.6 | Full cost implications & more people |
| Intelligent Systems (IS) | | | +8.4 | Full cost implications & less people |
| Computing, Networking, & Information Systems (CNIS) | -0.1 | | +37.9 | Full cost implications & more people |
| Space Communications (SC) | +1.4 | | +8.0 | Full cost implications & less people |

Indicates budget numbers in Full Cost.

Indicates changes since the FY 2003 Presidents Budget Submit.

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

**THEME:** Mission and Science Measurement Technology

**TECHNOLOGY AND ADVANCED CONCEPTS:** Engineering for Complex Systems (ECS) Program

## PURPOSE

| Objectives | Reference FY 2004 Strategic Plan | Perf. Measures |
|---|---|---|
| 6.1 | Improve student proficiency in science, technology, engineering and mathematics by creating a culture of achievement using educational programs, products and services based on NASA's unique missions, discoveries and innovations. | 4MSM15 |
| 7.3 | Increase public awareness and understanding of how research and innovations in aerospace technology affect and improve the qualiy of life. | 4MSM16 |
| 9.2 | Develop knowledge and technologies to make life support systems self-sufficient and improve human performance in space. | 4MSM1 |
| 10.1 | Improve the capability to assess and manage risk in the synthesis of complex systems. | 4MSM2 |

The Engineering for Complex Systems Program (ECS) will achieve ultra-high levels of safety and mission success by fundamentally advancing NASA's system life-cycle approach through the infusion of advanced technologies.

## OVERVIEW

The program is structured around developing technologies along three major thrusts: **1.** System Reasoning & Risk Management Project, work will encompass Risk-Based Design Methods, Risk, Mishap & Subsystem Models; Hazard & Failure Mode Identification; and Integration of Analysis Tools & Data. **2.** Knowledge Engineering for Safe Systems Project will address Risk Perception & Decision Research, Human & Organizational Risk Factors, Linked Heterogeneous Safety Critical Information, Knowledge Discovery from Data, and Virtual Iron Bird High Fidelity Environments., **3.** Resilient Systems & Operations Project will focus on Autonomous and Adaptive Systems, Resilient Software Technologies, Human Interfaces for State Awareness, and High Fidelity Validation Testbeds.

## PROGRAM MANAGEMENT

NASA OAT HQ is responsible for the management and implementation of the ECS program. The Office of Aerospace Technology Program Management Council (PMC) has governing responsibility. Enterprise official is Jeremiah Creedon, Associate Administrator for Aerospace Technology at HQ. Theme Director and Point of Contact is Dennis Andrucyk, Director for Mission and Science Measurement Technology at HQ. The Program Manager is Mr. Yuri Gawdiak at HQ. This program is in full compliance with NPG7120.5B.

## TECHNICAL COMMITMENT

The baseline for this technical commitment is the FY02 budget.

| Technical Specifications | | FY04 President's Budget | | | | Change from Baseline |
|---|---|---|---|---|---|---|
| | | FY02 | FY03 | FY04 | FY05 | |
| **Organizational Risk Model:** Social & Organizational Systems - risk perception & management within organizations, including culture, decision, and individual agent attributes. TRL advanced from 1-2. Provide a model-building tool for researchers, to capture and analyze data on social/organizational system risks, enabling the description and analysis of risks in organization-level decisions. Successfully model one key risk-drivers (variables) in one specific NASA context; The risk model shall include at least one variable related to culture, two variables related to structure, and two variables related to decision-making; Construct validity check- assessment by two experts that the model represents a reasonable theory of organizational risk. (KESS) | TRL | 1 | 2 | | | -- |
| | $M | 2.3 | 2.4 | | | -- |
| **Initial High Dependability Computing Testbeds:** High fidelity testbeds supporting key NASA software risks in the areas of dependability performance, risk measurement tools in complex systems. Install, load, and provide initial simulations for at least two NASA software systems. (RSO) | TRL | 1 | 2 | | | -- |
| | $M | 3.9 | 4.4 | | | -- |
| Current TRL status relative to FY03 plan (R/Y/G/B) | | | | Planned TRL status to FY03 plan | | |

***Table is continued on next sheet.***

## TECHNICAL COMMITMENT (Continued)

| Technical Specifications | | FY02 | FY03 | FY04 | FY05 | Change from Baseline |
|---|---|---|---|---|---|---|
| | | FY04 President's Budget | | | | |
| **Prototype Concept Design Risk Tool:** Address agency-wide risk management gaps in the Concept Development lifecycle phase of program/missions. The current state-of-the-art relies on informal, manual, incomplete, and sporadic processes to generate, assess, mitigate and trade risks in the concept design phases. There exists no standard representations and lifecycle-wide management of risks. The ECS program will develop a concept design risk tool that provides systematic processes to do risk identifications, mitigation strategies, assessments, and key trade-off capabilities not only between risks, but between risks and other mission design criteria. Success Criteria: add two new risk types from either software, organizational, and/or programmatic; demonstrate ability to modify risk profiles as a result of system models; meet customer requirements for real-time design agility performance. (4MSM1) (SRRM, KESS) | TRL | 3 | 4 | 6 | | -- |
| | $M | 3.0 | 3.8 | 3.8 | | -- |
| **Virtual Iron Birds** - Enabling knowledge management environment technologies for design and operations engineering models. TRL advancement from 2-4 with two of the following three software demonstrations: 1) Digital Shuttle- ontology and standardized tags for four classes of objects, three dimensional representations for at least two Shuttle components or subsystems; 2) Simstation- two simulation models of Station subsystems that share data and contribute to risk assessment for two classes of risks; 3) WIRe- two types of wire defects modeled, and one wire-related risk modeled. Documents delivered: VIB (as instantiated in Digital Shuttle or SimStation)- Requirements Analysis, Concept of Operations, Architecture/Ontology Description, Benefits and Use Case Analysis; WIRe- Report on risk analysis methods based on library of wire defect models. (KESS, SRRM) | TRL | 2 | 3 | 3 | **4** | -- |
| | $M | 4.0 | 3.9 | 3.7 | | -- |
| **Mishap Initiator Identification System** - Demonstration of integrated tool suite for risk identification, analysis, and lifecycle decision support. Demonstrate the successful delivery of mishap datasets by showing utilization in at least 6 conceptual designs in concert with the risk workstation. Demonstrate IO using at least one ontology, using at least 2 accident models, and accessing mishap information from MCC. Demonstrate investigation organizer tool use in 2 mishap investigations. (SRRM) | TRL | | 2 | 3 | 4 | -- |
| | $M | | 1.4 | 1.5 | | -- |
| **Organizational Risk Tool Suite** - Decision support tool suite for organizational risk assessment. Advance TRL from 2 to 4. Tools can be used by organizational modelers identify and analyze at least two key risk drivers, in at least one NASA domain. Tools based explicitly on the Organizational Risk Model defined in RMCS-3; The following items formally documented: Requirements, Benefits Analysis, Architectural Description. Paper accepted for presentation at a professional conference. Reports and analyses accepted and used for decision-making regarding organizational processes in at least one domain. Preliminary Technology Adoption Report submitted. (KESS) | TRL | | -- | 2 | 3 | -- |
| | $M | | | 2.8 | | -- |
| **Resilient System Technologies** - Adaptive technologies that learn and react to complex and dynamic environments. Successful demonstration of 3 out of 4resiliency capabilities including reconfiguration, real-time adaptive recovery from unexpected events, system self-assessment, scenario re-planning and execution, enhanced unambiguous human-machine interactions. Success is defined in the exit criteria for each individual demonstration milestone. (RSO) | TRL | 2 | 3 | 4 | 5 | -- |
| | $M | 5.3 | 4.9 | 3.5 | | -- |

Current TRL status relative to FY03 plan (R/Y/G/B) ⇧ Planned TRL status to FY03 plan

*Table is continued on next sheet.*

| THEME: | Mission and Science Measurement Technology |
|---|---|
| TECHNOLOGY AND ADVANCED CONCEPTS: | Engineering for Complex Systems (ECS) Program |

## TECHNICAL COMMITMENT (Continued)

| Technical Specifications | | FY04 President's Budget | | | | Change from Baseline |
|---|---|---|---|---|---|---|
| | | FY02 | FY03 | FY04 | FY05 | |
| **Prototype Model-Based System Analysis Tool Suite** - Develop prototype capability to analyze hardware, software, and human system specifications for hazards, risk analysis, and system complexity metrics. Develop and exercise risk assessment and management capability incorporating MIIS, IO, risk workstation, and other tools to develop a complete project risk profile and risk model for one Enterprise. Develop a complete technology development risk profile and risk model for one Enterprise program. Incorporate software risk attributes and models. Incorporate operational HORM model. Demonstrate the capability over the complete formulation phase. (SRRM, KESS, RSO) | TRL | 2 | 2 | 3 | 4 | -- |
| | $M | 5.4 | 5.4 | 5.2 | | -- |
| **High Dependability SW Standards** - Demonstration of successful measurement of dependability metrics on two NASA mission testbeds. Enable estimation of impact (cost vs. benefit) of software engineering technologies on software and system dependability based on empirically validated models. (RSO) | TRL | | -- | 2 | 3 | -- |
| | $M | | | 5.6 | | -- |
| Ground Demonstration of Mobile IVHM - Demonstrate the feasibility of adaptive risk management technologies for internal spacecraft operations. Help push the state-of-the-art in spacecraft risk mitigation strategies from redundancy based fault tolerance techniques which have significant cost, weight, volume, & common-cause-failure weaknesses to dynamic, adaptive resiliency approaches. The RMCS program will demonstrate an autonomous, mobile sensing system for spacecraft that will dynamically provide environmental sensing capabilities along with mobile knowledge management services to significantly enhance human operations situational awareness and fault isolation and recovery operations. Success Criteria: Demonstrate mobile navigation & control precision that passes safety requirements for spacecraft operations; Demonstrate environmental monitoring capabilities for the presence for atleast one atmospheric gas, temperature, pressure, humidity, and infra-red scans; Demonstrate intelligent planning & scheduling for fault, isolation, and recovery for a failed environmental sensor. (4MSM2) (RSO) | TRL | 2 | 3 | **4** | | -- |
| | $M | 1.28 | 1.32 | 1.4 | | -- |

Current TRL status relative to FY03 plan (R/Y/G/B) Planned TRL status to FY03

## TECHNICAL COMMITMENT (Continued)

| Schedule | FY04 President's Budget | Change from Baseline |
|---|---|---|
| Milestones | | |
| Non-Advocate Review | 1 Qtr FY03 | -- |
| Program Commitment Auth | 1Qtr FY03 | -- |
| Organizational Risk Model (ECS3) | 4 Qtr FY03 | -- |
| Initial High Dependability Computing Testbeds (ECS4) | 4 Qtr FY03 | -- |
| Prototype Concept Design Risk Tool (ECS5) | 4 Qtr FY04 | -- |
| Virtual Iron Birds (ECS6) | 3 Qtr FY05 | -- |
| Mishap Initiator Identification System (ECS7) | 1 Qtr FY06 | -- |
| Organizational Risk Tool Suite (ECS8) | 3 Qtr FY06 | -- |
| Resilient System Technologies (ECS9) | 4 Qtr FY06 | -- |
| Prototype Model-Based System Analysis Tools (ECS10) | 4 Qtr FY06 | -- |
| High Dependability SW Standards (ECS11) | 4 Qtr FY06 | -- |

## ACQUISITION STRATEGY & PERFORMING ORGANIZATIONS

The program will employ a mix of broadly competed procurements; full and open competitive procurements will be used to the maximum extent possible. External R&D activities will be solicited and funded under a number of competitive procurement actions utilizing various types of solicitation and contractual vehicles. Commercial systems will be acquired through competitive commercial purchases. Other contract vehicles such as Government-Wide Agency Contracts (GWAC), GSA Federal Supply Schedules, and Consolidated Contract Initiatives will be considered as part of the integrated acquisition strategy. The academic community will be involved in identifying, conceiving and developing new advances to meet Agency goals and objectives. The concept of a full spectrum of academic involvement will help assure that the full potential of these new technology advances can be achieved, and it will also catalyze and stimulate further innovative ideas for critical new technology.

| THEME: | Mission and Science Measurement Technology |
|---|---|
| TECHNOLOGY AND ADVANCED CONCEPTS: | Engineering for Complex Systems (ECS) Program |

## ACQUISITION STRATEGY & PERFORMING ORGANIZATIONS (Continued)

| Current Acquisitions | Actual * | Selection Method | Actual * | Performer | Actual * |
|---|---|---|---|---|---|
| Cooperative Agreements | 25% | Full & Open Competition | 96% | Industry | 50% |
| Cost Reimbursable | 62% | Sole Source | 2% | Government | 2% |
| Fixed Price | 4% | Govt | 2% | NASA Intramural | 13% |
| Grants | 9% | | 100% | University | 34% |
| Other | 0% | Sci Peer Review | 0% | Non Profit | 1% |
| * as % of FY02 direct procurement | 100% | * as % of FY02 direct procurement | | * as % of FY02 direct procurement | 100% |

| Future Acquisitions - Major | Selection | Goals |
|---|---|---|
| NASA Research Announcement FY03-FY06 | | Solicit broad inputs & innovations into the low TRL portions of the program (complexity research & human & organizational risk). |

## AGREEMENTS

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

***External:*** Memorandum of Understanding: Air Force/Boeing, GE, BAE, SRI International
Cooperative Agreements: U. of FL., CMU, Georgia Tech, & Penn State Software Consortium

**Changes since FY 2003 President's Budget: None.**

## INDEPENDENT REVIEWS

| Types of Review | Performer | Last Review | Next Review | Purpose |
|---|---|---|---|---|
| Quality | NRC / ASEB | 11-Jul-02 | 1-Jul-05 | Technical quality and relevance. |
| Performance | IPAO | n/a | 19-Feb-02 | Program Readiness Review, Non-Advocate Review, followed by annual Independent Implementation Reviews. |
| Relevance | ATAC MSM SC | 4-Sep-02 | 1-Mar-03 | External community reviews program status and plans. |
| Relevance | TEB | 29-Oct-02 | monthly | Enterprises review the relevance of program activities to their strategic needs, and identify transition opportunities for program products. |

## COST

| Budget Authority ($M) | FY02 | FY03 | FY04 | Comments |
|---|---|---|---|---|
| **FY 2004 Budget Submit (Technology)** | **27.8** | **28.0** | **44.0** | |
| System Reasoning & Risk Mgmt. | 9.7 | 9.0 | 12.6 | |
| Resilient Systems & Operations | 12.7 | 14.0 | 21.0 | |
| Knowledge Engineering for Safe Systems | 5.4 | 5.0 | 10.4 | |
| **Changes since FY 03 Pres. Budget** | **-0.2** | **+0.0** | **+16.1** | ***Reason for Change:*** |
| System Reasoning & Risk Mgmt. | | | +3.8 | Full cost implications |
| Resilient Systems & Operations | -0.2 | | +6.7 | Full cost implications |
| Knowledge Engineering for Safe Systems | | | +5.6 | Full cost implications |

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

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

| | |
|---|---|
| **Theme:** | Mission and Science Measurement Technology |
| **Technology and Advanced Concepts:** | Enabling Concepts and Technologies (ECT) Program |

## PURPOSE

| Objectives | Reference FY 2004 Strategic Plan | Performance Measures |
|---|---|---|
| 6.1 | Improve student proficiency in science, technology, engineering and mathematics by creating a culture of achievement using educational programs, products and services based on NASA's unique missions, discoveries and innovations. | 4MSM15 |
| 7.3 | Increase public awareness and understanding of how research and innovations in aerospace technology affect and improve the qualiy of life. | 4MSM16 |
| 10.2 | Create new system concepts and demonstrate new technologies that enable new science measurements. | 4MSM3, 4MSM4, 4MSM6, 4MSM7, 4MSM8, 4MSM9, 4MSM10, 4MSM12 |

The ECT Program explores revolutionary concepts for aerospace systems, and performs fundamental research and development of high-payoff technologies to enable pursuit of NASA Vision and Mission by all Themes and Enterprises. Program will identify, develop, and transfer breakthrough technologies that have broad potential across many types of systems to provide increased scientific return at lower cost, and to enable missions and capabilities beyond current horizons. Particular foucus on transition and insertion of products to Enterprise mission applications.

## OVERVIEW

The ECT Program is the front end of the enabling technology pipeline that supplies the focused technology development programs of the NASA Enterprises. The revolutionary system concepts and technologies developed by ECT are unique to NASA needs, and are applicable across many classes of missions in multiple Enterprises. The ECT program involves three phases: Exploration, Transition, and Insertion. Fundamental technology development is a long-term process that may require from 5 to 15 years to progress from initial conception to mission use. In order to manage short-term progress, each phase is planned for a two-to-three year period, with specific deliverable products at phase end. In the Exploration Phase, promising ideas are developed without specific application. Technology requirements are derived from NASA strategic goals and objectives, advanced concept studies, and systems analysis. The technology requirements guide development of component and subsystem technologies, with emphasis on efficiency, miniaturization, integration, and resiliency. Broadly-competed solicitations and university partnerships are used to capture innovative ideas from the external community, to leverage emerging technologies, and to complement NASA capabilities in critical areas. In the Transition Phase, which is done in collaboration with the Enterprise customers, technology products are integrated into proof-of-concept systems to identify technical issues, to mature designs, and to validate performance in representative applications. In the Insertion Phase, the performance of technologies is measured and evaluated in mission use to capture lessons learned that can benefit the next generation of technology development. The ECT Program departs significantly from past practice in NASA cross-enterprise technology programs that funded the delivery of a technology to a specific Technology Readiness Level (TRL), and it was left to chance as to whether the technology would be picked up by users. Instead, the ECT Program bridges this gap by allocating up to 50 percent of program funding for the transition and insertion of products to Enterprise mission applications. Customer investment (co-funding or partnership effort) is required for entering the Transition Phase, and must constitute all costs in the Insertion Phase that are not related to performance prediction, measurement, and assessment.

Five projects have been formulated to accomplish ECT program objectives:
• The **Advanced Systems Concepts (ASC) Project** performs conceptual studies and systems analysis of revolutionary aerospace systems that have the potential to leap well past current plans, or to enable new visions for NASA's strategic plans. Potentially enabling breakthrough technologies are examined in mission models, and the aggregated benefits of technology investments across multiple mission classes are evaluated.
• The **Energetics Project (Egtc)** develops advanced power and propulsion technologies to enable lower-cost missions with increased capabilities, and to extend mission reach beyond current horizons. Technology development includes solar power generation, energy storage and conversion, power management and distribution, and advanced electrical and chemical spacecraft propulsion.

***Continued On Next Page***

## OVERVIEW (Continued)

• The **Advanced Measurement and Detection (AMD) Project** develops miniaturized sensors, advanced instruments, and nanoscale devices to enable a wide array of in situ and remote sensing capabilities. Technology development includes lidar and radar instrument technology, detector arrays and cryocoolers for focal planes, broadband passive instruments, and in situ biological and chemical sensors.
• The **Revolutionary Spacecraft Systems (RSS) Project** develops advanced spacecraft systems and architectures to enable distributed science data collection, exploration of extreme environments, and lower mission costs. Technology development includes formation control sensors and algorithms for distributed spacecraft, microspacecraft components and subsystems, and space environment models and analytical tools to predict environmental effects.
• The **Large Space Systems (LSS) Project** develops concepts for large, ultra-lightweight space structures and apertures to expand mission capabilities, and to enable new visions of the Earth and the Universe. Technology development includes advanced materials, deployable and inflatable structures, multifunctional and adaptive structures, and ultra-lightweight optical systems.

## PROGRAM MANAGEMENT

The ECT Program is managed by NASA Headquarters (HQ). The Aerospace Technology Enterprise Program Management Council (PMC) has governing responsibility. Enterprise official is Jeremiah F. Creedon, Associate Administrator for Aerospace Technology at HQ. Acting Theme Director for Mission and Science Measurement Technology and Point of Contact is Dennis Andrucyk at HQ. Acting ECT Program Manager is Christopher L. Moore at HQ. Projects are established to develop concepts and technologies in specific areas. A Performing Center is designated for each project to lead implementation. This program is in full compliance with NPG7120.5B.

## TECHNICAL COMMITMENT

The baseline for this technical commitment is the FY03 budget.

| Technical Specifications | | FY04 President's Budget | | | | Change from Baseline |
|---|---|---|---|---|---|---|
| | | **FY02** | **FY03** | **FY04** | **FY05** | |
| Implement a systems analysis process to assess the system-level benefits of technologies in the ECT Program portfolio, and complete pilot technology assessments on 5 representative mission classes selected by the Enterprises. (4MSM3) (ASC) | TRL | | 1 | 3 | | -- |
| | $M | | 1.6 | 1.5 | | -- |
| Develop at least 5 advanced system concepts adopted by Enterprises for their long-range plans. (ASC) | TRL | | 1 | 1 | 2 | -- |
| | $M | | 12.0 | 12.0 | | -- |
| Develop advanced power technologies to enable a 40-60% reduction in power system mass. (Egtc) | TRL | | 2 | 2 | 3 | -- |
| | $M | | 9.9 | 9.5 | | -- |
| Develop concepts to enable 30% reduction in trip time, or 20% increase in payload for planetary missions. (4MSM4) (Egtc) | TRL | | 2 | 2 | 3 | -- |
| | $M | | 6.7 | 6.7 | | -- |
| Demonstrate tunable laser transmitter system with > 5% efficiency for active sensing. (4MSM6) (AMD) | TRL | | 2 | 3 | 4 | -- |
| | $M | | 5.0 | 5.0 | | -- |
| Develop detector, readout, and associated component technologies for focal planes and broadband instruments to enable at least 5 new measurement capabilities. (4MSM7) (AMD) | TRL | | 2 | 3 | 4 | -- |
| | $M | | 8.0 | 7.9 | | -- |
| Demonstrate at least two high performance, miniaturized (reduction of 10x), integrated biochemical analytical instrument prototypes. (4MSM8) (AMD) | TRL | | 2 | 3 | 3 | -- |
| | $M | | 1.5 | 2.0 | | -- |
| Demonstrate millimeter precision formation flying with a hardware-in-the-loop 3D dynamics simulation. (4MSM9) (RSS) | TRL | | 2 | 3 | 3 | -- |
| | $M | | 2.2 | 2.6 | | -- |
| Develop microavionics and multifunctional structures to reduce spacecraft mass by a factor of 3. (4MSM10) (RSS) | TRL | | 2 | 3 | 4 | -- |
| | $M | | 1.6 | 1.3 | | -- |
| Reduce uncertainty in predicting environmental effects on spacecraft systems to less than 15%. (RSS) | TRL | | 2 | 2 | 3 | -- |
| | $M | | 1.6 | 1.5 | | -- |
| Current TRL status relative to FY03 plan (R/Y/G/B) | | | | Planned TRL status to FY03 plan | | |

***Table is continued on next sheet.***

## TECHNICAL COMMITMENT (Continued)

| Technical Specifications | | FY04 President's Budget FY02 | FY03 | FY04 | FY05 | Change from Baseline |
|---|---|---|---|---|---|---|
| Demonstrate assembly/deployment of truss segments to enable 50-meter class space structures and apertures. (4MSM12) (LSS) | TRL | | 2 | 3 | **4** | -- |
| | $M | | 3.7 | 4.0 | | -- |
| Demonstrate diffraction-limited imaging at IR wavelengths with proof-of-concept membrane mirror telescope (area density < 1 kg/m2) and active wavefront control system. (LSS) | TRL | | 2 | 3 | 3 | -- |
| | $M | | 1.0 | 4.0 | | -- |
| Develop nanostructured composite material with strength > 2 Gpa. (LSS) | TRL | | 1 | 2 | 2 | -- |
| | $M | | 3.0 | 9.0 | | -- |
| Current TRL status relative to FY03 plan (R/Y/G/B) | | | | | | Planned TRL status to FY03 plan |

Major program milestones are independent reviews and competitive solicitations. Technical milestones contributing to the accomplishment of program goals are listed in project plans. The program is completing two sets of 3-year tasks inherited from the Code S Cross Enterprise Technology Development Program (CETDP). CETDP internal tasks were selected in a competition involving the NASA Centers in FY 1999, and will complete in FY 2002. Advanced Cross Enterprise NRA tasks, which are primarily external, were selected in an open competition in FY 2000, and will complete in FY 2003.

| Schedule | Date | Change from Baseline |
|---|---|---|
| NRC Reviews | first review 6/02; every 3 years | -- |
| Enterprise Relevance Reviews | first review 6/02; every year | -- |
| Technology Assessment Analysis | 6/04 pilot studies complete | -- |
| Sign MOAs with Enterprises | 3/03 | -- |
| Complete CETDP internal tasks | 9/02 | -- |
| Complete Cross Enterprise NRA tasks | 9/03 | -- |
| Issue FY04 NRAs | 3/03 | -- |
| Issue FY05 NRAs | 3/04 | -- |
| Issue FY06 NRAs | 3/05 | -- |
| URETI grants start | 10/02 | -- |
| New project formulation | 10/03 to 10/04 | -- |
| New project start | 10/04 | -- |

## ACQUISITION STRATEGY & PERFORMING ORGANIZATIONS

Data current as of 1/10/2003

The program will employ a mix of broadly competed procurements, joint funding of selected activities with partners, and directed funding to NASA Centers to ensure technical excellence, close relevance to NASA goals and objectives, and high infusion rates into NASA missions. The goal for program acquisitions is to openly and broadly compete 75% of all new procurements. A mixture of NASA Research Announcements (NRA), Requests for Proposals (RFP), and Cooperative Agreement Notices (CAN), and grants will be used to award funding for external technology development activities. These opportunities will capture innovative concepts from the external communities to support program objectives. The intent is to have a revolving set of procurements to ensure the timely adoption of the best new concepts from universities and industry into the program. Starting in FY04 and continuing yearly afterward, the program will release a series of solicitations from the ECT projects to fund new multi-year developments and activities. The solicitations will exclude NASA Centers and JPL from participation, to ensure that external organizations and NASA Centers will not compete against each other, and enhance cooperation between the Centers and the awardees. ECT projects will develop gap analyses on the awarded tasks, to guide the direction of internal work and the focus of future solicitations. The Centers will issue the solicitations, evaluate proposals, and administer the resulting contracts or grants.

The ECT Program begins with an existing set of 111 NRA tasks originally selected in the Advanced Cross-Enterprise Technologies NRA issued in 1999 by the Cross-Enterprise Technology Development Program (CETDP) in the Office of Space Science. This NRA encompassed a wide range of technical disciplines including power and propulsion, sensors and instruments, optics, structures and materials, robotics, communications, and advanced computing infrastructures. The research projects have duration of no longer than 3 years, and all will conclude by the end of FY 2003.

| **Theme:** | Mission and Science Measurement Technology |
|---|---|
| **Technology and Advanced Concepts:** | Enabling Concepts and Technologies (ECT) Program |

## ACQUISITION STRATEGY & PERFORMING ORGANIZATIONS (Continued)

Data current as of 1/10/2003

In FY 2002, three University Research and Engineering Technology Institutes (URETIs) were competitively selected to perform fundamental research in bio-nanotechnology for advanced materials. URETIs are cooperative arrangements between NASA and universities funded at $3M per year for up to five years.

| Current Acquisitions | Actual * | Selection Method | Actual * | Performer | Actual * |
|---|---|---|---|---|---|
| Cooperative Agreements | % | Full & Open Competition | 51% | Industry | 19% |
| Cost Reimbursable | % | Sole Source | 49% | Government | 5% |
| Fixed Price | % | | 100% | NASA Intramural | 52% |
| Grants | 24% | | | University | 24% |
| Other | % | Sci Peer Review | 51% | Non Profit | % |
| * as % of FY02 direct procurement | 100% | * as % of FY02 direct procurement | | * as % of FY02 direct procurement | 100% |

| Future Acquisitions - Major | Selection | Goals |
|---|---|---|
| 1. FY04 NRAs | 9/03 | |
| 2. FY05 NRAs | 9/04 | |
| 3. FY06 NRAs | 9/05 | |

## AGREEMENTS

***Internal:*** The program is not dependent on other NASA activities outside of the control of the Associate Administrator for Aerospace Technology. Memoranda of Agreement (MOAs) will be established with each of the NASA Enterprises to endorse program goals and content, and to collaborate on transitioning technology products from the ECT Program into Enterprise focused technology development and validation programs. The ECT Program and the Enterprises will co-fund technology maturation and integration into proof-of-concept systems in the transition phase.

***External:*** The ECT Program will leverage the technology programs of external organizations where synergy can be achieved. When appropriate, the ECT Program will provide funding, collaborative research, or test facility support to partner organizations. These commitments will be documented with MOAs and Space Act Agreements.

Changes since FY03 Pres. Budget: None.

## INDEPENDENT REVIEWS

| Types of Review | **Performer** | **Last Review** | **Next Revie** | **Purpose** |
|---|---|---|---|---|
| Performance | IPAO | Various | FY2003 | Program performance against plan. |
| Quality | NRC/ASEB | 6-Jun-02 | 1-Jun-05 | Peer review of technical quality and content. |
| Relevance | ATAC MSM SC | 4-Sep-02 | 1-Mar-03 | External community reviews status and plans. |
| Relevance | TEB | 29-Oct-02 | Monthly | Relevance of activities and identify opportunities. |

## COST

| Budget Authority ($M) | **FY02** | **FY03** | **FY04** | Comments |
|---|---|---|---|---|
| FY 2004 Budget Submit (Technology) | 92.8 | 92.9 | 161.2 | |
| Energetics (Egtc) | 20.3 | 21.6 | 34.6 | |
| Advanced Systems Concepts (ASC) | 13.0 | 12.0 | 43.9 | |
| * Adv Spacecraft & Science Components | 19.5 | 19.3 | 37.8 | |
| Space NRAs (NRA) | 40.0 | 40.0 | 44.9 | |
| **Changes since FY 03 Pres. Budget** | **+0.0** | **+0.0** | **+67.8** | ***Reason for Change:*** |
| Energetics (Egtc) | | | +12.9 | Full Cost Implications |
| Advanced Systems Concepts (ASC) | | | +31.7 | Increase from Rev Space Flight |
| * Adv Spacecraft (AS) & Science Components | | | +18.3 | Full Cost Implications |
| Space NRAs (NRA) | | | +4.9 | Full Cost Implications |

Indicates budget numbers in Full Cost.

Indicates changes since the FY 2003 Presidents Budget Submit.

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

* The budget line for Advanced Spacecraft & Science Components includes the Advanced Measurement & Detection **(AMD)** Project, the Revolutionary Spacecraft Systems **(RSS)** Project, and the Large Space Systems Project **(LSS);** which was restructured.

By seeking and acquiring vital technologies available through the wealth of U.S. technology developers, the Innovative Technology Transfer Partnership Program supports NASA's Enterprises in achieving their science and mission objectives.

# INNOVATIVE TECHNOLOGY TRANSFER PARTNERSHIPS

## MAJOR EVENTS IN FY 2004

- Award SBIR and STTR contracts.
- Establish partnerships with innovators under the operation of the Enterprise Engine.

## **THEME:** Innovative Technology Transfer Partnerships

### OVERVIEW

Innovative Technology Transfer Partnerships Theme consists of the Technology Transfer Activity and the SBIR/STTR programs. The FY 2004 budget terminates the Commercial Technology program. NASA will support necessary efforts to document and license technologies and make them available to the private sector as legislatively mandated, and prudently manage NASA's intellectual property. NASA will continue to advise entrepreneurs of our technology offerings available for licensing, as well as, solicit partnerships to meet Enterprise technology needs through the use of the Web.

The budget provides for a new approach, known as the Enterprise Engine, to partner with venture capital firms and U.S. industry for the development of technologies that can directly contribute to the agency's core research activities, while benefiting private industry. The Technology Transfer Activity contributes to support the Enterprise mission needs, as well as the national economic strength through innovative technology partnerships with non-aerospace industries. With the FY 2004 budget request, the SBIR/STTR programs and the NTTC will continue, and NASA will provide for tech transfer regulatory requirements, and the Enterprise Engine.

| Missions | Goals supported by this theme | Objectives supporting those goals Reference 2003 Strategic Plan |
|---|---|---|
| Understand and Protect our Home Planet | 3 - Create a more secure world and improve the quality of life by investing in technologies and collaborating with other agencies, industry, and academia. | 3.3 - Improve the Nation's economic strength and quality of life by facilitating innovative use of NASA technology. |
| Inspire the Next Generation of Explorers | 6 - Inspire and motivate students to pursue careers in science, technology, engineering, and mathematics. | 6.4 - Improve higher education capacity to provide for NASA's and the Nation's future science and technology workforce requirements. |
| Space Flight Capabilities | 10 - Enable revolutionary capabilities through new technology. | 10.6 - Enhance NASA's mission by leveraging partnerships between NASA Enterprises, U.S. industrial firms, and the venture capital community for innovative technology development. |

### RELEVANCE

The Innovative Technology Transfer Partnerships Program serves all NASA Enterprises and supports their missions by facilitating the development of new technologies through partnerships with U.S. industry. In addition, a new approach known as the Enterprise Engine, to partner with venture capital firms on the development of commercial technologies can directly contribute to the agency's core research activities, while benefiting private industry.

| Education and Public Benefits |
|---|
| The Innovative Technology Transfer Partnerships Theme engages institutions of higher education in the NASA mission by providing opportunities and experience for students to help them prepare for successful careers in the field of technology management through NASA intern experience. This portends a broader role for NASA, that of ensuring that management of its technology assets and know-how are effectively used to improve higher education capacity to provide for NASA's and the Nation's future science and technology workforce requirements. |

## **THEME:** Innovative Technology Transfer Partnerships

### IMPLEMENTATION

**Innovative Technology Transfer Partnerships Theme** consists of Technology Transfer Activities (NTTC, Tech Transfer Regulatory Requirements, Enterprise Engine), and the SBIR/STTR programs.

NASA **Commercial Programs** will be terminated in FY2004. NASA believes a better approach is to make technology transfer a normal part of doing business whenever it is developing new technologies and leverage existing mechanisms for technology transfer.

**Technology Transfer Activities** includes the National Technology Transfer Center (NTTC), Tech Transfer Regulatory Requirements and the Enterprise Engine.

The National Technology Transfer Center (NTTC) will continue to serve as a link between U. S. industry and NASA.

**Enterprise Engine:**

In FY2004, a new concept is being introduced, referred to as the Enterprise Engine. This entails the creation of partnerships between NASA, U.S. industrial firms and the venture capital community to address NASA's new technology mission needs through innovative technology development partnerships.

**SBIR/STTR:**

The Small Business Innovation Research (SBIR) Program was established by Congress in 1982 to provide increased opportunities for small businesses to participate in R&D, to increase employment, and to improve U.S. competitiveness. The program's specific objectives are to stimulate U.S. technological innovation, use small businesses to meet NASA research and development needs, increase private-sector commercialization of innovations derived from federal R&D, and foster and encourage participation by socially disadvantaged businesses. Legislation enacted in 2000 extended and strengthened the SBIR program and increased its emphasis on pursuing commercial applications of SBIR project results.

**Small Business Innovation Research (SBIR) Program:**

The Small Business Innovation Research (SBIR) Program was established by Congress in 1982 to provide increased opportunities for small businesses to participate in R&D, to increase employment, and to improve U.S. competitiveness. The program's specific objectives are to stimulate U.S. technological innovation, use small businesses to meet NASA research and development needs, increase private-sector commercialization of innovations derived from federal R&D, and foster and encourage participation by socially disadvantaged businesses. Legislation enacted in 2000 extended and strengthened the SBIR program and increased its emphasis on pursuing commercial applications of SBIR project results.

**Small Business Technology Transfer (STTR) Program:**

The Small Business Technology Transfer (STTR) Program (modeled after the SBIR program) awards contracts to small business concerns for cooperative research and development with a research institution (RI), such as a university. The goal of the Congress in establishing the STTR program is to facilitate the transfer of technology developed by an RI through the entrepreneurship of a small business. The STTR and SBIR programs share many of the same basic performance requirements and phased funding structures, but nevertheless, STTR is a separate legislated program, is separately funded, and differs from SBIR in several aspects.

| Strategy | Schedule by Fiscal Year 01 | 02 | 03 | 04 | 05 | 06 | 07 | 08 | Purpose |
|---|---|---|---|---|---|---|---|---|---|
| COMMERCIAL PROGRAMS | | | | | | | | | Transition to Technology Transfer through the Enterprise Engine Initiative. |
| TECHNOLOGY TRANSFER PARTNERSHIPS | | | | | | | | | FY 2004 and beyond includes the Enterprise Engine. |
| SBIR | | | | | | | | | Authority expires at end of FY08. |
| STTR | | | | | | | | | Authority expires at end of FY08. |

Tech. & Adv. Concept    Development    Operations

## **THEME:** Innovative Technology Transfer Partnerships

### PERFORMANCE MEASURES

Annual Performance Goals

**3.3.1 OUTCOME:** Transfer NASA technology to the Nation.

4ITTP1 Complete 200 transfers of NASA technologies, expertise or facility usage to the U.S. private sector, through hardware licenses, software usage agreements, or Space Act agreements.

**6.4.1 OUTCOME:** More students prepared to enter STEM workforce

4ITTP2 Engage at least four institutions of higher education in the NASA mission in FY '04 by providing opportunities and experience for students to help prepare them for successful careers in the field of technology management through NASA intern experience.

**10.6.1 OUTCOME:** Improve NASA's Mission by leveraging partnerships with non-aerospace industry and academia, and facilitate NASA's use of commercially available technology.

4ITTP3 Promote and develop innovative technology partnerships between NASA, venture capital firms and U.S. industry for the benefit of all Enterprise mission needs.

4ITTP4 Align SBIR/STTR with priorities contributing to NASA mission and vision.

4ITTP5 Review and rank all SBIR/STTR proposals within 100 days of solicitations closure.

**OUTCOME:** A well managed program in accordance with Agency implementing strategies.

4ITTP6 For each Development project, complete the current phase within 10% of total life-cycle cost shown on the table below.

4ITTP7 Distribute at least 80% of allocated procurement funding to competitively awarded contracts, including both continuing and new contract activities.

4ITTP8 Complete all milestones within 10% of its baseline schedules.

### INDEPENDENT REVIEWS

| Types of Review | Performer | Last Review | Next Review | Purpose |
|---|---|---|---|---|
| Review of Commercial Tech Division Program | National Academy of Public Administration | Jan 1997 | TBD | Relevance |
| Review of SBIR | National Research Council | Sep-02 | TBD | Congressional Request - Relevance. |

### COST

| Budget Authority ($millions) | FY02 | FY03 | Chng | FY04 | Comments |
|---|---|---|---|---|---|
| Full Cost Budget FY2004 Initial OMB Submit | <u>163.8</u> | <u>146.9</u> | <u>+22.4</u> | <u>169.3</u> | |
| **Technology Transfer Partnerships** | **48.7** | **35.6** | **+2.3** | **37.9** | Includes Commercial Program in FY02, FY03 and FY04 close out. |
| **SBIR/STTR Programs** | **115.1** | **111.3** | **+20.1** | **131.4** | |
| *Small Business Innovation Research (SBIR)* | *108.8* | *105.0* | **+12.2** | *117.2* | |
| *Small Business Tech Trans (STTR)* | *6.3* | *6.3* | **+7.9** | *14.2* | |

Indicates budget numbers in Full Cost.

Indicates changes since the FY 2003 Presidents Budget Submit.

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

| **THEME:** Innovative Technology Transfer Partnerships |
|---|
| **RESEARCH: Small Business Innovation Research (SBIR)** |

## PURPOSE

| Objective | Reference FY 2003 Strategic Plan | Performance Measures |
|---|---|---|
| 10.6 | Enhance NASA's mission by leveraging partnerships between NASA Enterprises, U.S. industrial firms, and the venture capital community for innovative technology development. | 4ITTP3, 4ITTP4, 4ITTP5 |

The SBIR program will invest in innovative technology transfer that can make important contributions to NASA's mission and vision. Furthermore the program will increase small business participation in federal R&D and to provide new technology for NASA needs, increase private sector commercialization of innovations, stimulate technological innovation in the U.S. derived from federal R&D and foster and encourage participation in technological innovation.

## OVERVIEW

The SBIR Program consists of two phases (Phase I & II), which leverage the innovation of the small business community by awarding NASA research contracts to meet NASA mission needs, as well as provide commercialization opportunities for the small business. The SBIR topics and subtopics which describe NASA technology needs are developed annually in alignment with NASA strategic planning and emphasize advanced concepts to meet Agency research needs across all NASA Centers.

Phase I is the opportunity to establish the feasibility and technical merit of a proposed innovation. Selected competitively, NASA's Phase I contracts last for 6 months with a maximum funding of $70,000.

Phase II is the major R&D effort in SBIR. It continues to be the most promising of the Phase I projects based on scientific/technical merit, expected value to NASA, company capability, and commercial potential. Phase II places greater emphasis on evidence of commercial development than Phase I, particularly for NASA uses. Phase II contracts are usually for a period of 24 months with a maximum funding of $600,000. NASA usually selects approximately 40% of the Phase Is to go on to a Phase II.

## PROGRAM MANAGEMENT

The SBIR/STTR Programs are the responsibility of the Office of Aerospace Technology, NASA HQ. The Program administration is implemented through the Commercial Technology Division. The Enterprise Official is Jeremiah Creedon, Associate Administrator for Aerospace Technology at NASA HQ. Theme Director is Robert L. Norwood, Commercial Technology Division and Point of Contact is Carl G. Ray, Program Executive Director for SBIR/STTR Programs at HQ.

## TECHNICAL COMMITMENT

| Technical Specifications | FY04 President's Budget | Change from Baseline |
|---|---|---|
| **SBIR Solicitations:** NASA issues one SBIR program solicitation annually that sets forth specific R/R&D topics and subtopic areas consistent with stated Agency needs and mission objectives. The topic and subtopic descriptions are sufficiently comprehensive to provide Small Business Concerns (SBCs) insights into NASA research and development needs. SBIR topics and subtopics are developed annually in alignment with NASA strategic planning and emphasize advanced concepts to meet Agency research needs across all NASA Centers. SBIR is a legislatively mandated program which is conducted on a yearly, scheduled basis (see Schedule below). | | |

| Schedule | FY04 President's Budget | Change from Baseline |
|---|---|---|
| SBIR 2003 Phase I Solicitation | 7-Jul-03 | 9-Sep-03 |
| SBIR 2002 Phase II Selections Announced | 6-Oct-03 | 6-Oct-03 |
| SBIR 2003 Phase I Selections Announced | 21-Nov-03 | 21-Nov-03 |

**THEME:** Innovative Technology Transfer Partnerships

# RESEARCH: Small Business Innovation Research (SBIR)

## ACQUISITION STRATEGY & PERFORMING ORGANIZATIONS

Data current as of 1/21/2003

The Call for Proposals in the SBIR Program is issued annually. Current research is conducted by small business contractors. Proposals are selected by the NASA SBIR Source Selection Official. In FY 2002, direct procurement represented 2.5% of NASA extra mural R&D funding, but the plan for FY 2003 changes the direct procurement to 0.30%.

| Current Acquisitions | | Selection Method | Actual * | Performer | Actual * |
|---|---|---|---|---|---|
| Cooperative Agreements | % | Full & Open Competition | 100% | Industry | 97.5% |
| Cost Reimbursable | % | Sole Source | % | Government | % |
| Fixed Price | 100% | | 100% | NASA Extramural | 2.5% |
| Grants | % | | | University | % |
| Other | % | Sci Peer Review | % | Non Profit | % |
| * as % of FY02 direct procurement | 100% | * as % of FY02 direct procurement | | * as % of FY02 direct procurement | 100% |

| Future Acquisitions - Major | Selection | Goals |
|---|---|---|
| Annual Solicitation | FY03 4Q | 100% Full & Open Competition |

## AGREEMENTS

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

*External:* This program is legislatively mandated and is conducted in accordance with the governing legislation. A legislated federal research and development (R&D) set aside reauthorized in 2000 (SBIR), 2002 (STTR) for small high tech firms. Public Law 106-544 enacted December 12, 2000. Re-authorization, extending the SBIR program to FY 2008 and increasing data collection requirements.

## INDEPENDENT REVIEWS

Data current as of 1/21/2003

| Types of Review | Performer | Last Review | Next Review | Purpose |
|---|---|---|---|---|
| Independent, External Review | NRC | | FY 03 | Assessment of the SBIR program. Mandated study will conclude in 3 years. |

## COST

| Budget Authority ($ in millions) | FY02 | FY03 | FY04 | Comments |
|---|---|---|---|---|
| Full Cost Budget FY2004 OMB Submit | | | | |
| **Small Business Innovation Research** | **108.8** | **105.0** | **117.2** | |
| Small Business Innovation Research | 108.8 | 105.0 | 117.2 | |
| **Changes since FY 03 Pres. Budget** | **+0.0** | **+0.0** | **+12.2** | ***Reason for Change:*** |
| **Small Business Programs** | | | | |
| Small Business Innovation | | | +12.2 | Full cost implications. |

Indicates budget numbers in Full Cost.

Indicates changes since the FY 2003 Presidents Budget Submit.

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

| THEME: | Innovative Technology Transfer Partnerships |
|---|---|
| **RESEARCH:** | **Small Business Technology Transfer Program (STTR)** |

## PURPOSE

| Objectives | Reference FY 2003 Strategic Plan | Performance Measures |
|---|---|---|
| 10.6 | Enhance NASA's mission by leveraging partnerships between NASA Enterprises, U.S. industrial firms, and the venture capital community for innovative technology development. | 4ITTP3, 4ITTP4, 4ITTP5 |

The STTR program will invest in innovative technology transfer that can make important contributions to NASA's mission and vision. Furthermore the program will increase small business participation in federal R&D and to provide new technology for NASA needs, increase private sector commercialization of innovations, stimulate technological innovation in the U.S. derived from federal R&D and foster and encourage participation in technological innovation.

The STTR Program consists of two phases (Phase I & II), which leverage the innovation of the research community in conjunction with a small business, by awarding NASA research contracts to meet NASA missions needs, as well as provide commercialization opportunities for the small business. The STTR topics and subtopics are developed annually in alignment with NASA strategic planning and emphasize advanced concepts to meet Agency research needs across all NASA Centers.

**Phase I** is the opportunity to establish the feasibility and technical merit of a proposed innovation. Selected competitively, NASA's Phase I contracts last for 1 year with a maximum funding of $100,000.

**Phase II** is the major R&D effort in STTR. It continues to be the most promising of the Phase I projects based on scientific/technical merit, expected value to NASA, company capability, and commercial potential. Phase II places greater emphasis on evidence of commercial development than Phase I, particularly for NASA uses. Phase II contracts are usually for a period of 24 months with a maximum funding of $600,000. NASA usually selects approximately 40% of the Phase Is to go on to a Phase II.

## PROGRAM MANAGEMENT

The SBIR/STTR Programs are the responsibility of the Office of Aerospace Technology, NASA HQ. The Program administration is implemented through the Commercial Technology Division. The Enterprise Official is Jeremiah Creedon, Associate Administrator for Aerospace Technology at NASA HQ. Theme Director is Robert L. Norwood, at NASA HQ and Point of Contact is Carl G. Ray, Program Executive Director for SBIR/STTR Programs at HQ.

## TECHNICAL COMMITMENT

| Technical Specifications | FY04 President's Budget | Change from Baseline |
|---|---|---|
| **STTR Solicitations:** NASA issues one STTR program solicitation annually that sets forth specific R/R&D topics and subtopic areas consistent with stated Agency needs and mission objectives. The topic and subtopic descriptions are sufficiently comprehensive to provide Small Business Concerns (SBCs), in collaboration with a Research Institution (RI), insights into NASA research and development needs. STTR topics and subtopics are developed annually in alignment with NASA strategic planning and emphasize advanced concepts to meet Agency institutionally focused research at selected NASA Centers of Excellence in those research areas (See hyperlink for latest research topics). STTR is a legislatively mandated program which is conducted on a yearly, scheduled basis (see Schedule below). | | |

| Schedule | FY04 President's Budget | Change from Baseline |
|---|---|---|
| STTR 2003 Phase I Solicitation | 7-Jul-03 | 9-Sep-03 |
| STTR 2003 Phase I Selections Announced | 21-Nov-03 | 21-Nov-03 |
| STTR 2002 Phase II Selections Announced | 6-Apr-04 | 6-Apr-04 |

**THEME** Innovative Technology Transfer Partnerships

# RESEARCH: Small Business Technology Transfer (STTR)

## ACQUISITION STRATEGY & PERFORMING ORGANIZATIONS

Data current as of 1/21/2003

The Call for Proposals in the STTR Program is issued annually. Current research is conducted by small business contractors in partnership with research institutions. Proposals are selected by the NASA STTR Source Selection Official. In FY 2002, direct procurement represented 0.15% of NASA extra mural R&D funding, but the plan for FY 2003 changes the direct procurement to 0.30%.

| Current Acquisitions | Actual * | Selection Method | Actual * | Performer | Actual * |
|---|---|---|---|---|---|
| Cooperative Agreements | % | Full & Open Competition | 100% | Industry | 99.7% |
| Cost Reimbursable | % | Sole Source | % | Government | % |
| Fixed Price | 100% | | 100% | NASA Extramural | 0.3% |
| Grants | % | | | University | % |
| Other | % | Sci Peer Review | % | Non Profit | % |
| * as % of FY02 direct procurement | 100% | * as % of FY02 direct procurement | | * as % of FY02 direct procurement | 100% |

| Future Acquisitions - Major | Selection | Goals |
|---|---|---|
| Annual Solicitation | Fall 03 | 100% Full & Open Competition |

## AGREEMENTS

*Internal:* The program is not dependent on other NASA activities outside of the control of the NASA Associate Administrator for Aeronautics Technology. *External:* This program is legislatively mandated and is conducted in accordance with the governing legislation. A legislated federal research and development (R&D) set aside reauthorized in 2000 (SBIR), 2002 (STTR) for small high tech firms. Public Law 106-544 enacted December 12, 2000. re-authorization, extending the SBIR program to FY 2008 and increasing data collection requirements.

## INDEPENDENT REVIEWS

Data current as of 1/21/2003

| Types of Review | Performer | Last Review | Next Review | Purpose |
|---|---|---|---|---|
| None | | | | |

## COST

| Budget Authority ($ in millions) | FY02 | FY03 | FY04 | |
|---|---|---|---|---|
| Full Cost Budget FY2004 OMB Submit | | | | |
| **Small Business Technology Transfer** | **6.3** | **6.3** | **14.2** | |
| Changes since FY 03 Pres. Budget | +0.0 | +0.0 | +7.9 | ***Reason for Change:*** |
| Small Business Technology Transfer | | | +7.9 | Increase STTR to 3.0% of NASA Extramural R&D expenditures and full cost implications. |

Indicates budget numbers in Full Cost.

Indicates changes since the FY 2003 Presidents Budget Submit.

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

**THEME:** Innovative Technology Transfer Partnerships

# TECHNOLOGY AND ADVANCED CONCEPTS: Technology Transfer Partnerships

## PURPOSE

| Objective: | Reference FY 2003 Strategic Plan | Performance Measures |
|---|---|---|
| 3.3 | Improve the Nation's economic strength and quality of life by facilitating innovative use of NASA technology. | 4ITTP1 |
| 6.4 | Improve higher education capacity to provide for NASA's and the Nation's future science and technology workforce requirements. | 4ITTP2 |
| 10.6 | Enhance NASA's mission by leveraging partnerships between NASA Enterprises, U.S. industrial firms, and the venture capital community for innovative technology development. | 4ITTP3, 4ITTP4, 4ITTP5 |

The Technology Transfer Activities are designed to foster partnerships and cooperative activities with U.S. non-aerospace Industry and academia to facilitate the development of technology that is both applicable to NASA mission needs and contributes to commercial competitiveness in global markets. A new element of the Technology Transfer Activity promotes innovative technology partnerships between NASA, venture capital firms and U.S. industry for the benefit of NASA's Enterprise mission needs. These activities engage institutions of higher education in the NASA missions by providing opportunities and experience for students in the field of technology management through NASA intern experience.

## OVERVIEW

The FY 2004 budget terminates the Commercial Technology program. The budget provides for a new approach, known as the Enterprise Engine, which establishes partnerships with venture capital firms and U.S. industry on the development of commercial technologies that can directly contribute to the agency's core research activities, while benefiting private industry.

## PROGRAM MANAGEMENT

The program responsibility resides at NASA HQ. Enterprise official is Jeremiah Creedon, Associate Administrator for Aerospace Technology at HQ. Theme Director and Point of Contact is Robert L. Norwood, at NASA HQ. This program is in full compliance with NPG 7120.5B.

## TECHNICAL COMMITMENT

| Technical Specifications | FY04 President's Budget | | | | Change from Baseline |
|---|---|---|---|---|---|
| | | FY02 | FY03 | FY04 | |
| Promote and develop innovative technology partnerships between NASA, venture capital firms and U.S. industry for the benefit of NASA's Enterprise mission needs. | $M | 47.2 | 54.1 | 28.9 | Terminated in FY04, Continue only mandated technology transfer activities. |
| Engage institutions of higher education in the NASA mission by providing opportunities and experience for minority students in the field of technology management. (CK Metic) | $M | 1.5 | 1.5 | 0.0 | Project Termination in FY03. |
| Utilize the Enterprise Engine process to develop new technologies needed for Enterprise missions. | | | | 5.0 | New Partnership concept. |

**THEME:** Innovative Technology Transfer Partnerships

# TECHNOLOGY AND ADVANCED CONCEPTS: Technology Transfer Partnerships

## ACQUISITION STRATEGY & PERFORMING ORGANIZATIONS

Data current as of 1/21/2003

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

| Current Acquisitions | Actual * | Selection Method | Actual * | Performer | Actual * |
|---|---|---|---|---|---|
| Cooperative Agreements | 16% | Full & Open Competition | 84% | Industry | 65% |
| Cost Reimbursable | 84% | Sole Source | 16% | Government | % |
| Fixed Price | % | | 100% | NASA Intramural | % |
| Grants | % | | | University | 35% |
| Other | % | Sci Peer Review | % | Non Profit | % |
| * as % of FY02 direct procurement | 100% | * as % of FY02 direct procurement | | * as % of FY02 direct procurement | 100% |

| Future Acquisitions - Major | Selection | Goals |
|---|---|---|
| None | | |

## AGREEMENTS

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

*External* None.

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

## INDEPENDENT REVIEWS

Data current as of 1/21/2003

| Types of Review | Performer | Last Review | Next Review | Purpose |
|---|---|---|---|---|
| Technology Program Assessment | NAPA | FY1997 | FY2004 | Assess the quality, relevance and performance of Innovative Technology Transfer Partnership Program. |

## COST

| Budget Authority ($ in millions) | FY02 | FY03 | FY04 | Comments |
|---|---|---|---|---|
| Full Cost Budget FY2004 OMB Submit | | | | |
| **Commercial Programs** | 48.7 | 35.6 | 37.9 | |
| Commercial Technology | 40.9 | 29.8 | 11.5 | |
| Technology Transfer | 7.8 | 5.8 | 22.4 | |
| SBIR/STTR Program Management | | | 4.0 | |
| Changes since FY 03 Pres. Budget | +0.0 | +0.0 | +2.3 | ***Reason for Change:*** |
| Commercial Technology | | | -18.3 | Terminates in FY 2004 with Full Cost Ramp Down. |
| Technology Transfer | | | +16.6 | Increased for Enterprise Engine and Transfer of Regulatory Rqmts from Commercial Programs & Full Cost Implications. |
| SBIR/STTR Program | | | +4.0 | Increase for Program Management. |

Indicates budget numbers in Full Cost.

Indicates changes since the FY 2003 Presidents Budget Submit.

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

# Inspector General

## Introduction

The NASA Office of Inspector General (OIG) budget request for Fiscal Year 2004 (FY04) is $26.3 million. The request supports our mission to prevent and detect crime, fraud, waste, abuse, and mismanagement while promoting economy, effectiveness, and efficiency within the Agency. This request represents the OIG resources needed at NASA Headquarters and field offices to fulfill the OIG mission. Recognizing that the number of identified audits, investigations, inspections, assessments, and other activities significantly exceed the available resources, continuous adjustments of priorities will be necessary to ensure that a balanced coverage of NASA's programs and operations is maintained, critical and sensitive matters are promptly evaluated and investigated, and all OIG customers receive timely, accurate, and complete responses.

The Office of Audits (OA) conducts independent, objective audits and reviews of NASA and NASA contractor programs and projects, to improve NASA operations, as well as conducts a broad range of professional audit and advisory services, comments on NASA policies, and is responsible for oversight of audits performed under contract or by other Federal agencies. The OA helps NASA accomplish its objectives by bringing a systematic, disciplined approach to evaluate and improve the economy, efficiency and effectiveness of NASA operations.

The OIG Office of Criminal Investigations (OCI) identifies, investigates, and refers for prosecution cases of crime, waste, fraud, and abuse in NASA programs and operations. The OIG's Federal law enforcement officers investigate false claims, false statements, conspiracy, theft, mail fraud, and violations of Federal laws, such as the Procurement Integrity Act and the Anti-Kickback Act. Through its investigations, the OCI also seeks to prevent and deter crime at NASA. The OCI computer crimes unit has solved cases involving extortion of NASA and contractor personnel, loss of communications services, and the use of NASA-funded networks to further criminal enterprises including the compromise of advanced technologies and industrial espionage.

The Office of Inspections and Administrative Investigations (I&A) consists of a small core of analysts with expertise in a variety of fields, including procurement, communications security, management analysis, safety, and aerospace technology to provide independent and objective inspections and assessments of the effectiveness, efficiency, and economy of NASA programs and operations.

Our FY 2004 request is broken out as follows:

- 92.8 percent of the proposed budget is dedicated to personnel and related costs, including salaries, benefits, monetary awards, worker's compensation, metro subsidies and training, as well as the Government's contributions for Social Security, Medicare, health and life insurance, retirement accounts, matching contributions to Thrift Savings Plan accounts, the required 25 percent law enforcement availability pay (LEAP) for criminal investigators, and permanent change of station costs (PCS).
- 4.2 percent of the proposed budget is dedicated to travel, including the cost of transportation, per diem at current rates, and related expenses. The OIG staff is located at 14 offices in or near NASA installations and contactor facilities.
- 3 percent of the proposed budget is dedicated to operations and equipment, including government vehicles, special equipment for criminal investigators, and information technology equipment unique to the OIG.

## Budget

| Budget Authority ($ in millions) | FY 2002 | FY 2003 President's Budget, As Amended | FY 2004 President's Budget |
|---|---|---|---|
| Personnel & Related Costs | 21.8 | 22.7 | 24.3 |
| Travel | 1.2 | 1.2 | 1.2 |
| Operations & Equipment | 0.7 | 0.7 | 0.8 |
| Total | 23.7 | 24.6 | 26.3 |
| Full Time Equivalent (FTE) | 200 | 213 | 213 |

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SCIENCE, AERONAUTICS AND EXPLORATION
(INCLUDING TRANSFER OF FUNDS)

*For necessary expenses, not otherwise provided for, in the conduct and support of science, aeronautics and exploration research and development activities, including research, development, operations, support and services; maintenance; construction of facilities including repair, rehabilitation, revitalization, and modification of facilities, construction of new facilities and additions to existing facilities, facility planning and design, and acquisition or condemnation of real property, as authorized by law; environmental compliance and restoration; space flight, spacecraft control and communications activities including operations, production, and services; program management; personnel and related costs, including uniforms or allowances therefor, as authorized by 5 U.S.C. 5901–5902; travel expenses; purchase and hire of passenger motor vehicles; not to exceed $24,000 for official reception and representation expenses; and purchase, lease, charter, maintenance and operation of mission and administrative aircraft, $7,660,900 to remain available until September 30, 2005, of which amounts as determined by the Administrator for salaries and benefits; training, travel and awards; facility and related costs; information technology services; science, engineering, fabricating and testing services; and other administrative services may be transferred to "Space flight capabilities" in accordance with section 312(b) of the National Aeronautics and Space Act of 1958, as amended by Public Law 106–377.*

SPACE FLIGHT CAPABILITIES
(INCLUDING TRANSFER OF FUNDS)

*For necessary expenses, not otherwise provided for, in the conduct and support of Space Flight capabilities research and development activities, including research, development, operations, support and services; maintenance; construction of facilities including repair, rehabilitation, revitalization and modification of facilities, construction of new facilities and additions to existing facilities, facility planning and design, and acquisition or condemnation of real property, as authorized by law; environmental compliance and restoration; space flight, spacecraft control and communications activities including operations, production, and services; program management; personnel and related costs, including uniforms or allowances therefor, as authorized by 5 U.S.C. 5901–5902; travel expenses; purchase and hire of passenger motor vehicles; not to exceed $24,000 for official reception and representation expenses; and purchase, lease, charter, maintenance and operation of mission and administrative aircraft, $7,782,100, to remain available until September 30, 2005, of which amounts as determined by the Administrator for salaries and benefits; training, travel and awards; facility and related costs; information technology services; science, engineering, fabricating and testing services; and other administrative services may be transferred to ''Science, aeronautics and exploration'' in accordance with section 312(b) of the National Aeronautics and Space Act of 1958, as amended by Public Law 106–377.*

OFFICE OF INSPECTOR GENERAL

*For necessary expenses of the Office of Inspector General in carrying out the Inspector General Act of 1978, as amended, $26,300,000.*

ADMINISTRATIVE PROVISIONS

*Notwithstanding the limitation on the availability of funds appropriated for "Science, aeronautics and exploration", or "Space Flight capabilities" by this appropriations Act, when any activity has been initiated by the incurrence of obligations for construction of facilities as authorized by law, such amount available for such activity shall remain available until expended. This provision does not apply to the amounts appropriated for institutional minor revitalization and construction of facilities, and institutional facility planning and design.*

*Notwithstanding the limitation on the availability of funds appropriated for "Science, aeronautics and exploration", or "Space Flight capabilities" by this appropriations Act, the amounts appropriated for construction of facilities shall remain available until September 30, 2006.*

*From amounts made available in this Act for these activities, the Administration may transfer amounts between aeronautics of the "Science, Aeronautics and Exploration" account and crosscutting technologies of the "Space flight capabilities" account.*

*Funds for announced prizes otherwise authorized shall remain available, without fiscal year limitation, until the prize is claimed or the offer is withdrawn.*

# **FY 2004 BUDGET DATA:** Distribution of Funds by Installation

| Millions of Dollars | | 2003 | 2004 | Center Major Activities by Budget Theme: |
|---|---|---|---|---|
| **Ames Research Center** | Direct Personnel | 99 | 101 | *Aeronautics Technology:* Airspace Systems Program (Advanced Air Transportation Technologies, Virtual Airspace Modeling and Simulation, Airspace Operation System); Aviation Safety and Security (Safe Systems Technologies). *Mission & Science Measurement Technology:* Computing, Information, and Communication Technology Program (CICT / IT Strategic Research; Intelligent Systems; Communication, Network, Information System project); Engineering for Complex Systems Program (Resilient Systems and Operations; Knowledge Engineering for Safety and Success). *Biological Sciences Research*: ISS Fundamental Space Biology operations, Fundamental Space Biology Research. *Origins*: SOFIA, Kepler. *Earth System Science*: Supercomputing Research. |
| | Direct Travel | 4 | 4 | |
| | Center G& A | 136 | 129 | |
| | Service Pools | 169 | 173 | |
| | Program CoF | 0 | 0 | |
| | Total | 408 | 407 | |
| | FTEs | 1,506 | 1,444 | |
| **Glenn Research Center** | Direct Personnel | 149 | 156 | *Solar System Exploration:* In-Space Propulsion, Nuclear Power, Jupiter Icy Moons Orbiter. *Physical Sciences Research:* Fluids and Combustion Facility, ISS Physical Sciences operations, Fundamental Microgravity Research. *Aeronautics Technology*: ERAST, Aviation Safety Program, Airspace Systems Program, Vehicle Systems Technology (Quiet Aircraft Technology, 21st Century Aircraft, Ultra-Efficient Engine Technology, Propulsion and Power). *Space & Flight Support:* Plum Brook Decommissioning. *Space Launch Initiative:* Orbital Space Plane, Next Generation Launch Technology. *Fundamental Technology:* CICT, Engineering for Complex Systems, Enabling Concepts & Technology. |
| | Direct Travel | 3 | 3 | |
| | Center G& A | 97 | 100 | |
| | Service Pools | 84 | 84 | |
| | Program CoF | 10 | 7 | |
| | Total | 343 | 350 | |
| | FTEs | 1,924 | 1,934 | |
| **Langley Research Center** | Direct Personnel | 132 | 139 | *Mars Exploration:* Mars Reconnaissance Orbiter (Aero assist), Mars Exploration Rovers (Entry, Descent, and Landing), Mars 2007 Scouts (Planetary aircraft and EDL). *Earth System Science:* EP/Calipso, EO/GIFTS, EOS Instruments (e.g. SAGE). *Aeronautics Technology:* Aviation Safety/Security Program, Airspace Systems Program (Small Aircraft Transportation System, AATT, VAMS), Vehicle Systems Technology (Quiet Aircraft Technology, 21st Century Aircraft Technology). *Space Launch Initiative:* OSP/NGLT subsystem technologies, X-43C (Hypersonic Flight Demonstration and Follow-ons), Rocket/Turbine-Based Combined-Cycle. *Fundamental Technology:* CICT (IT Strategic Research), ECS (Systems Reasoning for Risk Management, Resilient Systems & Operations, Simulation Based Life Cycle Mgmt. Systems), ECT (Space NRA's, Advanced Systems Concepts, Advanced Spacecraft & Science Components). |
| | Direct Travel | 3 | 3 | |
| | Center G& A | 137 | 143 | |
| | Service Pools | 124 | 126 | |
| | Program CoF | 0 | 0 | |
| | Total | 396 | 411 | |
| | FTEs | 2,365 | 2,365 | |
| **Dryden Flight Research Center** | Direct Personnel | 34 | 34 | *Space Launch Initiative:* X-37 Approach and Landing Tests; X-43A Third flight; X-43C Flight demonstration for hydrocarbon fuel scramjet. *Aeronautics Technology:* UAV flight in the National Air Space; Energy Systems for Long Duration Flight; Integrated Flight Control Systems; Systems integration on an NF-15 and C-17; Unmanned Combat Air Vehicle; Active Aeroelastic Wing; Western Aeronautical Test Range communications, tracking, data acquisition and mission control. *Earth System Science:* Airborne Science Missions. *Space Shuttle:* Alternate landing site and provides operational and technical support for missions. |
| | Direct Travel | 1 | 1 | |
| | Center G& A | 39 | 41 | |
| | Service Pools | 37 | 37 | |
| | Program CoF | 0 | 0 | |
| | Total | 110 | 113 | |
| | FTEs | 595 | 566 | |
| **Goddard Space Flight Center** | Direct Personnel | 207 | 214 | *Solar System Exploration*: MESSENGER. *Origins*: HST, and JWST. *Structure & Evolution of the Universe*: GLAST, Swift, GALEX, SPIDR, Astro-E2, Constellation-X, LISA, Technology, Research. *Sun-Earth Connections:* Solar Terrestrial Probes, Living with a Star, STEREO, AIM. *Earth System Science:* EOS, ESSP, Ground Networks, LDCM, GPM, EOSDIS, NPP, Supercomputing Operations. |
| | Direct Travel | 6 | 6 | |
| | Center G& A | 161 | 171 | |
| | Service Pools | 143 | 147 | |
| | Program CoF | 5 | 0 | |
| | Total | 522 | 538 | |
| | FTEs | 3,323 | 3,329 | |
| **Marshall Flight Center** | Direct Personnel | 196 | 201 | *Physical Sciences Research*: ISS Physical Sciences Research operations, Fundamental Microgravity Research. *Research Partnerships and Flight Support*: ISS Research Multi-User Systems. *Solar System Exploration*: In-Space Propulsion, Nuclear Propulsion. *Structure and Evolution of the Universe*: GP-B, Chandra, Solar-B; *Aeronautics Technology:* Next Generation Launch Technology; *Space Launch Initiative*: Orbital Space Plane Capabilities. *Space Shuttle:* Space Shuttle Service Life Extension. *Space Station*: ISS Development. |
| | Direct Travel | 5 | 5 | |
| | Center G& A | 139 | 146 | |
| | Service Pools | 121 | 120 | |
| | Program CoF | 6 | 7 | |
| | Total | 467 | 479 | |
| | FTEs | 2,761 | 2,684 | |

## **FY 2004 BUDGET DATA:** Distribution of Funds by Installation

| Millions of Dollars | | 2003 | 2004 | Center Major Activities by Budget Theme: |
|---|---|---|---|---|
| **Stennis Space Center** | Direct Personnel | 14 | 16 | *Earth Science Applications*: national applications program, crosscutting solutions. *Aeronautics Technology:* Next Generation Launch Technology. *Space Shuttle*: Shuttle Main engine testing. *Space and Flight Support*: propulsion testing. |
| | Direct Travel | <1 | <1 | |
| | Center G& A | 43 | 39 | |
| | Service Pools | 17 | 17 | |
| | Program CoF | 5 | 2 | |
| | Total | 79 | 74 | |
| | FTEs | 301 | 300 | |
| **Johnson Space Center** | Direct Personnel | 249 | 254 | *Space Shuttle:* Operations, Space Shuttle Service Life Extension. *Space Station*: ISS Development and Operations. *Physical Sciences Research:* ISS Physical Sciences Research operations. *Biological Science Research*: Bioastronautics Research, ISS Bioastronautics Research operations. *Research Partnerships & Flight Support:* ISS Research Multi-User Systems and Support. *Aeronautics Technology:* Next Generation Launch Technology. *Space Launch Initiative*: Orbital Space Plane Capabilities. |
| | Direct Travel | 7 | 7 | |
| | Center G& A | 157 | 159 | |
| | Service Pools | 114 | 121 | |
| | Program CoF | 3 | 4 | |
| | Total | 530 | 545 | |
| | FTEs | 2,975 | 2,895 | |
| **Kennedy Space Center** | Direct Personnel | 116 | 112 | *Space Shuttle Ground Operations*: Launch & Landing, Space Shuttle Service Life Extension. *Space and Flight Support Operations*: ISS Payload Processing, ELV Launch Processing, Other Payload Processing. *Space Launch Initiative*: Orbital Space Plane Capabilities. |
| | Direct Travel | 3 | 3 | |
| | Center G& A | 166 | 169 | |
| | Service Pools | 109 | 112 | |
| | Program CoF | 9 | 42 | |
| | Total | 403 | 438 | |
| | FTEs | 1,870 | 1,798 | |
| **Jet Propulsion Laboratory** | N/A since FFRDC | | | *Solar System Exploration*: Deep Impact, Dawn, Deep Space Network, Cassini, Jupiter Icy Moon Orbiter, Mission Development, and Operations, Research. *Mars Exploration*: All projects. *Origins*: SIRTF, SIM, TPF. *Structure and Evolution of the Universe*: Herschel, Planck. *Earth System Science*: EOS Instruments, Physical Oceanography Missions, ESSP Missions. |

## FY 2004 BUDGET DATA: Reimbursable Estimates

### Reimbursable Estimates by Appropriation

| Budget Authority ($ in millions) | FY 2002 | FY 2003 President's Budget, As Amended | FY 2004 President's Budget |
|---|---|---|---|
| Human Space Flight | 277.0 | 345.9 | -- |
| Science, Aeronautics and Technology | 455.0 | 641.8 | -- |
| Mission Support | 4.0 | -- | |
| Science, Aeronautics and Exploration | -- | -- | 617.4 |
| Space Flight Capabilities | -- | -- | 327.6 |
| Total | 736.0 | 987.7 | 945.0 |

# FY 2004 BUDGET DATA: Civil Service Distribution Detail

The civil service workforce is the underpinning for the successful accomplishment of the Nation's civil aeronautics and space programs. These are the people who plan the programs; conduct and oversee the research; select and monitor the contractors; manage the various research, development, and test activities; and oversee all of NASA's operations. A key dimension of the reinvention of NASA has been the restructuring of the civil service workforce to deliver a space and aeronautics program that is balanced, relevant, and at the forefront of technology development.

Primary goals:

- Acquire and maintain a civil service workforce reflecting the cultural diversity of the Nation.
- Provide a workforce sized and skilled consistent with accomplishing NASA's research, development, and operational missions with innovation, excellence, and efficiency.

.

## Civil Service Distribution Detail

| Full Time Equivalents (FTEs) | FY 2002 | FY 2003 | FY 2004 |
|---|---|---|---|
| Johnson Space Center | 2,999 | 2,975 | 2,895 |
| Kennedy Space Center | 1,832 | 1,870 | 1,798 |
| Marshall Space Flight Center | 2,703 | 2,761 | 2,684 |
| Stennis Space Center | 298 | 301 | 300 |
| Ames Research Center | 1,466 | 1,506 | 1,444 |
| Dryden Flight Research Center | 597 | 595 | 566 |
| Langley Research Center | 2,332 | 2,365 | 2,365 |
| Glenn Research Center | 1,923 | 1,924 | 1,934 |
| Goddard Space Flight Center | 3,273 | 3,323 | 3,329 |
| Headquarters | 1,048 | 1,217 | 1,378 |
| **Total** | **18,471** | **18,837** | **18,693** |

# FY 2004 BUDGET DATA: Personnel Salary, Benefits, and Related Costs (Fund Source 41), Travel (Fund Source 42) and Research Operations Support (Fund Source 43)

## DETAIL OF BUDGET PLAN BY FUNCTION

### A. Research and Program Management (R&PM) program

The Research and Program Management (R&PM) program provides the salaries, other personnel and related costs, travel and the necessary support for all of NASA's administrative functions and other basic services in support of research and development activities at NASA installations.

I. Personnel and Related Costs

a. Compensation and benefits: covers the salaries and benefits of the NASA's full-time permanent and other than full-time permanent positions, reimbursable detailees, overtime, and other compensation.

b. Supporting Costs: provides funding for relocation costs required by law, reimbursements to the Office of Personnel Management for activities such as security investigations of new hires and revalidation of sensitive position clearances, and personnel training.

II. Travel

Provides funding for direction, coordination, and management of program activities including international programs and activities. Also permits employees engaged in research and development to participates in both Government sponsored and non-government sponsored activities. Provides for direction and coordination of general management matters and travel by officials to review the status of programs.

III. Research Operations Support (ROS)

Provides broad range of services, supplies, and equipment in support of each center's institutional activities. These are divided into three major sub-functional areas. Facilities Services, covering the cost of rental of real property, maintaining and repairing institutional facilities and equipment, and the cost of custodial services and administrative utilities; Technical Services, covering the cost of automatic data processing for management activities, and the cost of informational programs and technical shops supporting institutional activities; Management and Operations, covering the cost of Administrative communications, printing, transportation, medical, supply, and related services. Reallocation of Research Operations Support under Full-Cost will begin in FY 04. Does not include personnel and travel funds.

Funding in FY 04 and out is more directly linked to supported programs/projects rather than being lumped in a single budget line. Institutional resources justified based on project requirements (directly or indirectly). Once we transition to full cost, direct traceability back to previous budgets is no longer possible. Previous year budgets cannot be recalculated into full cost. There is not a one to one correlation.

| **Previous ROS Funding** | **FY 04 and Out-Year Funding in Which ROS-like Capabilities Exist** |
|---|---|
| - Facilities Services | - Corporate General and Administrative Costs (G&A) |
| - Technical Services | - Service Pools |
| - Management & Operations | - Center General and Administrative Costs (G&A) |

# FY 2004 BUDGET DATA: Personnel Salary, Benefits, and Related Costs (Fund Source 41), Travel (Fund Source 42) and Research Operations Support (Fund Source 43)

| Detail of Budget Plan by Function ($ in millions) | FY 2002 | FY 2003 | FY 2004 |
|---|---|---|---|
| **I. Personnel and Related costs** | **$1,885.9** | **$2,013.8** | **$2,107.1** |
| A. Compensation and benefits | $1,821.9 | $1,951.1 | $2,037.0 |
| 1. Compensation | $1,486.4 | $1,596.6 | $1,646.1 |
| 2. Benefits | $335.5 | $354.5 | $390.9 |
| B. Supporting costs | $64.0 | $62.7 | $70.1 |
| 1. Transfer of personnel | $7.3 | $3.1 | $7.5 |
| 2. Investigative services | $2.0 | $1.9 | $0.7 |
| 3. Personnel training | $54.3 | $57.7 | $60.2 |
| 4. Other | $0.4 | $0.0 | $1.7 |
| **II. Travel** | **$52.6** | **$59.2** | **$63.1** |
| A. Program Travel | $29.9 | $35.2 | $33.5 |
| B. Scientific and technical development travel | $7.4 | $8.5 | $13.5 |
| C. Management and operations travel | $15.3 | $15.5 | $16.1 |
| **III. Research Operations Support** | **$645.1** | **$566.4** | **$0.0** |
| A. Facilities services | $246.8 | $182.7 | $0.0 |
| B. Technical services | $224.8 | $218.2 | $0.0 |
| C. Management and operations | $173.5 | $165.5 | $0.0 |
| **Total** | **$2,583.6** | **$2,639.4** | **$2,170.2** |

* FY2004 budget excludes ROS funding. Funding in FY 04 and the out-years are more directly linked to support programs/projects rather than being included in a single budget line. Institutional resources are justified based on project requirements (directly or indirectly).

## DISTRIBUTION OF BUDGET PLAN BY FUNCTION BY INSTALLATION

| Total Fund Source 41/42/43 (In Millions of Dollars) | FY 2002 | FY 2003 | FY 2004 |
|---|---|---|---|
| Johnson Space Center | $396.6 | $404.7 | $365.7 |
| Kennedy Space Center | $305.0 | $289.6 | $194.3 |
| Marshall Space Flight Center | $93.2 | $351.3 | $298.4 |
| Stennis Space Center | $289.0 | $49.6 | $28.7 |
| Ames Research Center | $216.2 | $214.5 | $186.2 |
| Dryden Flight Research Center | $253.5 | $258.6 | $250.3 |
| Langley Research Center | $211.2 | $223.9 | $207.8 |
| Glenn Research Center | $64.2 | $67.0 | $63.8 |
| Goddard Space Flight Center | $388.1 | $395.5 | $356.6 |
| Headquarters | $366.6 | $384.7 | $218.4 |
| **Total** | **$2,583.6** | **$2,639.4** | **$2,170.2** |

* FY2004 budget excludes ROS funding. Funding in FY 04 and the out-years are more directly linked to support programs/projects rather than being included in a single budget line. Institutional resources are justified based on project requirements (directly or indirectly).

# FY 2004 BUDGET DATA: Summary of Consulting Services

## Consulting Services

NASA uses paid experts and consultants to provide advice and expert input in addition to or beyond that available from its in-house civil service workforce. Management controls are established which assure that before entering into a consultant services arrangement with an individual that there is ample justification presented and the action is approved at top management levels.

NASA also uses experts and consultants to provide expert advice and input on the selection of experiments for future space missions. The use of these experts and consultants, in addition to NASA civil service personnel, provides the agency with an independent view that assures the selection of experiments likely to have the greatest scientific merit. Other individuals are used to provide independent looks at technical and functional problems in order to give top management the widest possible range of views before making major decisions.

| **Budget Authority ($)** | **FY 2002 Actuals** | **FY 2003 Estimates** | **FY 2004 Budget** |
|---|---|---|---|
| Number of Paid Experts and Consultants | 35 | 50 | 50 |
| Annual FTE Usage | 3 | 3 | 3 |
| Salaries | 290,000 | 298,990 | 306,166 |
| | | | |
| Total Salary and Benefit Costs | 314,650 | 324,404 | 332,190 |
| Travel Costs | 532,826 | 548,811 | 565,275 |
| Total Costs | 847,476 | 873,215 | 897,465 |

# FY 2004 BUDGET DATA: Full Funding of Federal Retiree Costs

## Full Funding of Federal Retiree Costs

The Administration has proposed legislation (Budgeting and Managing for Results: Full Funding for Federal Retiree Costs Act of 2002 to require agencies, beginning in FY 2004, to pay the full Government share of the accruing cost of retirement for current CSRS, CIA and Foreign Service employees, the Coast Guard, Public Health Service, and NOAA Commissioned Corps. The legislation also requires agencies to pay the full accruing cost of post-retirement health benefits for current civilian employees and the post retirement health costs of all retires (and their dependents/survivors) of the Uniformed Services (DOD, Coast Guard, Public Health Service, and NOAA Commissioned Corps).

| **Budget Authority ($ in millions)** | **FY 2002 Actuals** | **FY 2003 Estimates** | **FY 2004 Budget** |
|---|---|---|---|
| Human Space Flight | 39.5 | 43.6 | -- |
| Science, Aeronautics and Technology | 71.8 | 74.8 | -- |
| Inspector General | 1.2 | 1.3 | 1.4 |
| Science, Aeronautics and Exploration | -- | -- | 63.3 |
| Space Flight Capabilities | -- | -- | 62.8 |
| Total | 112.5 | 119.7 | 127.5 |

# FY 2004 BUDGET DATA: The National Institute of Aerospace (NIA)

## The National Institute of Aerospace (NIA)

The National Institute of Aerospace is a research and education institute initiated by NASA Langley Research Center (LaRC) to ensure a national capability to support NASA's mission by expanding collaboration with academia and leveraging expertise inside and outside NASA. A nationwide competitive procurement process resulted in the selection of a consortium that created the non-governmental, non-profit Institute. The consortium members include the American Institute of Aeronautics and Astronautics Foundation, Georgia Institute of Technology, North Carolina Agricultural and Technical State University, North Carolina State University, University of Maryland, University of Virginia, and Virginia Polytechnic Institute and State University.

The Institute will be a strategic partner conducting leading edge research working in collaboration with LaRC. The technical scope of the Institute is research and development of aerospace vehicle technologies, atmospheric sciences, and commercialization of the intellectual property created by the Institute. In synergy with the research programs at LaRC, the Institute will also have a science and engineering graduate education capability provided by the university partners.

One of the unique aspects of the Institute will be the use of information technology to create both a virtual collaborative research environment and a distance-learning educational capability. This is a particularly innovative approach to leveraging the unique facilities and laboratories of LaRC and the partners. The Institute has also established a permanent location in close proximity to LaRC to enhance collaboration with LaRC research personnel and to facilitate access to the extensive world-class experimental facilities located at LaRC. The Institute is housed in commercial rental office space.

NASA will provide up to $5M per year for five years to sponsor a Core Program. The Core Program includes support to establish the initial research and education infrastructure of the Institute and to fund the Distinguished Professor (DP) Program. The DP Program is a resident scholars program that will attract the nation's most gifted researchers to the Institute. After the first five years, the Institute will develop a broader customer base and become self-sufficient, receiving no "core" funding from NASA. The only NASA funds it will receive will be from those specific programs and projects that require the Institute's services. Anticipated funding by NASA to the Institute and University cost-sharing is given below:

| **Budget Authority ($ in millions)** | **FY 2002 Actuals** | **FY 2003 Estimates** | **FY 2004 Budget** |
|---|---|---|---|
| NASA Funding | 0.7 | 3.5 | 5.0 |
| University Cost-Sharing | -- | 1.4 | 1.6 |
| Total Core Program Funding | 0.7 | 4.9 | 6.6 |
| NASA "service pool" funding from programs/projects* | -- | [ * 2.4] | [ * est. 3.0-7.0] |

* - Other potential funding based on usage, may go to the Institute from NASA Programs/Projects using a "service pool" mode.

# FY 2004 BUDGET DATA: Construction of Facilities

## SUMMARY OF RESOURCES INCLUDED IN BUDGET REQUEST

| In Millions of Dollars | FY 2002 | FY 2003 | FY 2004 |
|---|---|---|---|
| Space Flight Capabilities Programs | 46.2 | 18.2 | 57.4 |
| Science, Aeronautics and Exploration Programs | 56.0 | 41.9 | 7.0 |
| Institutional Support Programs (included within Center G&A) | 177.2* | 161.9* | 184.0 |
| Total Construction of Facilities | 279.4* | 222.0* | 248.4 |

The Construction of Facilities (CoF) program ensures that the facilities critical to achieving NASA's space and aeronautics programs are constructed and continue to function effectively, efficiently, and safely, and that NASA installations conform to requirements and initiatives for the protection of the environment and human health. NASA facilities are essential to the Agency and facility revitalization is needed to maintain infrastructure that is safe and capable of supporting NASA's missions. The facilities being revitalized or constructed in this program are expected to remain active in the long term and are consistent with current and anticipated Agency roles and missions.

Funding for construction projects required for specific programs is included in the appropriate budget line item within each Enterprise. Institutional Support Construction of Facilities (CoF) projects are required for components of NASA's basic infrastructure and institutional facilities. Beginning in FY 2004, funding for Institutional Support CoF identified to specific Centers has been included in that Center's G&A rate, and the agency-wide initiatives are included as part of Corporate G&A. Descriptions and cost estimates of both institutional and program direct projects are provided to show a complete picture of NASA's budget requirement for facilities.

The institutional facility projects requested for FY 2004 continue the vital rehabilitation, modification, and repair of facilities to renew and help preserve and enhance the capabilities and usefulness of existing facilities and ensure the safe, economical, and efficient use of the NASA physical plant. They repair and modernize deteriorating and obsolete building and utility systems that have reached or exceeded their normal design life, are no longer operating effectively or efficiently, and cannot be economically maintained. These systems include mechanical, structural, cooling, steam, electrical distribution, sewer, and storm drainage. Some projects replace substandard facilities in cases where it is more economical to demolish and rebuild than it is to restore. In selected cases, additional square footage may be built when there are compelling reasons to support new or specialized technical and/or institutional requirements of a nature that cannot be provided by using existing facilities. Projects with an estimated cost of at least $5.0 million are budgeted as discrete projects, while projects between $0.5 million and $5.0 million are included as Minor Revitalization and Construction projects. Should residual resources become available from these projects, they will be used for urgently needed facility revitalization requirements. Congress will be notified before work is initiated for any such project that is $5.0 million or greater. Funds requested for Facility Planning and Design cover: advance planning and design requirements for potential future projects; preparation of facility project design drawings and bid specifications; master planning; facilities studies; engineering reports and studies; and critical functional leadership activities directed at increasing the rate of return of constrained Agency resources while keeping the facility infrastructure safe, reliable, and available.

** Construction of Facilities previously included the Environmental Compliance and Restoration program, which is now separately identified as a direct program within the Space and Flight Support theme.*

# FY 2004 BUDGET DATA: Construction of Facilities

## SUMMARY OF FY 2004 PROGRAM DIRECT PROJECTS BY PROGRAM

| In Millions of Dollars | FY 2002 | FY 2003 | FY 2004 |
|---|---|---|---|
| **SPACE FLIGHT CAPABILITIES COF PROGRAMS** | **46.2** | **18.2** | **57.4** |
| INTERNATIONAL SPACE STATION | 4.5 | --- | --- |
| Modify ISS Software Development Integration Lab (JSC) | 4.5 | --- | --- |
| SPACE SHUTTLE | 39.5 | 15.0 | 53.9 |
| Repairs to Launch Complex LC-39A (KSC) | --- | --- | 22.4 |
| Replace Roof, Vehicle Assembly Building (KSC) | --- | --- | 16.0 |
| Replace Cell "E" Air Handling Units, Building 110 (MAF) | --- | 1.7 | --- |
| Replace Chilled Water, Steam, and Condensate Systems (110, 114) (MAF) | 1.9 | 2.0 | --- |
| Replace Paint Spray Facility, Building 103 (MAF) | --- | 2.0 | --- |
| Repair Crane Hoist Trolley Motor Drive, Rotating Payload Servicing Facility (KSC) | 1.6 | --- | --- |
| Repairs to the Vehicle Assembly Building (KSC) | 25.0 | --- | --- |
| Restore Low Voltage Power System, Pad B (KSC) | 2.0 | --- | --- |
| Repair and Modernize A-Complex (SSC) | 3.0 | --- | --- |
| Minor Revitalization (various locations) | 4.5 | 7.8 | 13.8 |
| Facility Planning and Design | 1.5 | 1.5 | 1.7 |
| SPACE AND FLIGHT SUPPORT | 2.4 | 3.2 | 3.5 |
| Minor Revitalization (various locations) | 1.9 | 3.0 | 3.0 |
| Facility Planning and Design | 0.3 | 0.2 | 0.4 |
| **SCIENCE, AERONAUTICS & EXPLORATION COF PROGRAMS** | **56.0** | **41.9** | **7.0** |
| SPACE SCIENCE | 29.2 | 21.7 | 0.0 |
| Construct Flight Projects Center (JPL) | --- | 16.5 | --- |
| Safety Renovations, Buildings 2 and 26 (GSFC) | 1.7 | --- | --- |
| Construct 34-Meter Beam Waveguide Antenna, Spain (JPL) | 5.0 | --- | --- |
| Construct Propulsion Research Laboratory (MSFC) | 22.0 | --- | --- |
| Facility Planning and Design | 0.5 | 5.2 | --- |
| BIOLOGICAL AND PHYSICAL RESEARCH | 6.8 | 2.8 | 0.0 |
| Construct Booster Applications Facility, Brookhaven National Laboratory | 6.8 | 2.8 | --- |
| EARTH SCIENCE | 0.0 | 3.4 | 0.0 |
| Construct Flight Projects Center (JPL) | --- | 3.4 | --- |
| AERONAUTICS* | 20.0 | 14.0 | 7.0 |
| Modify Cell W-2 for Dual-Spool Turbine Research, ERB (GRC)** | --- | 10.0 | 7.0 |
| Construct Rocket-Based Combined Cycle Test Facility (SSC) | 8.0 | 4.0 | --- |
| Construct Addition to Main Administration Building (SSC) | 3.5 | --- | --- |
| Construct Propulsion Test Operations Facility (SSC) | 1.5 | --- | --- |
| Upgrade E-Complex Test Capabilities (SSC) | 5.0 | --- | --- |
| Construct Vehicle, Spacecraft & Payload Processing Facility (WFF) | 2.0 | --- | --- |

**FY02 and FY03 includes the non-aeronautics portion of Aerospace Technology*
***FY03 will be adjusted in future operating plan to reflect rephasing; total projected cost is $12M*

# FY 2004 BUDGET DATA: Construction of Facilities

## SUMMARY OF FY 2004 INSTITUTIONAL SUPPORT PROJECTS

| In Millions of Dollars | FY 2002 | FY 2003 | FY 2004 |
|---|---|---|---|
| **INSTITUTIONAL SUPPORT PROJECTS*** | **177.2** | **161.9** | **184.0** |
| Rehabilitate and Upgrade Electrical and Mechanical Systems (24) Phase 1 of 2 (JSC) | --- | --- | 5.0 |
| Consolidation of Business Functions into Building 1194 (LaRC) | --- | --- | 9.2 |
| Construct Replacement Office Building, 4600 Area (MSFC) | --- | 7.3 | 15.7 |
| Repair Roofs and Masonry, Various Buildings (GRC) | --- | 1.8 | --- |
| Repair Sanitary Sewer System (GRC) | 3.9 | 1.6 | --- |
| Upgrade 150 PSIG Combustion Air System, ERB, (GRC) | --- | 3.5 | --- |
| Realign Soil Conservation Service Road, Greenbelt (GSFC) | --- | 4.4 | --- |
| Repair Site Steam Distribution System (GSFC) | 4.0 | 2.3 | --- |
| Relocate and Revitalize High Efficiency Antenna, DSS-65, Madrid Spain (JPL) | --- | 2.0 | --- |
| Construct Operations Support Building II, LC-39 Area (KSC) | 12.8 | 5.6 | --- |
| Replace Air Handling Units, Headquarters Building (KSC) | --- | 2.0 | --- |
| Repairs to Air Conditioning Systems, Various Facilities (LaRC) | 2.1 | 3.7 | --- |
| Upgrade Hangar Fire Suppression System, B1244 (LaRC) | --- | 2.8 | --- |
| Replace Roof, External Tank Manufacturing Building (MAF) | 12.0 | 11.0 | --- |
| Replace Site-Wide High Voltage Oil Switches (MAF) | --- | 2.8 | --- |
| Repairs to Airfield (WFF) | --- | 2.0 | --- |
| Construct Child Care Facility (ARC) | 1.1 | --- | --- |
| Restore Electrical Distribution System (ARC) | 8.9 | --- | --- |
| Rehabilitate and Modify Central Emergency Generator System (DFRC) | 3.0 | --- | --- |
| Restore Parkway Bridge (GSFC) | 2.9 | --- | --- |
| Connect Madrid Deep Space Complex to Commercial Power (JPL) | 2.8 | --- | --- |
| Interior Modifications to Mission Operations Building 264 (JPL) | 1.9 | --- | --- |
| Rehabilitate Aircraft Hangar, Ellington Field (JSC) | 3.2 | --- | --- |
| Construct Operations Support Building, Pad A (KSC) | 4.5 | --- | --- |
| Construct Replacement Air Traffic Control Tower, Shuttle Landing Facility (KSC) | 2.2 | --- | --- |
| Rehabilitate Atmospheric Sciences Building, 1250 (LaRC) | 2.4 | --- | --- |
| Replace Heater, 20-inch Mach 6 CF4 Tunnel (LaRC) | 4.7 | --- | --- |
| Rehabilitate Interior, Office and Laboratory Building (MSFC) | 1.8 | --- | --- |
| Rehabilitate and Modify Productivity Enhancement Complex (MSFC) | 3.6 | --- | --- |
| Rehabilitate Precision Cleaning Facility (MSFC) | 2.1 | --- | --- |
| Repair and Upgrade Substations 31, 32, and 33 (MAF) | 2.4 | --- | --- |
| Renovation of Management Education Center Dormitory (WFF) | 2.0 | --- | --- |
| Minor Revitalization and Construction of Facilities at Various Locations, Less than $0.5M per project | | 91.9 | 127.1 |
| Facility Planning and Design | 15.7 | 17.2 | 17.0 |
| Demolition of Facilities | --- | --- | 10.0 |

**Beginning in FY 2004, funding for Institutional Support CoF identified to specific Centers has been included in that Center's G&A rate, and agency-wide initiatives are included within Corporate G&A.*

## SPACE FLIGHT CAPABILITIES PROGRAMS DISCRETE PROJECTS

Space Shuttle Program

Project Title: Repairs to Launch Complex 39A
Location: Kennedy Space Center, Brevard County, Merritt Island, FL
Enterprise: Human Exploration & Development of Space
FY 04 Estimate: $22.4M

This project provides for the complete repair and refurbishment of Launch Complex 39A (LC-39A). LC-39A consists of the Fixed Service Structure (FSS) tower, which is approximately 300 feet tall and 40 feet square with a central core containing two elevators, and the Rotating Service Structure (RSS) tower, which is approximately 130 feet tall and 52 feet square. The Orbiter Access Arm/White Room (OAA/WR), Orbiter Weather Protection (OWP), Payload Change-out Room (PCR), and Forward Reaction Control System (FRCS) are integral parts of these tower structures. This project removes and replaces corrosion damaged structural members and connections on the FSS and on the RSS at LC-39A. RSS drive truck assemblies and rail systems will be repaired. Existing deteriorated panels on the PCR and the FRCS will be replaced with corrugated stainless steel sandwich insulated panels. All mechanical and electrical wall penetrations will be removed and rerouted through new centralized bulkhead plates. The OAA/WR will be upgraded with stronger structural supports. The walls and floors will be refurbished to withstand the harsh launch environment. Orbiter weather protection will be upgraded to provide explosion proof, hardened enclosures against weather and launch environments. New controls will be installed to operate weather curtains and struts. The project will perform corrosion control and seal the LC-39A structure with inorganic zinc coating. The project also includes modifications to improve safe access for operations, maintenance, future inspections and corrosion protection where practical. All abandoned equipment, structural elements, supports, lines, and associated hardware shall be removed. Mechanical, electrical and control systems will be upgraded. LC-39A concrete surfaces, slopes and concrete structural beams will be repaired, reinforced and sealed. Other associated minor repairs, modifications and upgrades will be accomplished as required.

Project Title: Replace Roof, Vehicle Assembly Building
Location: Kennedy Space Center, Brevard County, Merritt Island, FL
Enterprise: Human Exploration & Development of Space
FY 04 Estimate: $16.0M

This project replaces the roof of the Vehicle Assembly Building (VAB), which is used to perform the final assembly and checkout of the Shuttle and serves as a safe haven for Shuttle components in times of severe weather threats such as hurricanes. The roofing membrane system will be replaced and necessary structural repairs made. The project includes replacing approximately 210,000 square feet (5 acres) of roofing and 6,500 square feet of roof vents, and repairing approximately 15,000 square feet of concrete roof slab. The construction work is complicated by several factors that drive up the project costs. The roof level is 526 feet above grade requiring special material and personnel access elevators, and limiting the flow of materials removed from and delivered to the roof. The existing roofing materials to be removed are 8 inches thick (140,000 cubic feet volume) and require extensive demolition work. Additionally, significant work restrictions due to safety, operational, and security considerations are applied that create inefficiencies to the workflow.

**SCIENCE, AERONAUTICS & EXPLORATION PROGRAMS DISCRETE PROJECTS**

Aeronautics -- Vehicle Systems Program

Project Title: Modify Cell W-2 for Dual-Spool Turbine Research, ERB
Location: Glenn Research Center, Cleveland, OH
Enterprise: Aerospace Technology
FY 04 Estimate: $7.0M

This project provides for the modifications to Cell W-2 of the Engine Research Building (ERB) No. 23. These modifications will provide a Dual Spool Turbine Facility (DSTF) for continuous flow testing of highly loaded, closely coupled turbine systems. Existing Glenn Central Systems such as the 150 psig Combustion Air System and the Altitude Exhaust System will be modified as part of this project. Combustion Air will be heated to 1000°F using a new non-vitiated air heater system. A custom-designed inlet air manifold will introduce uniform heater air into the inlet of the test section. Custom-designed bearing cartridges will accommodate a wide size and weight range of high-pressure (HP) and low-pressure (LP) turbine rotors. Turbine power absorption will be accomplished using two new synchronous generators controlled by the Variable Frequency System. A new exhaust manifold will be used to collect the primary and cooling air flows from the test section outlet. All exhaust will be ported to the Altitude Exhaust System. Facility health monitoring and control will be accomplished using Programmable Logic Controllers (PLCs) mounted in an existing control room.

## SUMMARY OF INSTITUTIONAL SUPPORT COF RESOURCE REQUIREMENTS

| In Millions of Dollars | FY 2002 | FY 2003 | FY 2004 |
|---|---|---|---|
| Discrete Projects | 84.3 | 52.8 | 29.9 |
| Minor Revitalization and Construction | 77.2 | 91.9 | 127.1 |
| Facility Planning and Design | 15.7 | 17.2 | 17.0 |
| Demolition | -- | -- | 10.0 |
| Total Institutional Construction of Facilities | 177.2 | 161.9 | 184.0 |

## INSTITUTIONAL SUPPORT DISCRETE PROJECTS

Project Title: Rehab and Upgrade Electrical and Mechanical Systems (Bldg. 24)
Location: Johnson Space Center, Harris County, Houston, TX
Enterprise: Human Exploration & Development of Space
FY 04 Estimate: $5.0M

This project upgrades the Central Heating and Cooling Plant, Building 24, which provides steam, chilled water, and compressed air to the entire JSC central mall. Scope includes installation of two 2,000-ton steam turbine drive chillers, a new filtration system on the chilled water distribution system, a new 60,000-pound per hour boiler and modifications to the 12 KV power distribution system (including a new pre-cast exposed aggregate facing panel enclosure). This is the first increment of a two-phase project with estimated total construction cost of $11.5 million.

Project Title: Consolidation of Business Functions into Building 1194
Location: Langley Research Center, Hampton, VA
Enterprise: Aerospace Technology
FY 04 Estimate: $9.2M

This project rehabilitates existing space to current standards, including replacement of mechanical and electrical systems, layout reconfiguration, replace finishes, and upgrade fire detection and suppression systems. The facility will also be expanded by 40,000 $ft^2$ to accommodate the consolidation of several business functions, including the Source Evaluation Boards, Training, and other administrative support functions. The construction will consist of a concrete foundation, structural steel frame, concrete floors, masonry exterior, and flat roof system. The site work includes reconfiguring the access roads, sidewalks, and handicap access ramps; constructing parking lots; and landscaping. The renovation and construction will meet all current national codes and standards including compliance with Americans for Disabilities Act, National Fire Protection Association, National Electric Code and American Society of Heating, Refrigeration, Air-Conditioning Engineers. Upon completion of the project, the Center will dispose of approximately 15 substandard trailers that currently house training and secure source board personnel.

Project Title: Construct Replacement Office Building, 4600 Area
Location: Marshall Space Flight Center, Huntsville, AL
Enterprise: Human Exploration & Development of Space
FY 04 Estimate: $15.7M

This project replaces about 130,000 square feet (SF) of mostly 1940's vintage office buildings scattered throughout the 4600 and 4700 areas with a multi-story office building of approximately 135,000 SF. Existing facilities are in an extreme state of disrepair and cannot be economically rehabilitated. Site utilities will include basic electrical, potable water, sanitary sewer, chilled water, communications, and storm drainage. Utility runs to the site will be sized to facilitate future construction of additional replacement office buildings over the next several years. Mechanical systems will provide climate control, potable water, sanitary sewer, chilled water, and sprinkler systems. Climate controls will be connected to the existing center-wide utility control system. Paved surface parking for the new facility and landscaping are included in the project. The buildings being replaced by this project will be demolished once they are vacated. This is the second and final increment of a two-phase project ($7.3M in FY03/$15.7M in FY04). Estimated total construction cost is $23 million. About $6 million in non-construction funds are being budgeted separately for the activation and outfitting costs associated with this project.

# FY 2004 BUDGET DATA: Construction of Facilities

**Minor Revitalization & Construction of Facilities less than $5.0M/project**

| | Institutional Support | Space Flight Capabilities |
|---|---|---|
| FY 04 Estimate (Millions of Dollars) | 127.1 | 16.8 |
| Ames Research Center | 10.5 | |
| Dryden Flight Research Center | 7.0 | |
| Glenn Research Center | 18.4 | |
| Goddard Space Flight Center | 17.2 | |
| Jet Propulsion Laboratory | 14.2 | |
| Johnson Space Center | 7.9 | 3.5 |
| Kennedy Space Center | 19.7 | 3.7 |
| Langley Research Center | 14.2 | |
| Marshall Space Flight Center | 8.7 | 7.4 |
| Stennis Space Center | 9.3 | 2.2 |

This request includes facility revitalization and construction needs greater than $0.5 million but less than $5.0 million per project. Projects $0.5 million and less are normally accomplished by routine day-to-day facility maintenance and repair activities provided for in direct program and Center operating budgets. Proposed FY 2004 Institutional Support projects total $127.1 million for components of the basic infrastructure and institutional facilities, and $16.8 million for specific Space Flight Capabilities projects. These resources provide for revitalization and construction of facilities at NASA field installations and Government-owned industrial plants supporting NASA activities. Revitalization projects provide for the repair, modernization, and/or upgrade of facilities and collateral equipment. Repair and modernization projects restore facilities and components to a condition substantially equivalent to the originally intended and designed capability. Repair and modernization work includes the substantially equivalent replacement of utility systems and collateral equipment necessitated by incipient or actual breakdown. It also includes major preventive measures that are normally accomplished on a cyclic schedule, and those quickly needed out of cycle based on adverse condition information revealed during predictive testing and inspection efforts. Upgrade projects include both restoration of current functional capability, and also enhancement of the condition of a facility so that it can more effectively accomplish its designated purpose or increase its functional capability. Occasionally minor facility construction projects will be required to provide for either the construction of small new facilities or additions to existing facilities.

The projects that comprise this request are of the highest priority based on relative urgency and expected return on investment. The titles of the projects are designed to identify the primary intent of each project and may not always capture the entire scope or description of each project. Also, during the year, some rearrangement of priorities may be necessary which may force a change in some of the items to be accomplished. Any such changes, however, will be accomplished within total the resources available.

**Institutional Support Minor Revitalization Programs: $127.1 million**

A. Ames Research Center (ARC), $10.5 million for the following:

1. Fire Exits and Egress Modifications - Various Buildings
2. Seismic Upgrades - Various Facilities (N201 & 223)
3. Seismic Upgrades - Various Facilities (N233)
4. Rehabilitate and Modify 20 MW DC Power Supply, Phase IV
5. Rehabilitate and Modify HVAC System, N239
6. Upgrade Underground Communications Ductbank
7. Repair Roofs, Chillers and Air Handlers (N200 & 201)
8. Rehabilitate and Modify Fire Suppression Systems, Various Buildings
9. Repair North and South Steam Vacuum System Plenum Shells
10. Rehabilitate and Modify Utility Control Panels, N234

B. Dryden Flight Research Center (DFRC), $7.0 million for the following:
1. Rehabilitate and Modify Southeast Wing, B4800
2. Rehabilitate and Modify Data Analysis Facility, B4838
3. Rehabilitate and Modify Institutional Support Facility B4825
4. Repair Paving

C. Glenn Research Center (GRC), $18.4 million for the following:
1. Rehab & Mod Electric Propulsion Research Building Systems and Life Safety (16), Ph 1
2. Repair Roofs & Masonry, Various Buildings
3. Add Turboexpander for Refrigerated Air System, PSL (124)
4. Rehabilitate and Modify Model Fabrication and Instrument Facility (14), Phase 4
5. Modifications to Fire Alarm & Sprinkler Systems, ERB, Phase 2
6. Rehabilitate Special Projects Laboratory (24), Phase 1
7. Repair High Voltage System, Plum Brook
8. Rehabilitate and Modify Shop Area, Microwave Systems Laboratory (7)
9. Rehabilitate EPL Controls (301), Phase 1
10. Restore Vacuum Facility VF-7 (16)
11. Upgrade Test Cell SE-18, (ERB)
12. Rehabilitate of OMPVE Crystal Growth Facility (302)

D. Goddard Space Flight Center (GSFC), $17.2 million for the following:
1. Restore Portions of Data Interpretation Laboratory, B23
2. Construct Consolidated Engineering Facility, WFF
3. Modify Building M-20 for Hazardous Processing Facility, WFF
4. Repair Various Roofs, GRB
5. Upgrade Island Electrical Distribution System, WFF
6. Restore Instrument Construction and Development Laboratory, Building 5, Phase 1
7. Repair Fire Protect & Domestic Water Piping System, GRB
8. Revitalize Low Voltage Electrical Systems, Various Buildings
9. Modify Fire Protection and Detection Systems, WFF
10. Repair of Stormdrain System, Phase
11. Modify E-Complex - Phase 3
12. Modify HVAC Systems, Bldg F-10, WFF
13. Construct Mezzanine in Building 29

E. Jet Propulsion Laboratory (JPL), $14.2 million for the following:
1. Construct Addition to Micro Devices Laboratory, B302
2. Modify Information Systems Development Building (B126)
3. Replace Diesel Generator Sets A-Station, CDSCC
4. Upgrade Thermal Vacuum Control Systems, Environmental Laboratory, B144
5. Rehabilitate Hydrostatic Bearing DSS-43, CDSCC
6. Rehabilitate Radial Bearings DSS-43, CDSCC
7. Upgrade Lighting, Physical Science Building, B183
8. Remodel Cafeteria, Building 190

F. Johnson Space Center (JSC), $7.9 million for the following:
1. Repair Building Foundations and Slabs, Various Locations
2. Install Roof Fall Prevention Systems, Various Locations
3. Replace Roofs, Various Facilities
4. Rehabilitate and Modify HVAC Systems (32)
5. Upgrade Back-Up Power Monitoring (30M, 30S, and 48)
6. Repair Exchange Facilities (3, 11, and 207) Phase 1of 3
7. Construct Health and Fitness Center, WSTF

G. Kennedy Space Center (KSC), $19.7 million for the following:
1. Replace Air Handling Units, Headquarters Building, Phase 2
2. Construct Source Evaluation Board Facility
3. Replace Roof, Building 1385
4. Upgrade Firex Pump Station [M7-1362]
5. Repair Roads and Paved Areas, NASA Parkway West
6. Repair Roads and Paved Areas, Industrial Area
7. Upgrade Bathroom Plumbing and Fixtures, Headquarters Building, Phase 2
8. Revitalize Power Cable and Duct Distribution, Industrial Area, Phase 1
9. Replace Critical Transformers, Industrial Area
10. Replace Critical Transformers, LC-39 Area
11. Install Automatic Fire Sprinkler System, Pad Terminal Connection Rooms, LC-39
12. Replace 15-KV Feeder 606/612, SS-900 To Pad B
13. Upgrade Facilities for Disabled Access, Various Locations
14. Demolish Boxcars and Trailers, Various Locations
15. Construct Multi-Function Propellants/Gases Maintenance Facility
16. Modifications for Internet and Information Technology Applications, Central Information Facility
17. Refurbish Mechanical Equipment, Various Facilities, LC-39 Area
18. Restore Cable Trays, LC-39A

H. Langley Research Center (LaRC), $14.2 million for the following:
1. Rehabilitation of AC Systems, Various Locations
2. ADA Upgrades, Various Facilities
3. Upgrade High Intensity Radiated Fields System & Airframe Emulation Testing and Integration Labs (1220)
4. Spare Fan Blades and Roll Coupling for 14x22-Ft. Tunnel, B1212C
5. Upgrades to Low Speed Anechoic WT, B1221B
6. Upgrade Communication Closets, Various Facilities
7. Construct Addition for Video Production Consolidation, B1145
8. Upgrade Security of LaRC Infrastructure
9. 14x22-Ft. Tunnel Automation System Upgrades, B1212C

I. Marshall Space Flight Center, $8.7 million for the following:
1. Rehabilitate Bridge Cranes, Phase 2
2. Replace Roof, Various Locations
3. Construct Replacement Facility for Shipping and Receiving

J. Stennis Space Center, $9.3 million for the following:
1. Rehabilitation of Institutional Support Building 2204
2. Repairs to Hydrogen Gas Piping Test Complex
3. Replace Cryogenic and High Pressure Components in the Test Complex
4. Repair Site-wide Storm Drainage
5. Repair and Modernize Secondary Power Systems, Phase 5
6. Repair Pavement, Various Locations
7. Upgrade and Modernize EMCS to Include Industrial Programmatic Systems, Phase 2
8. Repair and Modernize Underground Electrical Duct, Phase 2
9. Replacement of Obsolete Chillers, Phase 2
10. Repair and Modernize Area Lighting Systems

**Space Flight Capabilities Minor Revitalization Programs: $16.8 million**

A. Johnson Space Center (JSC), $3.5 million for the following:
   1. Repair Grounding, Bonding and Shielding Systems, Test Area, White Sands Test Facility (WSTF) (Shuttle)
   2. Repair Concrete Flumes and Catch Basins, Test Area, WSTF (Shuttle)
   3. Repairs to Diffuser and Ejector, Test Stand 401, WSTF (Shuttle)

B. Kennedy Space Center (KSC), $3.7 million for the following:
   1. Upgrade Interior of Hangar AF (Shuttle)
   2. Upgrade Lighting, Mobile Service Tower and Pad, SLC-2, Vandenberg Launch Site (ELV)
   3. Asbestos Abatement, Hangar AE, Cape Canaveral Air Force Station (ELV)
   4. Construct Replacement Housing for Customer Operations, Payload Hazardous Servicing Facility (PLC)
   5. Revitalize Electrical Power Systems, Multi-Operations Support Building [M7-1357] (PLC)

C. Marshall Space Flight Center (MSFC), $7.4 million for the following:
   1. Replace Roof, Building 131, Michoud Assembly Facility (MAF) (Shuttle)
   2. Replace Secondary Power Distribution System, Building 173, MAF (Shuttle)
   3. Replace Air Handlers and Exhaust Fans, Building 318, MAF (Shuttle)
   4. Replace Chiller #5, Building 207, MAF (Shuttle)
   5. Repair Roofs, Buildings 101 and 102, MAF (Shuttle)
   6. Rehab/Mod Building 4649 for Hazardous Operations (Shuttle)

D. Stennis Space Center (SSC), $2.2 million for the following:
   1. Refurbish High Pressure Industrial Water Pumps, Phase 2 (Shuttle)
   2. Replace LOX/LH2 Dock Ramps (Shuttle)

## Facility Planning and Design (FP&D)

Cognizant Office: Office of Management Systems
FY 04 Estimate: $17.0M

These funds are required to provide for advance planning and design activities; special engineering studies; facility engineering research; preliminary engineering efforts required to initiate design-build projects; preparation of final designs, construction plans, specifications, and associated cost estimates; and participation in facilities-related professional engineering associations and organizations. These resources provide for project planning and design activities associated with Institutional Support construction projects. Project planning and design activities for construction projects required to conduct specific Space Flight Capabilities or Science, Technology, and Exploration programs or projects are included in the appropriate budget line item. Other activities funded include master planning; value engineering studies; design and construction management studies; facility operation and maintenance studies; facilities utilization analyses; engineering support for facilities management systems; and capital leveraging research activities.

## Demolition of Facilities

Cognizant Office: Office of Management Systems
FY 04 Estimate: $10.0M

The amount requested is required to fund major demolition projects Agency-wide. NASA owns over 2,800 buildings, and over 2,600 other structures, totaling almost 44 million square feet with a current replacement value of over $20 billion. About 2 million square feet of these facilities are “mothballed” or “abandoned,” another million square feet are to be closed in the next four years, and possibly will be identified for closure due to an upcoming NASA Real Estate Strategic Review. Closed facilities are a drain on NASA resources, deteriorate into eyesores and possible safety hazards, and should be demolished.

| THEME: | N/A |
|---|---|
| **DEVELOPMENT:** | Integrated Financial Management Program (IFMP) |

## PURPOSE

| Objectives | Reference 2003 Strategic Plan | Performance Measures |
|---|---|---|
| IS 1.3 | Improve and streamline the NASA Financial management system to enhance accuracy, timeliness and acccountability. | See Technical Commitment section |

The overarching goal of the Integrated Financial Management Program (IFMP) is to improve the financial, physical, and human resources management processes throughout the Agency. IFMP will reengineer NASA's business infrastructure in the context of industry "best practices" and implement enabling technology to provide the necessary management information to support the Agency's strategic plan implementation.

## OVERVIEW

Several active projects are currently being managed by IFMP. The Core Financial Project is in the process of implementing NASA's first fully integrated financial management system. When completed this system will give the Agency timelier, more consistent and reliable information for management decisions. It will also improve accountability to enable full-cost accounting. Core Financial and its use of SAP software will also help NASA achieve efficiencies and operate more effectively, thereby improving its information exchange with customers and stakeholders. The recently completed Resume Management Project introduced a new process and system that has changed how Human Resources offices fulfill their recruiting and staffing responsibilities. NASA Staffing and Recruitment System (STARS) is being actively used at each Center. The Position Description Management Project, completed in September, 2002, enables users to rapidly prepare and classify Position Descriptions (PD's). The Travel Management Project is complete at 8 of 10 Centers, implementing a standardized, integrated travel management system that provides electronic routing, e-mail, and timely travel information. Future projects being pursued, beginning in calendar year 2003, include Human Resources (HR) (including e-Payroll), Asset Management (AM), and Contracts Administration (CA). The budget runout has been modified to focus on the development costs of the program. Deployment of all modules is planned to be completed by FY 2006. As a result, the program funding total is decreased from the current baseline of $644.8M, which included some operations costs beyond deployment, to $497.5M through FY 2006. The difference in funding will be transferred to a systems operating account.

For more information, please link to: http://ifmp.nasa.gov/

## PROGRAM MANAGEMENT

IFMP is a multi-project program with management responsibility residing within the Office of the Chief Financial Officer and overall program authority residing in the Office of the Administrator. The Agency Program Management Council (PMC) has IFMP governing responsibility. Program Executive is Patrick Ciganer and Program Director and point of contact is Mike Mann. This program is in full compliance with compliance with NPG7120.

## TECHNICAL COMMITMENT

The baseline for this technical commitment was made in February 2002 and is detailed in the IFMP Program Commitment Agreement (PCA).

| Technical Specifications | FY04 President's Budget | Performance Measures |
|---|---|---|
| 1. Provide timely, consistent, and reliable information for management decisions. | 1. Provide consistent, timely, and reliable financial data to Agency, Enterprise, Center, Program, Project and functional managers to support decision making;<br>2. Provide on-line access to program and project data to the Agency, Enterprises and Centers;<br>3. Implement standardized, reengineered processes across functions and systems throughout the Agency. | *Number of Days between periodic closings and availability of financial data to internal customers.<br>* Number of days lag time between real-time update and online |
| 2. Improve NASA's accountability and enable full cost management. | 1. Provide financial data for the purpose of determining the cost of providing specific Agency programs and projects;<br>2. Improve financial data consistency. | * % of standardization across the Agency consistent with the *Full Cost Initiative Agencywide Implementation Guide*. |

| THEME: | N/A |
|---|---|
| **DEVELOPMENT:** | Integrated Financial Management Program (IFMP) |

## TECHNICAL COMMITMENT (continued)

| Technical Specifications | FY 2004 President's Budget | Performance Measures |
|---|---|---|
| 3. Achieve efficiencies and operate effectively. | 1. Streamline and standardize financial business processes across NASA to operate more effectively;<br>2. Provide tools to utilize admin and tech work force more effectively;<br>3. Provide an automated audit trail for financial data. | * Number of Center-unique Core Financial systems. |
| 4. Exchange information with customers and stakeholders. | 1. Provide consistent, timely and reliable financial data to NASA's external customers;<br>2. Improve exchange of financial data among internal customers. | * Number of Center-unique Core Financial systems. |
| 5. Attract and retain a world-class workforce. | 1. Provide tools to users that enable them to do their jobs more effectively;<br>2. Provide increased opportunities for sharing of data, practices and teaming across Centers. | * Number of Reconciliation's required between Core Financial subprocesses within the IFM system. |

IFMP benefits a broad range of NASA processes and Programs and is principally aligned with the Manage Strategically crosscutting process defined in the NASA Strategic Plan. Each module project defines its functional drivers, which demonstrate how the Project supports accomplishment of the Agency Business Drivers, or Technical Specifications.

| Schedule | FY 2004 President's Budget | Change from Baseline |
|---|---|---|
| CF Operational Readiness Review | September 2002 | 9 months early |
| CF Roll out to all 10 Centers | June 2003 | 9 months early |
| Pos. Description Rollout to 10 Centers | September 2002 | new |
| Travel Manager roll out to all 10 Centers | February 2003 | new |
| Budget Formulation begin Implementation | September 2002 | new |
| Begin formulation of: | | |
| HR, IAM and Contract Admin | January 2003 | new |

## ACQUISITION STRATEGY & PERFORMING ORGANIZATIONS

Data current as of 1/12/2003

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

| Future Acquisitions - Major | Selection date | Goals |
|---|---|---|
| Asset Management | TBD | GSA Schedules |
| Human Resources | TBD | GSA Schedules |
| Contract Admin | TBD | GSA Schedules |

Multiple contracts are being utilized to support IFMP, all of which are using GSA Schedule contract vehicles. These contracts support IFMP as a whole, as well as the specific module Projects across the various Centers.

**Changes since FY 2003 President's Budget: None.**

## AGREEMENTS

*Internal:* The program relies on support from each of the ten NASA Centers. Agreements and Commitments are signed with each Center responsible official prior to beginning implementation work at the Center. **Changes since FY03 Pres. Budget:** External: NASA and several other Federal Agencies recently began collaborating to develop a Federalized version of the Human Resources module. NASA is also coordinating with the Department of Interior on the e-Payroll initiative.

**THEME:** N/A

# DEVELOPMENT: Integrated Financial Management Program (IFMP)

## INDEPENDENT REVIEWS

| Types of Review | Performer | Last Review | Next Review | Purpose |
|---|---|---|---|---|
| Independent Annual Review | IPAO | 19-Nov-02 | August 2003 | To validate performance of Program & Project commitments. |
| Core Financial Systems Compliance Review | PWC | October 2002 | N/A | Validate internal security & controls and satisfy Federal Financial Requirements/JFMIP. |
| SAP Technical Implementation Review | SAP | July 2002 | N/A | To insure the system architecture & configuration is at acceptable performance levels. |

## BUDGET/LIFE CYCLE COST

| Budget Authority ($ in M) | Prior | FY02 | FY03 | FY04 | FY05 | FY06 | FY07 | FY08 | BTC | Total | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|
| FY 2004 President's Budget | 75.4 | 72.3 | 93.5 | 108.7 | 87.6 | 60.0 | 0.0 | 0.0 | 0.0 | 497.5 | Direct procurement only. |
| Infrastructure | 8.5 | 14.6 | 25.3 | 12.9 | 10.3 | 9.7 | | | | 81.4 | |
| Integration Project | 24.7 | 10.2 | 19.0 | 24.4 | 21.3 | 12.5 | | | | 112.2 | |
| Core Financial | 34.6 | 41.5 | 34.2 | 4.7 | | | | | | 115.1 | |
| Resume Management | 2.7 | 0.3 | 0.5 | | | | | | | 3.5 | |
| Position Description | 1.1 | 0.1 | 0.6 | | | | | | | 1.9 | |
| Travel Management | 2.7 | 2.3 | 1.4 | 0.7 | | | | | | 7.0 | |
| Budget Formulation | 1.0 | 3.3 | 8.3 | 3.5 | | | | | | 16.1 | |
| Follow-on projects (AM, HR, CA) | | | 4.2 | 62.3 | 56.0 | 37.8 | | | | 160.3 | |
| Changes since FY 03 PBS | -1.3 | -1.0 | 8.4 | 17.5 | -3.2 | 11.8 | -67.0 | 0.0 | -112.5 | -147.3 | **Reason for Change: Development ends in FY 2006** |
| Infrastructure | -14.3 | -0.5 | +1.0 | -4.4 | -2.4 | +5.9 | -11.3 | | -21.8 | -47.7 | Reconcile Prior Years/ rephase schedule. |
| Integration Project | +10.1 | -8.9 | +3.1 | +6.8 | +1.8 | -1.0 | -10.3 | | -24.3 | -22.6 | Reconcile Prior Years/ rephase schedule. |
| Core Financial | +0.4 | +4.3 | +4.3 | -7.9 | -1.2 | | | | | 0.0 | Reconcile Prior Years/ rephase schedule. |
| Resume Management | +0.1 | -0.3 | -0.1 | -0.6 | | | | | | -0.9 | Project completed ahead of schedule/under budget. |
| Position Description | +1.1 | +0.1 | +0.6 | | | | | | | +1.9 | Project Plan approved (12/15/01). * |
| Travel Management | +0.2 | +1.4 | +0.5 | +0.4 | -0.4 | | | | | +2.0 | Expanded scope - Gelco S/W to version Web 8.0 and full integration. |
| Budget Formulation | +1.0 | +3.3 | +8.3 | +3.5 | | | | | | +16.1 | Initial Allocation / Approved Project Plan pending Feb 03. * |
| Integrated Asset Management | | | +3.1 | | | | | | | +3.1 | Initial Allocation for Formulation Phase. * |
| Human Resources | | | +0.8 | | | | | | | +0.8 | Initial Allocation for Formulation Phase. * |
| Contract Administration | | | +0.3 | | | | | | | +0.3 | Initial Allocation for Formulation Phase. * |
| Planning Wedge/Follow-on | 0.0 | -0.4 | -13.5 | +19.5 | -1.0 | +6.9 | -45.4 | 0.0 | -66.4 | -100.3 | * Wedge Updated for follow-on projects (IAM, HR, CA) and Refresh software |

**(Budget table continues on next page)**

Indicates changes since the FY 2003 Presidents Budget Submit.

**THEME:** N/A

# DEVELOPMENT: Integrated Financial Management Program (IFMP)

## BUDGET/LIFE CYCLE COST (Continued)

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| FY 2003 President's Budget (LCC) | 76.7 | 73.3 | 85.1 | 91.2 | 90.8 | 48.2 | 67.0 | 0.0 | 112.5 | 644.8 |
| Infrastructure | 22.8 | 15.1 | 24.3 | 17.3 | 12.7 | 3.8 | 11.3 | | 21.8 | 129.1 |
| Integration Project | 14.6 | 19.1 | 15.9 | 17.6 | 19.5 | 13.5 | 10.3 | | 24.3 | 134.8 |
| Core Financial | 34.2 | 37.2 | 29.9 | 12.6 | 1.2 | | | | | 115.1 |
| Resume Management | 2.6 | 0.6 | 0.6 | 0.6 | | | | | | 4.4 |
| Travel Management | 2.5 | 0.9 | 0.9 | 0.3 | 0.4 | | | | | 5.0 |
| Planning Wedge/Follow-on | | 0.4 | 13.5 | 42.8 | 57.0 | 30.9 | 45.4 | | 66.4 | 256.4 |
| Initial Baseline (LCC) | 63.7 | 73.3 | 79.2 | 78.1 | 78.2 | 78.2 | 0.0 | 0.0 | 194.6 | 645.3 |
| Infrastructure | 19.9 | 16.6 | 15.9 | 12.7 | 13.2 | 13.5 | | | 20.0 | 111.8 |
| Integration Project | 14.6 | 16.8 | 14.2 | 20.3 | 16.9 | 14.2 | | | 51.4 | 148.4 |
| Core Financial | 23.5 | 31.0 | 25.1 | 4.9 | 3.1 | 3.2 | | | 38.0 | 128.8 |
| Planning Wedge/Follow-on | 5.7 | 8.9 | 24.0 | 40.2 | 45.0 | 47.3 | | | 85.2 | 256.3 |

Indicates changes since the FY 2003 Presidents Budget Submit.

# FULL COST BUDGETING

## Full Cost Implementation

With the start of FY 2004, October 1, 2003, NASA is to fully implement the Agency's Full Cost Initiative and for the first time, will operate in a full cost environment in managing, accounting, and budgeting for its programs and resources. This budget submission provides for NASA's programs and projects in a full cost format whereby the Agency's infrastructure and supporting capabilities have been examined and matched against the demand of NASA's programs. Full cost implementation is designed to enhance cost-effective mission performance by modifying the way the Agency does business so that managers are provided with better information to support decision-making. Having full cost in place will be a tremendous asset to the Agency in facing its management challenge of effectively controlling costs and maximizing efficient utilization of its resources.

In its simplest terms, the full cost concept ties all Agency direct and indirect costs (including civil service personnel costs) to NASA's major activities. These major activities (final "cost objects") are NASA's programs and projects. Under full cost, there are no "free" resources for program managers. In contrast to the current approach, for the first time, all institutional infrastructure costs such as civil service salaries and the use of facilities/support services are associated with benefiting programs/projects. Therefore, full cost budget information highlights the full cost, including support costs, of each NASA project and thereby supports more complete, "full" disclosure of NASA's activities, clearer linkage between resource inputs and outputs/outcomes, and greater accountability regarding NASA's use of taxpayer resources.

NASA's full cost concept integrates several key fundamental improvements: accounting for all NASA costs as direct costs (including supporting service costs) or as general and administrative (G&A) costs (center and corporate); budgeting for all appropriate program, project, and initiative ("project") costs; and managing such "projects" from a full cost perspective.

Since NASA began its Full Cost Initiative in 1995, full cost practices have been defined to improve the way NASA achieves its mission by implementing new, improved management, budgeting, and accounting policies, practices, and procedures. These new full cost practices are designed to provide timely, accurate estimates and actual cost information on the services and support activities required to achieve cost efficient administrative and program mission performance. The use of full cost management, budgeting, and accounting does not, in and of itself, change the infrastructure; rather, it more clearly discloses infrastructure costs, and their relationship to projects, while facilitating the decision-making process.

Implementing full cost budget formulation and execution at NASA is a key component in NASA successfully integrating budget and performance as set forth in the President's Management Agenda (PMA). NASA's status rating for the PMA has improved due to the major full cost budgeting accomplishments made this past year, and in NASA integrating its budget and performance reports starting with this FY 2004 budget submit.

Full cost management, budgeting, and accounting are to be accomplished throughout NASA in accordance with the Agency's Full Cost Implementation Guide, which was issued in February 1999 after the conduct of a feasibility study and the development of processes with input from across the Agency.

Where full cost figures appear on budget tables in this document, they are highlighted in yellow.

## Full Cost Components for NASA's Projects

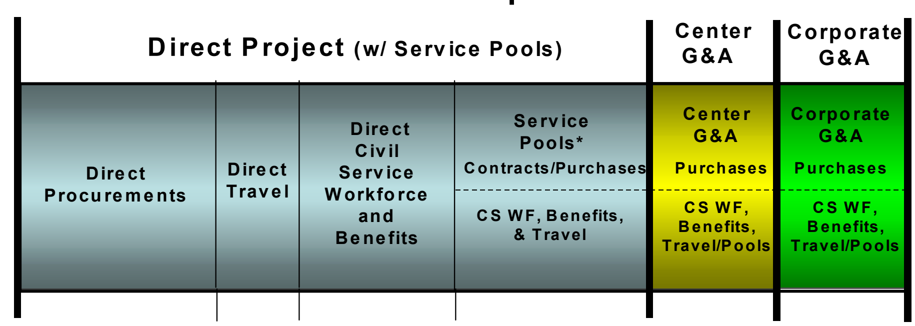
With full cost, all Agency costs are separated into one of three major cost categories: Direct (with Service Pools); Center G&A; and Corporate G&A. The full cost of a program/project is the sum of all direct costs and G&A costs associated with the program/project.

Full Cost = Direct Cost (with Service Pools) + Center G&A Cost + Corporate G&A Cost

Exhibit 1 below depicts in detail the cost components for each NASA full cost program/project. A detailed explanation for each cost component is included later in this chapter.

EXHIBIT ONE

**Full Cost Components**

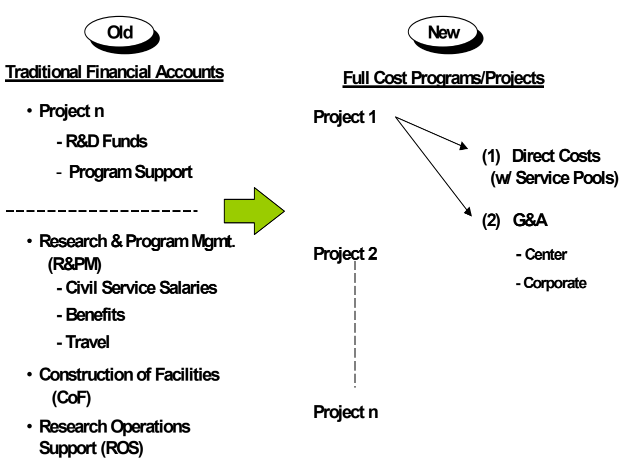



* - Costs of services provided to projects based on on use/ consumption

## Converting to Full Cost within NASA's Existing Appropriation Structure

Exhibit 2 provides a macro view of how NASA's traditional budget structure maps to the Agency's new full cost structure. As shown, NASA's program/project budgets have historically only captured direct R&D costs including supporting costs called program support. The Agency costs for both direct and indirect civil service workforce and travel dollars (previously budgeted under Research and Program Management (R&PM)), and other institutional infrastructure costs such as Research Operations Support (ROS) (used to support business management functions and basic center operations) have not been included. As stated above, now under full cost, all costs (both direct and indirect) are tied to NASA's activities at the project level.

EXHIBIT TWO **Mapping to Full Cost**




Since the submittal of NASA's FY 2002 budget, the appropriation structure in the Agency has evolved to support the full implementation of full cost practices in FY 2004. For the FY 2002 and FY 2003 Agency budgets, NASA retained the Science, Aeronautics and Technology (SAT), Human Space Flight (HSF), and Inspector General appropriations and eliminated the mission support appropriation, which funded civil service salaries/benefits, travel, ROS, and the construction of facilities. The budget requirements for mission/institutional support was developed at a high level by NASA Enterprise, and then merged into SAT and HSF by spreading mission support costs against the FTE's identified for SAT and HSF.

With this FY 2004 full cost budget submit, all institutional costs are budgeted for at a much lower level, at the NASA program/project activity level. The Agency's direct workforce and related costs are directly matched to programs worked. In the case of indirect civil service labor, these costs are initially captured in G&A and service pool accounts, and are eventually distributed back to using programs based on actual consumption or a G&A approved distribution. Therefore, at the NASA program/project level, under full cost, the budget for the program/project will increase since all costs are now captured under the program budget. The target for applying full cost is typically at the project level (usually at Level 3 in the budget structure and at Level 4 for projects in formulation or less than $100M), except for Space Station where full cost has thus far been applied primarily at the theme level (referred to as Level 2). The other exception is for Environmental Compliance under Space & Flight Support, where the activities themselves are not directly full costed since the NASA personnel who conduct these activities are considered part of the Center and Headquarters general and administrative (G&A) cost pools.

# FULL COST BUDGETING

## Cost Component Detail

**Direct Project Costs**

This cost category consists of:

**(1) Direct costs** that are obviously and physically related to a project at the time the costs are incurred such as purchased goods and services, contracted support, and direct civil service salaries/benefits/travel; and

**(2) Service pool costs** cover a broad range of infrastructure capabilities that support multiple programs/projects at a center. The following seven standard service pools have been established at each NASA center for support of work performed at their site: Facilities and Related Services; Information Technology; Publishing Services; Science and Engineering; Fabrication; Test Services; and Wind Tunnel Services. These costs can be traced/linked to a given project based on usage/consumption.

Each pool carries all supporting costs incurred for that given function including: civil service salaries/benefits; contractor labor; travel; purchases; pool management; facility related costs. These costs are collected in a cost pool arrangement and are periodically distributed backed to using programs during the fiscal year.

During the budget formulation process, the demand for a pool's services in relation to its projected customers (using programs) and the pool's needed funding level are identified through negotiations with project managers and service providers. The projected service pool bill is then included in the project's full cost budget.

**Center General and Administrative (G&A) Costs**

This cost category captures center costs that cannot be related or traced to a specific project, but benefit all activities. These costs are allocated to center programs based on the number of direct civil servants (including service pool workforce) and on-site contractors that work a given project. This method of cost allocation (cost per FTE (full time equivalent)) is considered to provide an appropriate indication of the amount of general infrastructure that is driven (consumed) by a project activity at a Center. A review of alternative G&A allocation methods used outside NASA will be conducted over the next year.

The following standard types of costs/functions are included in each center's G&A account: G&A civil service salaries/benefits/travel; center training and awards; security; grounds maintenance; pavement/roads; fire protection; library; business computing; public affairs; non-program construction of facilities (CoF); transportation services; legal; human resources department; procurement support; budgeting; accounting; equal opportunity; educational outreach; medical services; and logistics services.

During the budget formulation process, each Center Director determines the appropriate funding levels for G&A functions for the upcoming fiscal year, consistent with Agency guidance and with the approval of Enterprises. The total Center G&A is then spread back against center programs, and is included in the program's full cost budget.

**Corporate G&A Costs**

This cost category consists of costs that are related to the business operations of NASA Headquarters as a center and Agency level functions that are G&A in nature. This includes costs for: the NASA Administrator and immediate staff; the Enterprise level/management; Headquarters Operations management; and Functional management, including Safety and Mission Assurance (SMA). Costs for Corporate G&A functions performed for the Agency at NASA centers are also included. Some of these activities performed at Centers on behalf of the Agency were previously budgeted as part of the Center's institutional budget and have now been transferred to the Corporate G&A budget.

For the FY 2004 NASA Budget, Corporate G&A costs are allocated to agency programs/projects based on the program's share of NASA's total direct cost including service pool costs; however, over the next year, a review of alternative allocation methods will be performed.

## Benefits of Full Cost

- Applying full cost practices will help lead to a more efficient, optimal use of institutional resources.
  - Institutional resources justified based on project requirements (directly or indirectly).
  - No "free" resources; program managers will have move insight and role in defining institutional capabilities.
  - A better linkage between services and their customers and the integration of civil service labor cost exists; funding for service pools allocated is based on demand/consumption rather than with a parametric formula used with old program support account; civil service workforce is allocated based on specified need.

  - Increased attention on G&A infrastructure and sources of support capabilities by managers at all levels (Center, Enterprise, and program); will help reduce underutilized institutional capabilities and find more cost effective alternatives.
  - Increases competitive selection of support capabilities.
- Supports economic decisions for appropriate resource allocations, and the bench-marking of NASA service activities with other similar services; also provides a more comparable means for evaluating government vs. contractor options leading to minimization of government-held infrastructure.
- Strengthens ties between NASA's missions, programs/projects, and budget requests; helps justify NASA's budget on a program/project basis.
- Provides an effective tool for program/project managers to better manage, and motivates managers to operate efficiently.

## Full Cost Assumptions

With full cost, institutional funds are budgeted within the supported project's budget line. This integration (within the appropriation) of previously separate defined funding for personnel, travel, and CoF is needed in order to obtain the full benefits of full cost management whereby a program manager has oversight for the full cost of a given project. The use of personnel, travel, and facilities funding will be tracked through service and G&A pools that represent an integral part of a program's full cost budget. To have to appropriate each of these support funds separately would decrease response time for applying resources, and would significantly increase the number of funding allotments and operating plan actions.

Under full cost, if a project is terminated or adjusted (downward or upward), associated funds for G&A, civil service workforce, and service pools require time to be reassessed and reallocated to other new using programs, and are also available for reduction or an increase. NASA needs time following a budget decision to realign/change institutional resources affected by those decisions. Center G&A and civil service workforce are the least flexible and will likely need to be maintained especially in the near-term. Service pool costs are somewhat more flexible in the short run.

## One-Way Transition by Agency to Full Cost

Once NASA transitions to full cost, direct traceability back to previous budgets, especially at the project level, is not possible. Previous years' budgets cannot be recalculated and presented in full cost since there is not a one-to-one relationship of previously used cost categories to the new full cost categories (Direct with Service Pools and G&A).

The Program Support accounts previously used are not directly interchangeable with Service Pools since pools are based more directly on project consumption and include associated civil service workforce costs. Plus, a portion of Program Support is now budgeted under the Center G&A account. The ROS account previously used is not directly interchangeable with Center G&A that now includes associated civil service workforce costs. ROS is now included in Service Pools, Center G&A, and Corporate G&A. Previous estimates of direct project workforce may have included some indirect workforce. In addition, Agency-wide activity performed at a center that was previously budgeted under Center ROS transferred to Corporate G&A.

## Potential for Future Refinement

The FY 2004 budget process is NASA's first attempt to budget completely in full cost. Pools and workforce allocations were constructed without specialized computer tools resulting in a labor-intense process until the new Agency Budget Formulation Module is ready for use. It is expected that refinements in full cost allocations will likely be seen in the next budget cycle.

# **FULL COST BUDGETING:** Transition to Full Cost and New Budget Structure

| IN MILLIONS OF DOLLARS | FY 2003 PRES BUDGET | FY 2003 AMENDED FULL COST* | FY 2004 BUDGET FULL COST |
|---|---|---|---|
| **SCIENCE, AERONAUTICS AND TECHNOLOGY (FY 03) / SCIENCE, AERONAUTICS AND EXPLORATION (FY 04)** | **7,015.1** | **7,100.6** | **7,660.9** |
| SPACE SCIENCE | 3,414.3 | 3,468.4 | 4,007.1 |
| SOLAR SYSTEM EXPLORATION | 975.7 | 1,046.2 | 1,358.6 |
| MARS EXPLORATION | 495.5 | 550.6 | 570.2 |
| ASTRONOMICAL SEARCH FOR ORIGINS | 698.1 | 798.9 | 877.0 |
| STRUCTURE AND EVOLUTION OF THE UNIVERSE | 331.0 | 398.3 | 431.7 |
| SUN-EARTH CONNECTIONS | 544.2 | 674.3 | 769.6 |
| INSTIUTIONAL SUPPORT | 369.8 | -- | -- |
| EARTH SCIENCE | 1,628.4 | 1,610.3 | 1,552.2 |
| EARTH SYSTEM SCIENCE | 1,248.8 | 1,529.0 | 1,477.4 |
| EARTH SCIENCE APPLICATIONS | 61.7 | 81.3 | 74.8 |
| INSTITUTIONAL SUPPORT | 317.9 | -- | -- |
| BIOLOGICAL & PHYSICAL RESEARCH | 842.3 | 912.7 | 972.7 |
| BIOLOGICAL SCIENCES RESEARCH | 245.1 | 304.0 | 358.6 |
| PHYSICAL SCIENCES RESEARCH | 247.2 | 351.2 | 353.2 |
| RESEARCH PARTNERSHIPS AND FLIGHT SUPPORT | 169.5 | 254.1 | 260.9 |
| INSTITUTIONAL SUPPORT | 180.5 | 3.4 | -- |
| AEROSPACE TECHNOLOGY | 986.4 | 949.2 | 959.1 |
| AERONAUTICS TECHNOLOGY | 541.4 | 949.2 | 959.1 |
| INSTITUTIONAL SUPPORT | 445.0 | -- | -- |
| ACADEMIC PROGRAMS/EDUCATION PROGRAMS | 143.7 | 160.0 | 169.8 |

* Full cost is estimated for FY 2003 for comparison purposes only.

NOTE: Full funding for Federal retiree costs not included.

Indicates budget numbers in Full Cost.

# **FULL COST BUDGETING:** Transition to Full Cost and New Budget Structure

| IN MILLIONS OF DOLLARS | FY 2003 PRES BUDGET | FY 2003 AMENDED FULL COST* | FY 2004 BUDGET FULL COST |
|---|---|---|---|
| **HUMAN SPACE FLIGHT (FY 03) / SPACE FLIGHT CAPABILITIES (FY 04)** | **7,960.3** | **7,874.8** | **7,782.1** |
| SPACE FLIGHT | 6,130.9 | 6,107.0 | 6,109.8 |
| INTERNATIONAL SPACE STATION | 1,492.1 | 1,850.7 | 1,707.1 |
| SPACE SHUTTLE | 3,208.0 | 3,785.7 | 3,968.4 |
| SPACE & FLIGHT SUPPORT | 238.7 | 470.6 | 434.3 |
| INSTITUTIONAL + SMA | 1,192.1 | -- | -- |
| CROSSCUTTING TECHNOLOGY | 1,829.4 | 1,767.9 | 1,672.3 |
| SPACE LAUNCH INITIATIVE | 879.4 | 1,150.4 | 1,064.6 |
| MISSION AND SCIENCE MEASUREMENTS TECHNOLOGY | 274.9 | 434.3 | 438.4 |
| INNOVATIVE TECHNOLOGY TRANSFER PARTNERSHIPS | 146.9 | 183.1 | 169.3 |
| INSTITUTIONAL SUPPORT | 528.2 | -- | -- |
| **INSPECTOR GENERAL** | **24.6** | **24.6** | **26.3** |
| **TOTAL AGENCY** | **15,000.0** | **15,000.0** | **15,469.3** |

* Full cost is estimated for FY 2003 for comparison purposes only.

NOTE: Full funding for Federal retiree costs not included.

Indicates budget numbers in Full Cost.

## **HISTORICAL DATA:** Table of Contents


Page

**Reconciliation of Appropriations to Budget Plans chart**.................................. S&AP 3-2

**Distribution by Appropriation by BLI**................................................................ S&AP 3-3

## **HISTORICAL DATA:** Summary of Reconciliation of Appropriations to Budget Plans

| *(In Millions of Real Year Dollars)* | TOTAL | Human Space Flight | Science, Aeronautics and Technology | Office of Inspector General |
|---|---|---|---|---|
| **FISCAL YEAR 2002 REQUEST** | **14,511.4** | **7,296.0** | **7,191.7** | **23.7** |
| VA-HUD INDEPENDENT AGENCIES APPROPRIATIONS ACT, FY 2002 (P.L. 107-73) AS PASSED BY CONGRESS, DIRECTION INCLUDED IN CONFERENCE REPORT (H.R. 107-272) | **281.8** | -383.6 | 665.4 | -- |
| TRANSFERS PER NATIONAL AERONAUTICS AND SPACE ACT AS AMENDED BY P.L. 106-377 | **0.0** | -210.0 | 210.0 | -- |
| DOD APPROPRIATIONS ACT, FY 2002 (P.L. 107-117) | **108.5** | 76.0 | 32.5 | -- |
| FY 2002 RESCISSION (P.L. 107-206) | **-10.0** | -5.4 | -4.6 | -- |
| **TOTAL FY 2002 BUDGET PLAN** | **14,891.7** | **6,773.0** | **8,095.0** | **23.7** |

| | | | | |
|---|---|---|---|---|
| **FISCAL YEAR 2003 REQUEST** | **15,000.0** | **6,130.9** | **8,844.5** | **24.6** |
| **TOTAL FY 2003 BUDGET PLAN** | **15,000.0** | **6,130.9** | **8,844.5** | **24.6** |

## **HISTORICAL DATA:** Distribution of Appropriation by Budget Line Item (BLI)

| OLD APPROPRIATION STRUCTURE | FY 2002 OP PLAN 9/30/2002 | FY 2003 PRES BUDGET |
|---|---|---|
| **HUMAN SPACE FLIGHT** | **6,773.2** | **6,130.9** |
| INTERNATIONAL SPACE STATION | 1,720.8 | 1,492.1 |
| SPACE SHUTTLE | 3,270.0 | 3,208.0 |
| PAYLOAD & ELV SUPPORT | 91.3 | 87.5 |
| HEDS INVESTMENTS AND SUPPORT | 1,161.7 | 1,178.2 |
| SPACE OPERATION | 481.8 | 117.5 |
| SAFETY, MISSION ASSURANCE & ENGINEERING | 47.6 | 47.6 |
| **SCIENCE, AERONAUTICS & TECHNOLOGY** | **8,094.8** | **8,844.5** |
| SPACE SCIENCE | 2,901.8 | 3,414.3 |
| BIOLOGICAL & PHYSICAL RESEARCH | 824.1 | 842.3 |
| EARTH SCIENCE | 1,592.2 | 1,628.4 |
| AEROSPACE TECHNOLOGY | 2,549.4 | 2,815.8 |
| ACADEMIC PROGRAMS | 227.3 | 143.7 |
| **INSPECTOR GENERAL** | **23.7** | **24.6** |
| **TOTAL AGENCY** | **14,891.7** | **15,000.0** |

NOTE: Full funding for Federal retiree costs not included

## **SPECIAL ISSUES:** Table of Contents


| | Page |
|---|---|
| **Performance Evaluation of Select Programs** .................................................... | S&AP 4-2 |
| **Update on the President's Management Agenda** ............................................. | S&AP 4-3 |
| **Performance Budgeting** ......................................................................................... | S&AP 4-4 |
| **The New Budget Format – Overview** .................................................................. | S&AP 4-5 |
| **The New Budget Format -- How to Read a Data Sheet** ..................................... | S&AP 4-6 |
| **Terms** ........................................................................................................................ | S&AP 4-11 |
| **Performance Plan Summary** ................................................................................. | S&AP 4-16 |

## SPECIAL ISSUES

### PERFORMANCE EVALUATION OF SELECT PROGRAMS

Three NASA Themes have been reviewed by OMB for performance effectiveness using the Performance Assessment Rating Tool (PART). The results are summarized in the accompanying table. For further details on the performance assessments of the Themes listed here, refer to the NASA chapter in the *Performance and Management Assessments* volume of the President's Budget.

The PART is an evaluation tool developed by the White House Office of Management and Budget (OMB) to assess the effectiveness of Federal programs. The PART will be phased in over time across all Federal Agencies. After undergoing extensive testing by OMB, Federal Agencies and Departments were asked to apply the PART to 20% of all programs (NASA Themes) to determine how well it assesses program effectiveness and management performance.

The PART will be applied to an additional 20% of Federal Programs each year until the tool is used as a standard assessment for all Programs. The PART identifies the program management changes needed to improve a program's effectiveness. As PART is applied to the remaining NASA Themes, they will need to demonstrate the same high standards of performance as these initial Themes. Programs previously assessed using the PART will be reassessed and their scores raised or lowered depending on changes in performance.

| Theme | Rating | Explanation | Recommendations |
|---|---|---|---|
| Space Station | **Results Not Demonstrated** | Space Station cost controls have improved since recent overruns, but it is too early to tell whether management reforms will continue to be successful. | NASA will continue building the U.S. core Space Station, and the Administration will monitor program performance to see if recent management reforms are successful. |
| Space Shuttle | **Moderately Effective** | Shuttle operations are well managed, but investments to improve the Shuttle suffer from inadequate planning and poor cost management. | NASA will develop tools to track the impact of investments on the Shuttle's operational life, flight safety, and facilities conditions. NASA also will strengthen capital investment cost controls. |
| Mars Exploration Program | **Effective** | Good planning and execution have led to important scientific discoveries. The program has recovered from the loss of two spacecraft in late 1990s. | NASA will carefully track development of the 2003 Mars rover missions which are a major program challenge. NASA also will use planning for potential missions next decade to drive technology investments this decade. |

## UPDATE ON THE PRESIDENT'S MANAGEMENT AGENDA

NASA is fully committed to improving the quality of our management by implementing the President's Management Agenda. This is a government-wide effort to improve the way that Government manages in five key areas: Human Capital, Financial Management, E-Government, Competitive Procurement, and Integrated Budget and Performance. The Office of Management and Budget (OMB) uses a red/yellow/green 'stoplight' rating system to rate for agency status and progress. Green is the best possible rating. The discussion below describes our progress in 'getting to green' in all five areas.

The President's Management Agenda provides the central focus for all management reform efforts across the Agency, including our Freedom to Manage initiatives. NASA has established a highly integrated, disciplined process for 'getting to green' with weekly status reports to the Administrator by each of our five President's Management Agenda (PMA) area champions. NASA is one of only a few agencies that have a written agreement with OMB on the specific steps required to achieve green; and other agencies are seeking to adopt NASA's approach.

NASA's status rating improved for both human capital and budget and performance integration efforts. For human capital, NASA has begun to implement its strategic human capital plan, including a tracking system to identify workforce deficiencies across the agency. In competitive sourcing, NASA has achieved the government-wide, 15 percent competitive sourcing goal, but is still working on a plan to achieve the long-term, 50 percent goal. The status of financial performance fell due to a disclaimer on NASA's 2001 audit, but the agency has worked hard to resolve all issues from that audit. As of January 2003, NASA now has an unqualified opinion. Progress in E-Government has been slower due to information technology security reporting issues and problems with completing documentation to justify some information technology investments. In budget and performance integration, NASA is now budgeting for the full cost of its programs and has integrated its budget and performance plans starting with this budget.

| | **Human Capital** | **Competitive Sourcing** | **Financial Performance** | **E-Government** | **Budget and Performance Integration** |
|---|---|---|---|---|---|
| **Status** | ↑ 🟡 | 🔴 | ↓ 🔴 | 🔴 | ↑ 🟡 |
| **Progress** | 🟢 | 🟢 | 🟢 | 🟢 | 🟢 |
| *Arrows indicate change in status since baseline evaluation on September 30, 2001* | | | | | |

# SPECIAL ISSUES

## PERFORMANCE BUDGETING

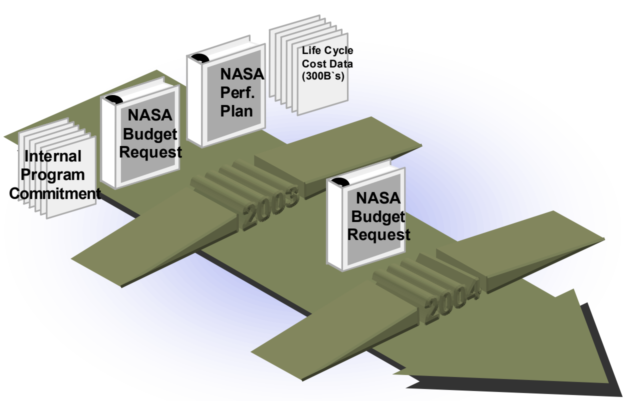
The FY 2004 NASA Budget Request is a performance-based budget. This represents a significant change from past years' budgets. It addresses challenges posed by NASA's stakeholders.

"What has been missing:

- Past and planned results are not shown with budget requests, let alone lined in a cost-and-results relationship.
- Program managers responsible for achieving results often do not control the resources they use or have flexibility to use them effectively.
- Performance and cost data are recorded in separate systems and not integrated to provide timely, analytical, feedback to decision makers and managers.
- Americans cannot readily assess program results, and cannot compare performance and cost across programs."

-- *FY03 Pres. Budget (Government-Wide Analytical Perspectives pg. 3)*

Many of the documents that in past years were separate, have now been combined into one. Most importantly, this brings together the NASA Budget Request and the NASA Performance Plan. Beyond these two major documents, the data sheets in this new document replace many separately published and maintained data sheets. These include presentations of the life cycle cost of development programs and projects.




The FY 2004 Budget Request integrates the information that was provided in past years in separate documents.

The benefits of this integrated, performance-based budget are significant.

First, there will be fewer, more informative pages. The same information was provided in multiple documents before. For instance, program descriptions appeared in the Budget Request, the Performance Plan, special life-cycle cost exhibits, and internal commitment agreements. Now, this information is presented once and the chance of discrepancy between documents is eliminated. There is also a uniformity of information across programs. As part of the integration, a single set of Agency-wide templates was developed. Each Enterprise, Theme, Program, and Project had to provide comparable information in the appropriate template.

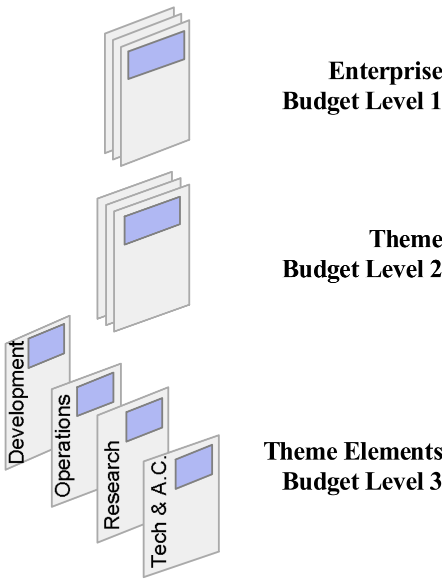
Beyond providing consistent and comparable information, the templates are concise. Details about acquisition strategy and technical commitments are presented in one place. In previous years there was a great deal of information that was redundant or excessive, and that has been eliminated. In other areas it might be useful to have access to additional detail. A comprehensive approach was used where hyperlinks are presented so that an interested reader can easily access this detail.

The second major benefit of the integrated budget and performance document is that the same structure is used across all Agency documentation, including the 2003 Strategic Plan, the Budget and integrated Performance Plan, and the Performance Report. The performance of strategic investments can be directly measured because the investment will be explicitly tracked under one name. Every program or project can be traced from the Agency Vision and Mission, by way of the Strategic Plan.

# SPECIAL ISSUES

## THE NEW BUDGET FORMAT - OVERVIEW

This year, the budget has a new look. The new format was devised as a part of the budget and performance integration effort. It should provide an easy to navigate system to reference all the elements of the NASA FY 2004 Budget. It also presents the costs and benefits of each element in a consistent, easy to understand way.




The budget is structured in levels. At the first level are the 6 Enterprises. At the second level are the 18 Themes. The third level is split into four categories. Each of these levels is described on a set of uniform sheets. The fourth level provides additional detail and is discussed on the Level 3 sheets.

The new look of the budget comes from the use of standardized templates. A different template is used to present each budget level. The templates ensure that the same information is provided for each element of the budget. It is this standardization that makes it easy to navigate through the document to find the information you need and also makes it easy to compare information between two parts of the budget.

**Content at Level 1**
Each Enterprise section starts with a two-page summary of the Theme areas within the Enterprise plus an outline of the purpose of the Enterprise.

**Content at Level 2**
Each Theme section has a four page "business case" followed by data sheets for the programs and projects within this area.

The Theme is discussed in terms of the President's Research and Development Investment Criteria. These criteria lay out the benefits of a Theme in three parts: relevance, quality, and performance. The Theme's cost is also presented.

With this information, it is possible to evaluate the Theme as an investment. The sheets should provide the answers to the questions:

- What is this investment?
- Why is this investment relevant?
- How and when are the activities being performed?
- Who is accountable for the quality of the outcomes and outputs?

The Theme's cost and performance should be viewed together. The performance section conveys the expected outcomes and outputs that can be achieved by the funding in the request.

**Content at Level 3**
The four sheets for the Level 3 Theme elements -- Development, Operations, Research, and Technology and Advanced Concepts -- each contain the same sections. The specific data presented within some sections is different among the four types of Level 3 elements. Most Level 3 write-ups are 2 pages in length and Technology and Advanced Concepts are usually 3 pages.

The first page is the commitment page. Here, each sheet must clearly describe the Program or Project's connection to its parent Theme. Commitment page tying the program or project to the strategic and performance plans plus the specific technical commitment made.

The second page is the implementation page showing detailed information about how the Program or Project is being implemented. This information includes the acquisition strategy. It also includes a list of internal and external agreements as well as a list of planned and past independent reviews.

The last section of the second page shows the budget or life cycle cost. Here, the requested levels of budget authority are shown for the current budget request. For development activities that have a life cycle, the complete cost from start to finish is shown.

# SPECIAL ISSUES

## THE NEW BUDGET FORMAT – HOW TO READ A DATA SHEET

**Sections of Level 1 Enterprise Data Sheets**

The Enterprise data sheets provide the purpose of the Enterprise plus they guide a reader to the Themes that comprise an Enterprise.

There is one large Enterprise image here that is carried throughout the document. Theme images and names are listed on the right representing each of the budget Themes. These Theme images also appear on the appropriate Level 2 Theme data sheets.

The Enterprise images are retrospective, and the theme images are prospective. The retrospective images and their captions depict a NASA accomplishment from the previous year. The prospective images and their captions depict a planned activity, concept vehicle, or scientific area of study.

**Sections of Level 2 Theme Data Sheets**

The Theme data sheets are a minimum of four pages, and the Themes represent the key elements of the new budget structure. The uniformity of the sheets facilitates an investment-oriented discussion so decisions and trade-offs can be made using comparable data.

The sheets begin with the single Theme image – the same image that represents the Theme elsewhere in the budget. The additional Theme pages lay out the justification for the budget request and performance commitment for which the Theme will be accountable. The justification is addressed in terms of relevance, strategy, performance, and budget.

**Overview**

In this section, each Theme lays out the broad picture of what its activities are. The overview should answer the question, "What is this investment and what are its benefits?" In particular, there should be a synopsis of the FY 2004 highlights.

Each Theme is part of NASA's 2003 Strategic Plan. The activities of the Theme are directly responsible for performance that leads to the Agency's goals and objectives. The table presented on each overview page is an excerpt of the Plan, showing the Theme's specific responsibilities. For each objective, there are performance measures in a section of the Theme data sheet that follows. The Theme must demonstrate progress toward these long-term objectives on an annual basis through the performance measures.

The Theme's relevance discussion must further make the case that this Theme's implementation strategy will help NASA meet its strategic goals and objectives.

**Relevance**

Relevance, quality, and performance are the Research and Development Investment Criteria established by the White House Office of Science and Technology Policy (OSTP) and the OMB. "R&D investments must have clear plans, must be relevant to national priorities, agency Missions, and relevant fields, and must justify their claim on taxpayer resources."

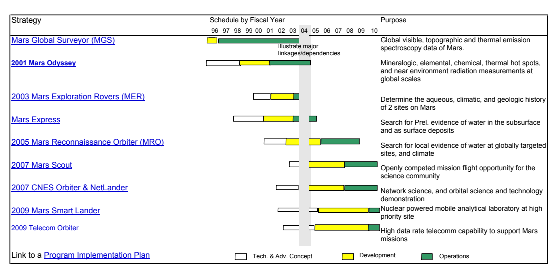
The narrative on relevance for each Theme demonstrates why the theme:

- is relevant to national priorities;
- is relevant to the NASA Strategic Plan, tying the table above to the measures on the next page; and
- is relevant to the scientific community.

The relevance to education and public benefits is called out separately. NASA has both longstanding and new initiatives in educational outreach, with contributions from each Theme. Each Theme also articulates its public benefits by answering the question, "In what ways will NASA's explorations and investigations change the way we live in and view our world?"

Relevance should be verifiable from the Independent Reviews listed at the Theme level and below.

**Implementation**




The implementation chart is a strategic roadmap, showing how each of the Level 3 elements fit and is integrated and contributes to achieving the goals and objectives of the Theme. The elements on the chart are color-coded depending on their phase by Development, Operations, Research, and Technology and Advanced Concepts. The year of the budget request is highlighted with a vertical bar.

# SPECIAL ISSUES

The purpose of each element is presented in a column on the right. This purpose is a synopsis of the "Level 3" data sheet's Purpose section, intended to briefly summarize what each element does, how the elements are interdependent, and how they work together to achieve the Theme's objectives and the Agency's goals.

Some Themes present their implementation strategy in other ways while still addressing the timetable and the purpose.

**Status**

In this section, the Theme reports noteworthy accomplishments and successes from the previous fiscal year. This is a general discussion of past performance and not directly tied to individual FY 2002 performance measures. Because the Theme structure is new with the 2003 Strategic Plan, the FY2002 Performance Plan cannot be directly assessed according to the 2003 organization. For a more in-depth discussion of FY2002 performance by individual annual goal, please refer to the *Fiscal Year 2002 Performance and Accountability Report*.

**Performance Measures**

Based on the new Administration R&D Investment Criteria, OMB Circular A-11, and the Government Performance and Results Act, the performance measures are quantitative long term outcomes supported by annual output metrics. These measures indicate how this Theme is contributing towards the strategic objectives.

In the past, the connection between the Performance Plan measures and the Strategic Plan objectives was not explicit. Now there is an explicit linkage. Strategic Objectives and long-term outcomes are numbered according to the goals and objectives in the 2003 Strategic Plan. Annual performance measures are numbered by Theme. A measure number consists of the one digit fiscal year, identifying the fiscal year of the performance plan, the standard abbreviation of the Theme name, then the number of this measure within the Theme. For example, 4MEP9 is used for the 9th metric in the Mars Exploration Program Theme for the FY04 budget.

There are also uniform metrics for which each Theme is accountable and will eventually be rolled up to assess overall performance at the Agency level. These are:

1. Each Development project will complete its current phase within 10% of total life-cycle cost shown on the table below.

2. Each Research project will allocate *[a Theme specific percentage]* of its funding competitively during FY04.

3. The Theme will complete all of its missions within 10% of its baseline schedules.

**Independent Review**

**INDEPENDENT REVIEWS** Data current as of 9/9/2002

| Types of Review | Performer | Last Review | Next Review | Purpose |
|---|---|---|---|---|
| Indep Annual Review | IPAO | 01-Jan-01 | 03-Mar-03 | |
| Nat'l Academy | SSB | | | |

Relevance and quality are verified through the prior and planned Independent Reviews listed at the Theme level and below.

The purpose should note -- in addition to the topics covered -- whether the review is a retrospective evaluation of ongoing efforts or it is a prospective evaluation of planning and implementation.

If no reviews are conducted at the Theme level, it will be noted that reviews were conducted at the Project level. For these reviews, refer to the appropriate page.

**Budget**

The budget tables present the proposed FY 2004 budget. Three years are shown, from FY 2002 to FY 2004. All the Themes' Level 3 elements are also shown, labeled as one of the four types Development, Operations, Research, and Technology and Advanced Concepts. The "FY 02" column reflects the FY 2002 budget as adjusted per the Congressional Operating Plan letter dated 9/30/02. The "FY 03" column reflects the FY 2003 Presidents Budget Submit (PBS) as Amended. The "Change" column includes both programmatic and full cost adjustments. FY 2004 is in full cost. In the table, the change column is highlighted in blue and all numbers in full cost are highlighted in yellow.

Themes only report a LCC for development activities. FY 2002, FY 2003, Prior and BTC are not in full cost. The years FY 2004 to FY 2008 are in full cost. Next year, we will have complete lifecycle costs for Development activities in full cost.

# SPECIAL ISSUES

**<u>Sections of Level 3 Data Sheet</u>**

Each Level 3 data sheet is one of four activity types (Development, Operations, Research, or Technology and Advanced Concepts.) These sheets are organized in very similar manners, but with specific differences. There is one exception, the Education programs, which appears on a custom sheet.

The specific differences are appropriate to the different types of activities. Development sheets, for example, represent specific commitments to technical requirements and a life cycle cost with a level of maturity that allows NASA to be committed to and accountable for the budget and schedule estimates. Technology and Advanced Concepts shows the progression of new technologies according to their technology readiness levels.

Each Level 3 sheet consists of two or three pages with the following sections.

### Purpose

**PURPOSE**

| Objectives | Reference 2003 Strategic Plan Performance Me |
|---|---|
| Strategic objective that the ASO Theme is addressing [TBD] | 4ASO1, 4ASO3, 4ASO4 |

The purpose of this activity must be clearly presented. In particular, the purpose must be tied to the Strategic Objectives with a commitment to a set of annual performance goals. These are referenced by number and can be found on the parent Theme sheet.

### Overview

The overview explains what the elements of this activity are, the summary of what work is being performed, what is being built, or what is being investigated.

### Program Management

NASA manages its Programs and Projects according to internal policies and procedures. The primary document is NASA Procedures and Guidelines (NPG) 7120.5B. Programs that are not in full compliance with NPG 7120.5B are documented.

The Programs and Projects also have accountable officials responsible for the management of this investment. Primary points of contact are provided to the NASA Headquarters level. The NASA Centers with Program responsibility are also listed.

### Technical Commitment

The technical commitment is presented relative to an original baseline. This baseline, with date, is defined right under the heading so that it may be referenced as needed. For Development, this baseline will be some form of commitment agreement document, in most cases a NASA Program Commitment Agreement.

**TECHNICAL COMMITMENT**

Baseline Commitment as of 7/02, as established in the Level Requirement Document for the Mars Reconnaissance Orbiter (MRO) project.

| Technical Specifications | FY04 President's Budget | Change from Baseline |
|---|---|---|
| End of nominal life | 5.4 years after launch; December 31, 2010 | Unchanged |
| Primary Science Phase | Dec. '06 thru Dec. '08 | Unchanged |
| Mass | 2000 kg | Unchanged |
| Power | 5 kW (Beginning of Mission (BOM) at Earth) | Unchanged |
| Raw Data Volume | 26 Tbits | Unchanged |
| Mapping Targeted Imaging | 30cm/pixel ground sampling monochromatic imaging; < 40m/pixel ground sampling for mineralogical mapping | Unchanged |
| Contex imaging | <7.5 m/pixel ground sampling context imaging from 300 km altitude | Unchanged |
| Primary science orbit (PSO) | 255 X 320 km | Unchanged |

| Schedule | FY04 President's Budget | Change from Baseline |
|---|---|---|
| Instruments selection | Nov-01 | Unchanged |
| Mission PDR | Jul-02 | Unchanged |
| NAR | Jul-02 | Unchanged |
| Mission CDR | 3Q/FY03 | Unchanged |
| Start S/C level I&T | 3Q/FY04 | Unchanged |
| Ship to launch site | 3Q/FY05 | Unchanged |
| Launch | 4Q/FY05 | Unchanged |

Two tables are always presented. The first is specifications; the second is schedule. These tables are tailored, depending on whether the data sheet is for Development, Operations, Research, or Technology and Advanced Concepts activity.

For Development sheets, the precise, fixed requirements will be presented. These are usually the top-level requirements that the program is committed to achieving. For spacecraft, the schedule will include the launch date.

For Operations sheets, the elements being operated will be listed. This list may be facilities on board the International space Station or it may be a set of independent spacecraft. Only key milestones will be presented in the schedule, particularly FY 2004 milestones.

For Research sheets, the portfolio will be described. With many individual Principal Investigators carrying out a large set of experiments and data analysis, research is discussed only at the portfolio level. The schedule will note any periodic research announcements that are planned.

**TECHNICAL COMMITMENT**

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

| Technical Specifications | | FY04 President's Budget | | | | Change from Base |
|---|---|---|---|---|---|---|
| | | FY02 | FY03 | FY04 | | |
| Validate in a laboratory and a relevant environment aircraft component technologies and advanced flight operations for reducing noise by 10 dB (re. to CY 1997 soa) to simultaneously enable air traffic growth and reduce community noise impact. | TRL | 2 | 3 | 3 | 4 | None |
| | $M | 20.0 | 41.3 | 58.7 | | |

*Chart Continued on Next Page*

For Technology and Advanced Concepts, there are two types of tables. Advanced Concepts are typically projects that will eventually move to development when they reach an appropriate level of maturity, including an independent cost estimate, a non-advocate review (NAR), and a preliminary design review (PDR). For technology, there is a unique table to identify which technologies are advanced and identify the specific application if it is in support of a future mission. As appropriate, the individual technology and advanced concepts may be listed separately or they may be rolled together.

Technologies have a Technology Readiness Level (TRL) progress roadmap, showing progress, plans, and status as well as associated funding. Advanced concepts have a list of preliminary requirements.

| Technology Readiness Level Description | |
|---|---|
| Increasing Maturity ↑ | 9. Actual system proven through successful mission operations |
| | 8. Actual system completed and qualified through test and demonstration |
| | 7. System prototype demonstration in an operational environment |
| | 6. System/subsystem model or prototype demonstration in a relevant environment |
| | 5. Component and/or breadboard validation in relevant environment |
| | 4. Component and/or breadboard validation in laboratory environment |
| | 3. Analytical and experimental critical function and/or characteristic proof of concept |
| | 2. Technology concept and/or application formulated Invention begins |
| | 1. Basic principles observed and reported |

### Acquisition Strategy & Performing Organizations

**ACQUISITION STRATEGY & PERFORMING ORGANIZATIONS**

The prime contractor for HST operations is the Consolidated Space Operations Contractor, Lockheed Martin Space Operations. FUSE operations are performed by the Johns Hopkins University. SIRTF operations will be performed by the Jet Propulsion Laboratory. In FY02, direct procurement represented 100% of budget authority. **Changes since FY03 Pres. Budget: None.**

| Current Acquisitions | Actual * | Selection Method | Actual * | Performer | Actual * |
|---|---|---|---|---|---|
| Cooperative Agreements | 0% | Full & Open Competition | 100% | Industry | 66% |
| Cost Reimbursable | 100% | Sole Source | | Government | 0% |
| Fixed Price | 0% | | 100% | NASA Intramural | 0% |
| Grants | 0% | | | University | 0% |
| Other | 0% | Sci Peer Review | 100% | Non Profit | 34% |
| * as % of FY02 direct procurement | 100% | * as % of FY02 direct procurement | | * as % of FY02 direct procurement | 100% |

| Future Acquisitions - Major | Selection | Goals |
|---|---|---|
| CSOC recompetition | late 2003 | 100% Full & Open Competition |

The Programs and Projects all present a standard set of information about their procurement. There is a general discussion plus two tables covering current data and planning data. All information pertains to the direct procurement portion of the Level 3 element's budget. The procurement data is typically based on the prior fiscal year for which data is available.

The discussion presents highlights of and changes to the acquisition strategy as well as a list of noteworthy performing organizations. Different Programs and Projects have distinct procurement strategies. Some are new efforts and some are nearing completion. Research procurements are different in nature from spacecraft development procurements in how they are solicited and in the type of procurement vehicle, such as grants or cost-plus contracts.

In the table for current acquisitions, three categories are displayed. The procurement part of the FY 2002 budget data is characterized by type, by selection method, and by performing organization. Different types of Programs can be distinguished by their procurement distributions. Research and data analysis programs will be predominantly grants selected through peer review and the work will be carried out predominantly at universities.

In the table for future acquisitions, the top planned announcements, procurements, etc. are presented. This table is not intended to show exhaustive detail of all future procurements, but rather to provide a snapshot and a way to compare the near-term strategies across all Theme areas. The selection time frame is presented as precisely as it is known. This may be a month, a quarter, or even just a year. The acquisition goals are also presented as precisely as they are known. For instance, it would already be known that a NASA Research Announcement would be selected through full and open competition.

### Agreements

This section lists significant internal or external agreements that have been forged to carry out this Program or Project. Internal agreements are internal to NASA and represent cross-Theme and cross Enterprise activities. External agreements are between NASA and other organizations, in particular other U. S. Government agencies or foreign entities.

### Independent Review

**INDEPENDENT REVIEWS** Data current as of 9/9/2002

| Types of Review | Performer | Last Review | Next Review | Purpose |
|---|---|---|---|---|
| Indep Annual Review | IPAO | 01-Jan-01 | 03-Mar-03 | |
| Nat'l Academy | SSB | | | |

Relevance and quality are verified through Independent Reviews listed at the Theme level and at Level 3.

The summary should note -- in addition to the topics covered -- whether the review is a retrospective evaluation of ongoing efforts, a prospective evaluation of planning and implementation, and whether it addresses relevance or quality.

### Budget and Life Cycle Cost

The budget tables present the FY 2004 budget request. Level 3 Development sheets present a life cycle cost. Level 3 Operations, Research, and Technology and Advanced Concepts sheets present a three-year budget.

The "FY 02" column reflects the FY 2002 budget as updated by the Congressional Operating Plan letter dated 9/30/02. The "FY 03" column reflects the FY 2003 Presidents Budget Submit (PBS) as Amended. The "Change" block includes all changes, both programmatic and full cost adjustments. A comparison to show FY 03 as translated to full cost, with FY 04, to isolate the programmatic changes, is included in the Full Cost Budgeting discussion starting on page S&AP 2-6 and 2-7. FY 2004 is in full cost. In the table, the change block is highlighted in blue and all numbers in full cost are highlighted in yellow.

For Development sheets, a life cycle cost is presented. These sheets expand upon the three budget columns, adding “Prior,” “BTC,” and “FY05” to “FY08” columns. FY 2002, FY 2003, Prior and BTC are not in full cost. The years FY 2004 to FY 2008 are in full cost. The specific items that are included in this program/project's definition of life cycle are listed above the table. Some examples of life cycle definitions are:

- These figures include all costs excluding retirement costs and pre-development technology.
- These figures include the costs of all phases.
- These figures represent all costs associated with a program completion date of 2012.

During this year, we will update lifecycle estimates so that all estimates will be in Full Cost for next years Budget Request.

## TERMS

| | |
|---|---|
| 2GRLV | Second Generation Reusable Launch Vehicle Program |
| AAH | Advanced Animal Habitat |
| AATT | Advanced Air Transportation Technology |
| ACS | Advanced Camera for Surveys |
| ADF | Avian Development Facility |
| AEE | Advanced Engineering Environment |
| AFRL | Air Force Research Lab |
| AGATE | Advanced General Aviation Transport Experiments |
| AHMS | Advanced Health Management System |
| AHST | Advanced Human Support Technology |
| ALTV | Approach and Landing Test Vehicle |
| AMS | Alpha Magnetic Spectrometer |
| AO | Announcement of Opportunity |
| AOS | Airspace Operations Systems |
| APG | Annual Performance Goal |
| APL | Applied Physics Laboratory (John Hopkins) |
| APMC | Agency Program Management Council |
| ARPO | Autonomous Rendezvous and Proximity Operations |
| ASC | Aviation System Capacity |
| ASI | Agenzia Spaziale Italiana *or* Italian Space Agency |
| ASO | Astronomical Search for Origins |
| AST | Aerospace Technology (Enterprise) |
| AT | Aeronautics Technology |
| ATAC | Air Transport Association of Canada |
| ATLO | Assembly, Test, Launch Operations |
| ATMIS | ATMospheric Instrumentation System |
| AU | Astronomical Unit |
| AVGS | Advanced Video Guidance Sensor |
| AvSSP | Aviation Safety and Security Program |
| BAAs | Broad Agency Announcements |
| BAF | Booster Applications Facility |
| BAT | Burst Alert Telescope |
| BATC | Ball Aerospace and Technology Corporation |
| BEC | Bose Einstein Condensate |
| BNL | Brookhaven National Laboratory |
| BOE | Basis of Estimate |
| BPR | Biological and Physical Research (Enterprise) |
| BPRAC | Biological and Physical Research Advisory Committee |
| BR | Bioastronautics Research |
| BTC | Baseline To Completion |
| BTF | Biotechnology Facility |
| CAIG | Cost Analysis Improvement Group |
| CAM | Centrifuge Accommodation Module |
| CANs | Cooperative Agreement Notices |
| CAPPS | Checkout and Payload Processing Services |
| CARA | CA Association for Research in Astronomy |
| CARD | Cost Analysis Requirements Document |
| CAS | Commercial Advisory Subcommittee |
| CAU | Cockpit Avionics Upgrade |
| CCRI | U.S. Climate Change Research Initiative |
| CCU | Cell Culture Unit |
| CDC | Center for Disease Control |
| CDP | Command and Display Processor |
| CDR | Critical Design Reviews |
| CEOS | Committee On Earth Observation Satellites |
| CERCLA or Superfund | Comprehensive Environmental Response, Compensation, and Liability Act |
| CETDP | Cross Enterprise Technology Development Program |
| CFIT | Controlled Flight Into Terrain |
| CFO | Chief Financial Officer |
| CFPs | Calls for Proposal |
| CFR | Code of Federal Regulations |
| CICT | Computing, Information and Communications Technology |
| CIR | Combustion Integrated Rack |
| CLCS | Checkout and Launch Control System |
| CME | Coronal Mass Ejection |
| CMG | Control Moment Gyro |
| CNES | Centre National d'Etudes Spatiales *or* French Space Agency |
| COF | Construction of Facilities |
| Co-Is | Co-Investigators |
| COLSA | COLSA Corporation |
| Core Values (NASA's) | Safety, People, Excellence and Integrity |
| COS | Cosmic Origins Spectrograph |
| CRFS | Commercial Research and Flight Support |
| CSA | Canadian Space Agency |
| CSOC | Consolidated Space Operations Contract |
| CTV | Crew Transfer Vehicle |
| DA | Data Analysis |
| DAA | Deputy Associate Administrator |

## SPECIAL ISSUES: Terms

| | |
|---|---|
| DAAC | Distributed Active Archive Center |
| DAG/TM | Distributed Air/Ground Traffic Management |
| DARA | See DLR |
| DART | Demonstration of Autonomous Rendezvous Technology |
| DD250 | Defense Department Form DD250 |
| DDR&E | Director, Defense Research and Engineering |
| DES | Dewar and Enclosure Subsystem |
| DLR | German Aerospace Center |
| DOD | Department of Defense |
| DOE | Department of Energy |
| DOT | Department of Transportation |
| DSS | Decision Support System |
| E2 | Extended Science |
| EAP | Educator Astronaut Program |
| ECLSS | Environmental Control and Life Support System |
| ECR | Environmental Compliance and Restoration |
| ECS | Engineering for Complex Systems |
| ECT | Enabling Concepts and Technologies |
| ED | Education Programs |
| EDL | Entry, Descent, and Landing |
| El Nino | A climate disturbance created in the Pacific Ocean every 2-5 years. |
| ELV | Expendable Launch Vehicle |
| ELVIS | Expendable Launch Vehicle Integrated Support |
| EMD | Engineering, Manufacturing and Development |
| Enterprises | Space Science, Earth Science, Biological and Physical Research, Aerospace Technology, Education, and Space Flight |
| EOS | Earth Observing System |
| EPA | Environmental Protection Agency |
| EPMC | Enterprise Program Management Council |
| EPO | Education and Public Outreach |
| EPPS | Energetic Particle and Plasma Spectrometer |
| ERAST | Environmental Research Aircraft and Sensor Technology |
| ESA | European Space Agency |
| ESE | Earth Science Enterprise |
| ESS | Electronics and Software Subsystem |
| ESSAAC | Earth Systems Science Applications Advisory Committee |
| EVA | Extravehicular Activity |
| EVE | Extreme Ultraviolet Variability Experiment |
| EXPRESS | Expedite the Processing of Experiments to the Space Station (Pallet) |
| FAA | Federal Aviation Administration |
| FAD | Formulation Authorization Document |
| FAT | Final Assembly and Test |
| FCF | Fluids and Combustion Facility |
| FEMA | Federal Emergency Management Agency |
| FHA | Flight Hardware Available |
| FIR | Fluids Integrated Rack |
| FSB | Fundamental Space Biology |
| FSD | Full Scale Development |
| FUSE | Far Ultraviolet Spectroscopic Explorer |
| FY | Fiscal Year |
| G&A | General and Administrative (costs) |
| GEO | Geosynchronous Earth Orbit |
| GFE | Government Furnished Equipment |
| Goals | There are 10 goals: 7 are Mission driven and 3 are enabling. |
| GOJ | Government of Japan |
| GRB | Gamma Ray Burst |
| GRNS | Gamma-Ray and Neutron Spectrometer |
| GSRP | Graduate Student Research Program |
| GWAC | Government Wide Agency Control |
| HHR | Habitat Holding Racks |
| HIRDLS | High Resolution Dynamics Limb Sounder |
| HMF FRCS | Hypergolic Maintenance Facility Forward Reaction Control System |
| HMI | Helioseismic and Magnetic Imager |
| HRF | Human Research Facility |
| HRI | Human Research Initiative |
| HST | Hubble Space Telescope |
| IAA | International Academy of Astronautics |
| IBPD | Integrated Budget and Performance Document |
| ICE | Independent Cost Estimate |
| IDP | Integrated Display Processor |
| IG | Inspector General |
| IGA | Intergovernmental Agreement |
| IIR | Independent Implementation Review |
| IIRT | Independent Implementation Review Team |
| IMCE | Management and Cost Evaluation |
| IMPACT | In situ Measurements of Particles and CME Transients |
| IPAO | Independent Program Assessment Office |
| IPS | Integrated Planning System |
| IRT | Independent Review Team |
| IS | Implementing Strategies |
| ISAS | Institute of Space and Astronautical Science |

| | |
|---|---|
| ISP | In-Space Propulsion |
| ISPR | International Standard Payload Rack |
| ISS | International Space Station |
| ISTAR | Integrated System Test of an Air Breathing Rocket |
| ISTP | Integrated Space Transportation Plan |
| IT | Information Technology |
| ITF | Integrated Training Facility |
| IVHM | Intelligent Vehicle Health Management |
| JACIE | Joint Agency Committee for Imagery Evaluation |
| JIMO | Jupiter Icy Moons Orbiter |
| JSRA | Joint Sponsored Research Agreement |
| JWST | James Webb Space Telescope |
| LASP | Laboratory for Atmospheric and Space Physics (University of Colorado) |
| LBTI | Large Binocular Telescope Interferometer |
| LCC | Life Cycle Cost |
| LEO | Low Earth Orbit |
| LISA | Laser Interferometer Space Antenna |
| LMA | Lockheed Martin Astronautics |
| LSG | Life Science Glovebox |
| LSTO | Launch Services Task Order |
| LTMPF | Low Temperature Microgravity Physics Facility |
| MAG | Magnetometer |
| MARSIS | Mars Advanced Radar for Subsurface and Ionospheric Sounding |
| MASCS | Mercury Atmospheric and Surface Composition Spectrometer |
| MCC | Mission Control Center |
| MCC-H | Mission Control Center-Houston |
| MCC-M | Mission Control Center-Moscow |
| MCR | Mission Confirmation Review |
| MDIS | Mercury Dual Imaging System |
| MEMS | Micro Electro-Mechanical Systems |
| MEP | Mars Exploration Program |
| MEPAG | Mars Exploration Program Analysis Group |
| MESSENGER | Mercury Surface, Space ENvironment, GEochemistry and Ranging |
| MGS | Mars Global Surveyor |
| MIDEX | NASA Medium-Size Explorer |
| MIIS | Mishap Initiator Identification System |
| MLA | Mercury Laser Altimeter |
| MLP | Mobile Launcher Platforms |
| MLS | Microwave Limb Sounder |
| MMRTG | Multi-Missions Radioisotope Thermoelectric Generators |
| MO | Missions of Opportunity |
| MOA | Memoranda of Agreement |
| MOU | Memorandum of Understanding |
| MPLM | Multi Purpose Logistic Modules |
| MSL | Mars Science Laboratory |
| MSM | Mission and Science Measurement Technology |
| MSRF | Materials Science Research Rack |
| MT | Mobile Transporter |
| MUBLCOM | Multiple path Beyond Line of Sight Communication |
| MUREP | Minority University Research and Education Program |
| MUSS | Multi-User Systems and Support |
| NAC | NASA Advisory Committee |
| NACA | National Advisory Committee for Aeronautics |
| NAI | National Aerospace Initiative |
| NAR | Non-Advocate Review |
| NAS | National Airspace System |
| NASDA | National Space Development Agency of Japan |
| NBL | Neutral Buoyancy Lab |
| NCAM | National Consortium for Aviation Mobility |
| NEIGE | NetLander Ionosphere and Geodesy Experiment |
| NEO | Near Earth Object |
| NEPER | NASA Education Program Evaluation Review Panel |
| NESDIS | National Environmental Satellite, Data and Information Service |
| NEXT | NASA Exploration Team |
| NExTNAS | NASA Exploratory Technologies for the National Airspace System |
| NGLT | Next Generation Launch Technology |
| NICMOS | Near Infrared Camera and Multi-Object Spectrometer |
| NIH | National Institutes of Health |
| NIMA | National Imagery and Mapping Agency |
| NISN | NASA Integrated Services Network |
| NLS | NASA Launch Services |
| NOAA | National Oceanic and Atmospheric Administration |
| NPG | NASA Procedures and Guidelines |
| NRA | NASA Research Announcement |
| NRC | National Research Council *or* Nuclear Regulatory Commission |
| NRC/ASEB | National Research Council Aeronautics and Space Engineering Board |
| NSBRI | National Space Biomedical Research Institute |
| NSF | National Science Foundation |

| | |
|---|---|
| NSI | Nuclear Systems Initiative (Program) |
| NSSC | NASA's Shared Services Center |
| NSTC | National Science and Technology Council |
| NTTC | National Technology Transfer Center |
| OAT | Office of Aerospace Technology |
| OBPR | Office of Biological and Physical Research (Enterprise) |
| OEP | Operational Evolution Plan |
| OHS | Office of Homeland Security |
| OMB | Office of Management and Budget |
| OPF | Orbiter Processing Facilities |
| OPF ORR | Orbiter Processing Facility Orbiter Rollout Review |
| OPIMC | OSF Program and Institutional Management Council |
| OSF | Office of Space Flight |
| OSP | Orbital Space Plane |
| OSS | Office of Space Science |
| OSTP | Office of Science and Technology Policy |
| PAD | Pad Abort Demonstrator |
| PAO | Public Affairs Office |
| PBOSG | Plum Brook Operations Support Group |
| PBRF | Plum Brook Reactor Facility |
| PBS | President's Budget Submit |
| PCA | Program Commitment Agreement |
| PCS | Physics of Colloids in Space |
| PCU | Power Control Unit |
| PDR | Preliminary Design Review |
| PDS | Hungarian Space Agency *or* Passive Dosimeter System *or* Planetary Data System |
| PI | Principal Investigator |
| PIMC | Program Institutional Management Council |
| PLASTIC | PLAsma and SupraThermal Ion and Composition |
| PMC | Program Management Council |
| PO | Physical Oceanography (at Jet Propulsion Laboratory) |
| POC | Point of Contact |
| POCAAS | Payload Operations Concepts and Architecture Assessment Study |
| POIC | Payloads Operations Information Center |
| POIF | Payloads Office Information Facility |
| POP | Program Operating Plan |
| PPARC | Particle Physics CNES |
| PPSF | Psychological and Physiological Stresses and Factors |
| PRU | Plant Research Unit |
| PSO | Primary Science Orbit |
| PSR | Physical Sciences Research |
| QAT | Quiet Aircraft Technology |
| R&A | Research and Analysis |
| R&D | Research and Development |
| R&T | Research and Technology |
| RAND | The RAND Corporation |
| RBCC | Rocket Based Combined Cycle |
| RCRA | Resource Conservation and Recovery Act |
| ReMaP | Research Maximization and Prioritization Task Force |
| RFPs | Request for Proposals |
| RHU | Radioactive Heater Units |
| RI | Research Institution |
| RLV | Reusable Launch Vehicle |
| ROSS | Research Opportunities in Space Science |
| RP | Rocket Propellant |
| RPC | Research Partnership Center |
| RPT | Rocket Propulsion Test |
| S&MA | Safety and Mission Assurance |
| S/C I & T | Spacecraft Integration and Test |
| SAE | Science, Aeronautics and Exploration |
| SAGAT | Situation Awareness Global Assessment Technique |
| SAIC | Science Applications International Corporation |
| SAO | Smithsonian Astrophysical Observatory |
| SATS | Small Aircraft Transportation System |
| SB | Small Business |
| SBCs | Small Business Concerns |
| SBIR | Small Business Innovative Research |
| SDB | Small disadvantaged business |
| SDMAC | Space Department MAnagement Committee |
| SDR | System Design Review |
| SEAT | Science Engineering Analysis and Test |
| SEC | Sun-Earth Connection |
| SECAS | Sun-Earth Connection Advisory Subcommittee |
| SECCHI | Sun-Earth Connection Coronal and Heliospheric Investigation |
| SEIS | SEISmology Experiment |
| SELVS | Support of Expendable Launch Vehicles |
| SEU | Structure and Evolution of the Universe |
| SEUS | Structure and Evolution of the Universe Subcommittee |
| SFC | Space Flight Capabilities |
| SFOC | Space Flight Operations Contract |

## **SPECIAL ISSUES:** Terms

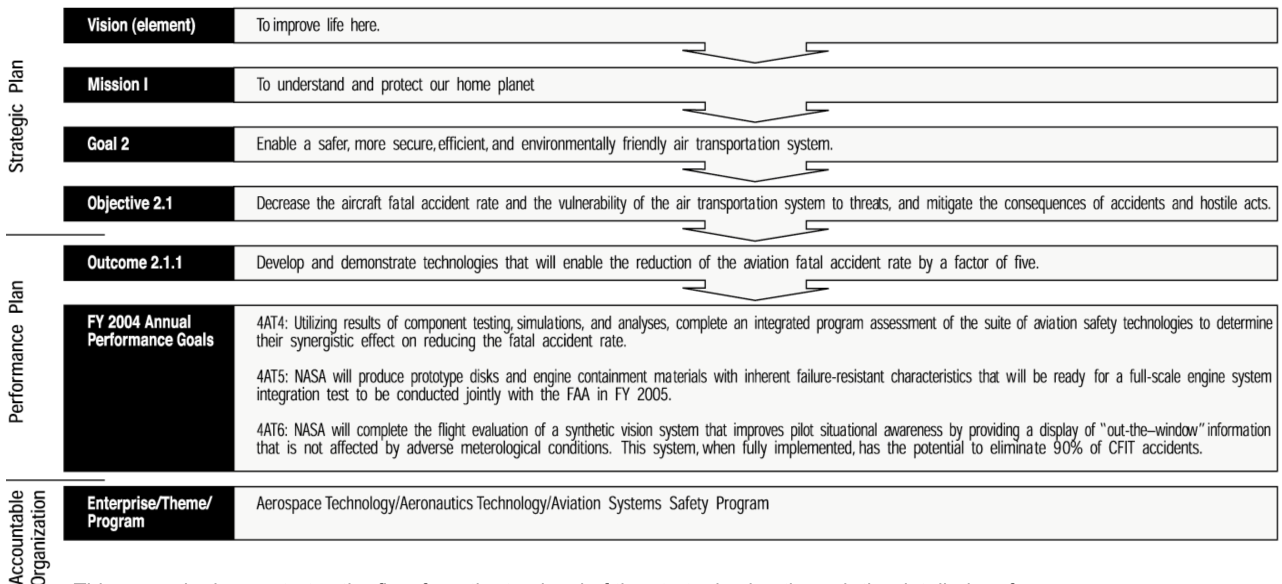
| | |
|---|---|
| SHARAD | Shallow Radar |
| SHARP | Slender Hypervelocity Aerothermodynamic Research Probes |
| SHARPP | Solar Heliospheric Activity Research and Prediction Program |
| SHCT | Short Hall Civil Tiltrotor |
| SIM | Space Interferometry Mission |
| SIRTF | Space Infrared Telescope Facility |
| SLEP | Service Life Extension Program |
| SLI | Space Launch Initiative |
| SLWT | Super Lightweight Tank |
| SMC | Senior Management Council |
| SMEX | Small Explorer |
| SMO | Systems Management Organization |
| SMPMC | Systematic Measurements Program Management Council |
| SMS | Surface Management System |
| SOA | State of the Art |
| SOFIA | Stratospheric Observatory for Infrared Astronomy |
| Space Flight Capabilities | Space Flight, Crosscutting Technology, Safety & Mission Assurance, and Institutional Support |
| SPD | Space Product Development |
| SPF | Software Production Facility |
| SPRL | Space Physics Research Laboratory (University of Michigan) |
| SSB | Space Studies Board |
| SSBRP | Space Station Biological Research Project |
| SScAC | Space Science Advisory Committee |
| SSE | Space Science Enterprise *or* Solar System Exploration |
| SSES | Solar System Exploration Subcommittee |
| SSME | Space Shuttle Main Engines |
| SSP | Space Shuttle Program |
| SSRMS | Space Station Remote Manipulator System |
| SSTF | Space Station Training Facility |
| STARS | NASA's Staff and Recruiting System |
| STEM | Science, Technology, Engineering, and Mathematics |
| STLT | Space Transfer and Launch Technology Program |
| STTR | Small Business Technology Transfer |
| SWAVES | STEREO/WAVES |
| SWOB | Small women owned business |
| TAP | Terminal Area Productivity |
| TBCC | Turbine Based Combined Cycle |
| TCA | Theme Commitment Agreement |
| TCAT | 21st Century Aircraft Technology |
| TDRSS | Tracking and Data Relay Satellite system |
| TEB | Technology Executive Board |
| TES | Thermal Emissions Spectrometer |
| Themes (NASA) | There are 18 themes, grouped by Enterprise. |
| TMCO | Technical, Management, Cost, and Other Program Factors. Other includes E/PO, SDB, and tech infusion/transfer. |
| TPF | Terrestrial Planet Finder |
| TRL | Technology Readiness Level, see page S&AP 4-9 |
| TRMM | Tropical Rainfall Measuring Mission |
| TSA | Transportation Security Agency |
| TSC | Telecommunications Support Center |
| TTA | Technical Task Agreements |
| UAV | Unmanned Aerial Vehicles |
| UEET | Ultra-Efficient Engine Technology |
| UHF | Ultra High Frequency |
| ULF | Ultra Low Frequency |
| UNESCO | United Nations Educational, Scientific and Cultural Organization |
| URETI | University Research and Engineering Technology Institute |
| USACE | U.S. Army Corps of Engineers |
| USAF | United States Air Force |
| USDA | U. S. Department of Agriculture |
| USGS | U.S. Geological Survey |
| USRA | Universities Space Research Association |
| UVOT | UltraViolet/Optical Telescope |
| VAB | Vehicle Assembly Building |
| VAMS | Virtual Airspace Modeling and Simulation |
| VIB | Virtual Iron Birds |
| VS | Vehicle Systems |
| VSP | Vehicle Systems Program |
| WFC3 | Wide Field Camera 3 |
| WORF | Window Observational Research Facility |
| X43C | Flight demonstrator combining NASA airframe experience and USAF propulsion development |
| XRT | X-Ray Telescope |

# SPECIAL ISSUES: Performance Plan Summary

NASA's planning process starts with long-term Vision and Mission and flows to more focused near-term plans and documents.

The NASA Vision, Mission, goals, and objectives are documented in the strategic plan. These have been further decomposed into outcomes and FY 2004 annual performance goals, which are distributed throughout the themes in this Integrated Budget and Performance Document. Each theme traces its allocations from the Mission statements to the annual performance goals. The table in this section shows the total allocation of outcomes and annual performance goals to each mission, goal and objective, as collected from the themes throughout this document.

The specific annual performance goals in this summary are traceable to the themes using the naming convention for the annual performance plans. For example, 4AT6 is goal number 6 for the Aeronautics Theme for FY2004, and 4ISS5 is goal number 5 for the International Space Station Theme for FY2004. The theme identifiers are shown below.




This example demonstrates the flow from the top level of the strategic plan through the detailed performance measures.

**Themes**

ASO–Astronomical Search for Origins
AT–Aeronautics Technology
BSR–Biological Sciences Research
ED–Education Programs
ESA–Earth Science Applications
ESS–Earth System Science
ISS–International Space Station
ITTP–Innovative Technology Transfer Partnerships
MEP–Mars Exploration Program
MSM–Mission and Science Measurement Technology
PSR–Physical Sciences Research
RPFS–Research Partnerships and Flight Support
SEC–Sun-Earth Connection
SEU–Structure and Evolution of the Universe
SFS–Space and Flight Support
SLI–Space Launch Initiative
SSE–Solar System Exploration
SSP–Space Shuttle Program

# **SPECIAL ISSUES:** Performance Plan Summary

## Mission I: To Understand and Protect our Home Planet

**Goal 1: Understand the Earth system and apply Earth system science to improve prediction of climate, weather, and natural hazards.**

**Obj. 1.1 Understand how the Earth is changing, better predict change, and understand the consequences for life on Earth.**

*Outcome 1.1.1 Observe, analyze, and model the Earth system to discover how it is changing and the consequences for life on Earth.*

4ESS7 Atmospheric Composition - Integrate high latitude satellite, suborbital, and ground based observations, coupled with laboratory studies and model calculations to assess the potential for future ozone depletion in the arctic, and characterize the properties and distributions of various types of clouds and aerosols as they relate to the extinction of solar radiation in the atmosphere. In the 2010-2014 timeframe, we will aim to improve our ability to predict future ozone change by developing multi-year maps of key tropospheric pollutants and their altitude distribution and variability. Progress toward achieving outcomes will be validated by external review.

4ESS8 Weather - Improve predictive capabilities of regional models using satellite-derived localized temperature and moisture profiles and ensemble modeling. We plan to greatly improve weather and severe storm forecasting by 2014 by creating cloud models with detailed microphysics and spatial resolution of approximately 25 kilometers or less. Progress toward achieving outcomes will be validated by external review.

4ESS9 Carbon Cycles, Ecosystems, and Biogeochemistry - Reduce land cover errors in ecosystem and carbon cycle models, and quantify global terrestrial and marine primary productivity and its interannual variability. One goal we plan to reach by the 2010-2014 timeframe is the identification and quantification of carbon sources and sinks at the sub-regional scales (approximately 100 kilometers) with high confidence, leading to progress in predicting the future of carbon-cycling. Progress toward achieving outcomes will be validated by external review.

4ESS10 Water and Energy Cycle - Enhance land surface modeling efforts, which will lead to improved estimates of soil moisture and run-off. One of our goals for the 2010-2014 timeframe is to have global observation of precipitation over the entire diurnal cycle and important land surface quantities, such as soil moisture and snow quantity at mesoscale resolution (i.e., on the order of kilometers). Progress toward achieving outcomes will be validated by external review.

4ESS11 Climate, Variability and Change - Assimilate satellite and in situ observations into a variety of ocean, atmosphere, and ice models for purposes of state estimation; provide experimental predictions on a variety of climatological timescales; and determine the plausibility of these predictions using validation strategies. One of the goals in the 2010-2014 timeframe is the development of 10-year or longer climate forecasts leading to better informed policy choices on greenhouse gas emissions and carbon management. Progress toward achieving outcomes will be validated by external review.

4ESS12 Earth Surface and Interior Structure - Advance understanding of surface change through improved geodetic reference frame, estimates of mass flux from satellite observations of Earth's gravitational and magnetic fields, and airborne and spaceborne observations of surface height and deformation. One goal toward predicting changes in Earth's surface is to achieve high resolution global topography at meter resolution and decimeter vertical accuracy for the 2010-2014 timeframe. Progress toward achieving outcomes will be validated by external review.

*Outcome 1.1.2 Expand Earth Science research opportunities through utilization of the unique capabilities of the Space Shuttle.*

4SSP1 Achieve 100% on-orbit mission success when carrying Earth science payloads. For this metric, mission success criteria are those provided to the prime contractor (SFOC) for purposes of determining successful accomplishment of the performance incentive fees in the contract.

*Outcome 1.1.3 Provision of Space Station accommodations to support Earth Science Research.*

4ISS1 Provide, at least, 80% of the upmass, middecks and crew time for Earth Science payloads as established at the beginning of FY 2004.

*Outcome 1.1.4 Enhance Earth Science research through definition of future opportunities for utilization of unique human capabilities in space.*

4SFS1 Identify 2-3 innovative system and infrastructure concepts (and associated technologies) driven by the requirements of ambitious future Earth system science missions.

4SFS2 Develop and review technology maturation road maps and investment strategies necessary to realize these transformational capabilities for Earth system science.

**Obj. 1.2 Expand and accelerate the realization of economic and societal benefits from Earth science, information, and technology.**

*Outcome 1.2.1 Expand and accelerate the realization of economic and societal benefits from Earth science, information, and technology.*

4ESA1 National applications: Benchmark measurable enhancements to at least 2 national decision support systems using NASA results.

4ESA2 Cross Cutting Solutions: Expand DEVELOP (Digital Earth Virtual Environment and Learning Outreach Project) workforce development program to at least 5 additional states.

4ESA3 Cross Cutting Solutions: Competitively select at least 5 solutions projects for the Research, Education, Applications solutions Network (REASoN) program to serve national applications.

4ESA4 Cross Cut Solutions: Verify and validate at least two commercial remote sensing sources/products for Earth science research.

**Obj. 1.3 Understand the origins and societal impacts of variability in the Sun-Earth connection.**

*Outcome 1.3.1 Define the origins and societal impacts of variability in the Sun-Earth Connection.*

4SEC4 Successfully demonstrate progress in developing the capability to predict solar activity and the evolution of solar disturbances as they propagate in the heliosphere and affect the Earth. Progress towards achieving outcomes will be validated by external review.

4SEC5 Successfully demonstrate progress in specifying and enabling prediction of changes to the Earth's radiation environment, ionosphere, and upper atmosphere. Progress towards achieving outcomes will be validated by external review.

4SEC6 Successfully demonstrate progress in understanding the role of solar variability in driving space climate and global change in the Earth's atmosphere. Progress towards achieving outcomes will be validated by external review.

**Obj. 1.4 Catalog and understand potential hazards to Earth from space.**

*Outcome 1.4.1 Explore the space environment to discover hazards to Earth.*

4SSE4 Successfully demonstrate progress in determining the inventory and dynamics of bodies that may pose an impact hazard to Earth. Progress towards achieving outcomes will be validated by external review.

4SSE5 Successfully demonstrate progress in determining the physical characteristics of comets and asteroids relevant to any threat they may pose to Earth. Progress towards achieving outcomes will be validated by external review.

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

**Obj. 2.1 Decrease the aircraft fatal accident rate and the vulnerability of the air transportation system to threats, and mitigate the consequences of accidents and hostile acts.**

*Outcome 2.1.1 Develop & demonstrate technologies that will enable the reduction of the aviation fatal accident rate by 50% from the FY 1991 - 1996 average.*

4AT4 Utilizing results of component testing, simulations, and analyses, complete an integrated program assessment of the suite of aviation safety technologies to determine their synergistic effect on reducing the fatal accident rate. (AvSSP)

4AT5 Propulsion system malfunctions are cited in 25% of fatal accidents, with disk and/or fan blade component failures being attributed to about 15% of these malfunctions. In FY 2004 NASA will provide deliver prototype disks, and engine containment materials with inherent failure resistant characteristics that will be ready for a full scale engine system integration test to be conducted jointly with the FAA in FY05. (AvSSP)

4AT6 Controlled Flight into Terrain (CFIT) accounts for 30% of General Aviation fatal accidents. During FY 2004, NASA will complete the flight evaluation of a synthetic vision system that improves pilot situational awareness by providing a display of "out-the–window" information that is not effected by adverse metrological conditions. This system when fully implemented has the potential to eliminate 90% of CFIT accidents. (AvSSP)

*Outcome 2.1.2 Develop & demonstrate decision support technologies for ground-based and air/ground air traffic management systems that detect and manage threatening aircraft.*

4AT7 Complete a preliminary demonstration, in a realistic operational environment, of an automated system to provide real-time identification of flight path deviations and a means to alert authorities in a prompt and consistent manner. (AvSSP)

**Obj. 2.2 Protect local and global environmental quality by reducing aircraft noise, emissions and other contaminants.**

*Outcome 2.2.1 Validate aircraft component technologies and advanced operations for reducing noise by 10dB (re: CF 1997 SOA) in laboratory and relevant environment to enable air traffic growth.*

4AT8 Validate initial concepts for engine and airframe source noise reduction by 5dB (re: to CY 2001 SOA). (Vehicle Systems)

*Outcome 2.2.2 Demonstrate combustor configurations for reducing NOx emission by 70% (re. to 1996 ICAO standard) to reduce smog and lower atmospheric ozone. Demonstrate airframe and engine component technologies for reducing the green-house gas, CO2, emissions by 25% (re. to 2000 SOA).*

4AT9 Experimentally demonstrate a 2-stage highly loaded compressor for increasing pressure rise per stage. (Vehicle Systems)

**Obj. 2.3 Enable more people and goods to travel faster and farther, with fewer delays.**

*Outcome 2.3.1 Develop & demonstrate technologies that enable a 50% increase in the aviation system throughput.*

4AT10 Complete validation and assessment of the Advanced Air Transportation Technologies products (tools/concepts) through field and laboratory demonstrations, analyses, evaluations, and assessments on a tool-by-tool basis to demonstrate an increase in terminal throughput by 35 percent and an increase in en route throughput by 20 percent. (Airspace Systems)

*Outcome 2.3.2 Provide the technologies and processes for conducting trade-off analyses amongst future air transportation system's concepts and technologies.*

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

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

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

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

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

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

**Obj. 3.1 Enhance the Nation's security by developing and demonstrating critical access-to-space technologies that benefit NASA, DOD, and other government agencies.**

*Outcome 3.1.1 An established partnership between NASA and DoD to ensure space technology investments are fully leveraged. (NGLT)*

4SLI17 The DoD responsive space lift requirements as defined by the Analysis of Alternatives process will be assessed to determine the potential and priorities for leveraged technology investments that support both NASA and DoD needs.

*Outcome 3.1.2 Advance goals of a more secure world and a higher quality of life by providing and defining more capable and affordable future in space operations infrastructure.*

4SFS3 Identify 2-3 innovative systems and infrastructure concepts (and associated technologies) that can support prospective requirements of ambitious future space systems that contribute materially to security and the quality of life.

4SFS4 Develop and review of technology maturation road maps and investment strategies necessary to realize these transformational capabilities.

*Outcome 3.1.3 Create a more Secure World and improve the quality of life by investing in technologies and collaborating with other agencies, industry, and academia.*

4ESA5 Benchmark improvements to at least two of the target national applications - Air quality and Agricultural competitiveness.

**Obj. 3.2 Enhance the Nation's security through aeronautical partnerships with DOD and other government agencies.**

*Outcome 3.2.1 Gain experience in multi-national space construction & operations to support future cooperative programs.*

4ISS2 The ISS will meet its commitments with the International Partners to provide Node-2 in FY04.

*Outcome 3.2.2 Develop and conduct tests of innovative technologies that contribute to the superiority of air vehicles in support of the National defense.*

4AT14 Conduct and obtain flight test data of Autonomous Aerial refueling technologies in support of DoD UCAV Program. (Vehicle Systems)

**Obj. 3.3 Improve the Nation's economic strength and quality of life by facilitating innovative use of NASA technology.**

*Outcome 3.3.1 Transfer NASA technology to the Nation.*

4ITTP1 Complete 200 transfers of NASA technologies, expertise or facility usage to the U.S. private sector, through hardware licenses, software usage agreements, or Space Act agreements.

**Obj. 3.4 Leverage resources in support of national priorities through partnerships across industry, academia, and government for market-driven research in space.**

*Outcome 3.4.1 Advance NASA's vision and mission by leveraging industry investment in space-based commercial activity through active partnership with industry and academia.*

4RPFS1 Complete realignment plans of SPD, initiate phase-out, and demonstrate contributions to agency mission.

4RPFS2 Enable industry research in space that allows them to bring one commercial product under investigation to market by FY04.

**Obj. 3.5 Resolve scientific issues impacting Earth-based technological and industrial applications using the unique low-gravity environment of space.**

*Outcome 3.5.1 Use the unique low-gravity environment to resolve scientific issues that impact Earth-based technological and industrial applications.*

4PSR1 Improve understanding of the detailed physical and chemical processes associated with combustion, the efficiency of combustion, and how soot is produced in flames; the properties and behavior of granular materials such as soils and powders; growing crystals of large molecules for applications in drug development and biomedical research; and growing tissues outside the body (cellular assembling processes in tissue cultures) for research and medical treatments. Progress toward accomplishing this Performance Goal will be assessed by an advisory committee.

4RPFS3 Integrate and prepare the Combustion Integrated Rack research facility for launch in the FY 2004 time frame.

*Outcome 3.5.2 Provision of ISS accommodations to support NASA, other U.S. Government Agencies, Industry and Academic research and technology development.*

4ISS3 Provide at least 80% of the upmass, middecks, and crewtime for technology development payloads as established at the start of FY 2004.

## Mission II: To Explore the Universe and Search for Life

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

**Obj. 4.1 Understand how life responds to the space environment and the role of gravity in the processes of life.**

*Outcome 4.1.1 Describe and determine the ability of life to adapt and thrive in the space environment.*

4BSR1 Advance understanding of the role of gravity in biological processes at all levels of biological complexity. FY 04 activities will include soliciting ground-based research in all Fundamental Biology disciplines, planning for increased early ISS utilization for basic biology research in the 2005 and beyond time frame, and maintaining an open, competitive and productive program in fundamental space biology.

*Outcome 4.1.2 Ensure the opportunity for successful scientific research projects and programs by providing safe, reliable, and affordable launch and recovery capability, sustaining payload resources, and a human presence.*

4SSP2 Achieve 100% on-orbit mission success when carrying physical science payloads. For this metric, mission success criteria are those provided to the prime contractor (SFOC) for purposes of determining successful accomplishment of the performance incentive fees in the contract.

**Obj. 4.2 Understand the fundamental organizing principles of nature and how they give rise to structure and complexity in matter, using the unique low-gravity environment in space.**

*Outcome 4.2.1 Advance the scientific understanding of complex biological and physical systems.*

4PSR2 Use research in the low gravity environment of space to advance the scientific understanding of complex biological and physical systems. FY 04 accomplishments will include maintaining an open, competitive, and productive research community, and carrying out and analyzing results of ISS experiments in colloidal physics. Progress toward accomplishing this performance goal will be assessed by an advisory committee.

*Outcome 4.2.2 Advance understanding of fundamental issues in condensed matter physics and atomic physics.*

4PSR3 Investigate fundamental and unresolved issues in condensed matter physics and atomic physics. FY 04 activities will include maintaining an open, competitive and productive research program in condensed matter physics, Bose-Einstein condensation, and atomic clocks development for space-based utilization. Progress toward accomplishing this performance goal will be assessed by an advisory committee.

*Outcome 4.2.3 Provision of Space Station accommodations to support Physics, Chemistry and Biological Research.*

4ISS4 Provide, at least, 80% of the upmass, middecks and crew time for Biological and Physical Sciences' payloads as established at the beginning of FY 2004.

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

**Obj. 5.1 Learn how the solar system originated and evolved to its current diverse state.**

*Outcome 5.1.1 Determine how the solar system originated and evolved to its current diverse state.*

4SSE6 Successfully demonstrate progress in understanding the initial stages of planet and satellite formation. Progress towards achieving outcomes will be validated by external review.

4SSE7 Successfully demonstrate progress in studying the processes that determine the characteristics of bodies in our solar system and how these processes operate and interact. Progress towards achieving outcomes will be validated by external review.

4SSE8 Successfully demonstrate progress in understanding why the terrestrial planets are so different from one another. Progress towards achieving outcomes will be validated by external review.

4SSE9 Successfully demonstrate progress in learning what our solar system can tell us about extra-solar planetary systems. Progress towards achieving outcomes will be validated by external review.

*Outcome 5.1.2 Support future exploration by providing Space Shuttle launch capability for research, technology development, and exploration missions.*

4SSP3 Achieve 100% on-orbit mission success when servicing HST. For this metric, mission success criteria are those provided to the prime contractor (SFOC) for purposes of determining successful accomplishment of the performance incentive fees in the contract.

**Obj. 5.2 Determine the characteristics of the solar system that led to the origin of life.**

*Outcome 5.2.1 Determine the characteristics of the solar system that led to the origin of life.*

4SSE10 Successfully demonstrate progress in determining the nature, history, and distribution of volatile and organic compounds in the solar system. Progress towards achieving outcomes will be validated by external review.

4SSE11 Successfully demonstrate progress in identifying the habitable zones in the solar system. Progress towards achieving outcomes will be validated by external review.

**Obj. 5.3 Understand how life begins and evolves.**

*Outcome 5.3.1 Understand how life begins and evolves.*

4SSE12 Successfully demonstrate progress in identifying the sources of simple chemicals that contribute to prebiotic evolution and the emergence of life. Progress towards achieving outcomes will be validated by external review.

4SSE13 Successfully demonstrate progress in studying Earth's geologic and biologic records to determine the historical relationship between Earth and its biosphere. Progress towards achieving outcomes will be validated by external review.

# **SPECIAL ISSUES:** Performance Plan Summary

**Obj. 5.4 Understand the current state and evolution of the atmosphere, surface, and interior of Mars.**

*Outcome 5.4.1 Understand the current state and evolution of the atmosphere, surface, and interior of Mars.*

4MEP4 Successfully demonstrate progress in characterizing the present climate of Mars and determine how it has evolved over time. Progress towards achieving outcomes will be validated by external review.

4MEP5 Successfully demonstrate progress in investigating the history and behavior of water and other volatiles on Mars. Progress towards achieving outcomes will be validated by external review.

4MEP6 Successfully demonstrate progress in studying the chemistry, mineralogy, and chronology of Martian materials. Progress towards achieving outcomes will be validated by external review.

4MEP7 Successfully demonstrate progress in determining the characteristics and dynamics of the interior of Mars. Progress towards achieving outcomes will be validated by external review.

**Obj. 5.5 Determine if life exists or has ever existed on Mars.**

*Outcome 5.5.1 Determine whether life exists or has ever existed on Mars.*

4MEP8 Successfully demonstrate progress in investigating the character and extent of prebiotic chemistry on Mars. Progress towards achieving outcomes will be validated by external review.

4MEP9 Successfully demonstrate progress in searching for chemical and biological signatures of past and present life on Mars. Progress towards achieving outcomes will be validated by external review.

**Obj. 5.6 Develop an understanding of Mars in support of possible future human exploration.**

*Outcome 5.6.1 Develop an understanding of Mars in support of possible future human exploration.*

4MEP10 Successfully demonstrate progress in identifying and studying the hazards that the Martian environment will present to human explorers. Progress towards achieving outcomes will be validated by external review.

4MEP11 Successfully demonstrate progress in inventorying and characterizing Martian resources of potential benefit to human exploration of Mars. Progress towards achieving outcomes will be validated by external review.

*Outcome 5.6.2 Enable safer, more affordable and more effective future human and robotic exploration missions by defining science-driven, innovative approaches and concepts to inform future decisions concerning systems infrastructures.*

4SFS5 Identify 4-6 innovative system and infrastructure concepts (and associated technologies) that can support the requirements of ambitious future space science missions.

4SFS6 Develop and independently review technology maturation road maps and investment strategies necessary to realize these transformational capabilities for Space Science.

**Obj. 5.7 Discover what powered the Big Bang and the nature of the mysterious dark energy that is pulling the Universe apart.**

*Outcome 5.7.1 Discover what powered the Big Bang and the nature of the mysterious dark energy that is pulling the Universe apart.*

4SEU4 Successfully demonstrate progress in search for gravitational waves from the earliest moments of the Big Bang. Progress towards achieving outcomes will be validated by external review.

4SEU5 Successfully demonstrate progress in determining the size, shape, and matter-energy content of the Universe. Progress towards achieving outcomes will be validated by external review.

4SEU6 Successfully demonstrate progress in measuring the cosmic evolution of the dark energy, which controls the destiny of the Universe. Progress towards achieving outcomes will be validated by external review.

**Obj. 5.8 Learn what happens to space, time, and matter at the edge of a black hole.**

*Outcome 5.8.1 Learn what happens to space, time, and matter at the edge of a black hole.*

4SEU7 Successfully demonstrate progress in determining how black holes are formed, where they are, and how they evolve. Progress towards achieving outcomes will be validated by external review.

4SEU8 Successfully demonstrate progress in testing Einstein's theory of gravity and mapping space-time near event horizons of black holes. Progress towards achieving outcomes will be validated by external review.

4SEU9 Successfully demonstrate progress in observing stars and other material plunging into black holes. Progress towards achieving outcomes will be validated by external review.

**Obj. 5.9 Understand the development of structure and the cycles of matter and energy in the evolving Universe.**

*Outcome 5.9.1 Understand the development of structure and explore the cycles of matter and energy in the evolving Universe.*

4SEU10 Successfully demonstrate progress in determining how, where, and when the chemical elements were made, and tracing the flows of energy and magnetic fields that exchange them between stars, dust, and gas. Progress towards achieving outcomes will be validated by external review.

4SEU11 Successfully demonstrate progress in exploring the behavior of matter in extreme astrophysical environments, including disks, cosmic jets, and the sources of gamma-ray bursts and cosmic rays. Progress towards achieving outcomes will be validated by external review.

4SEU12 Successfully demonstrate progress in discovering how the interplay of baryons, dark matter, and gravity shapes galaxies and systems of galaxies. Progress towards achieving outcomes will be validated by external review.

**Obj. 5.10 Understand how today's universe of galaxies, stars, and planets came to be.**

*Outcome 5.10.1 Understand how today's Universe of galaxies, stars, and planets came to be.*

4ASO4 Successfully demonstrate progress in learning how the cosmic web of matter organized into the first stars and galaxies and how these evolved into the stars and galaxies we see today. Progress towards achieving outcomes will be validated by external review.

4ASO5 Successfully demonstrate progress in understanding how different galactic ecosystems of stars and gas formed and which ones might support the existence of planets and life. Progress towards achieving outcomes will be validated by external review.

**Obj. 5.11 Learn how stars and planetary systems form and evolve.**

*Outcome 5.11.1 Learn how stars and planetary systems form and evolve.*

4ASO6 Successfully demonstrate progress in learning how gas and dust become stars and planets. Progress towards achieving outcomes will be validated by external review.

4ASO7 Successfully demonstrate progress in observing planetary systems around other stars and comparing their architectures and evolution with our own. Progress towards achieving outcomes will be validated by external review.

**Obj. 5.12 Understand the diversity of other worlds and search for those that might harbor life.**

*Outcome 5.12.1 Explore the diversity of other worlds and search for those that might harbor life.*

4ASO8 Successfully demonstrate progress in characterizing the giant planets orbiting other stars. Progress towards achieving outcomes will be validated by external review.

4ASO9 Successfully demonstrate progress in finding out how common Earth-like planets are and seeing if any might be habitable. Progress towards achieving outcomes will be validated by external review.

4ASO10 Successfully demonstrate progress in tracing the chemical pathways by which simple molecules and dust evolve into the organic molecules important for life. Progress towards achieving outcomes will be validated by external review.

4ASO11 Successfully demonstrate progress in developing the tools and techniques to search for life on planets beyond our solar system. Progress towards achieving outcomes will be validated by external review.

**Obj. 5.13 Understand the changing flow of energy and matter throughout the Sun, heliosphere, and planetary environments.**

*Outcome 5.13.1 Understand the changing flow of energy and matter throughout the Sun, heliosphere, and planetary environments.*

4SEC7 Successfully demonstrate progress in understanding the structure and dynamics of the Sun and solar wind and the origins of magnetic variability. Progress towards achieving outcomes will be validated by external review.

4SEC8 Successfully demonstrate progress in determining the evolution of the heliosphere and its interaction with the galaxy. Progress towards achieving outcomes will be validated by external review.

4SEC9 Successfully demonstrate progress in understanding the response of magnetospheres and atmospheres to external and internal drivers. Progress towards achieving outcomes will be validated by external review.

**Obj. 5.14 Understand the fundamental physical processes of space plasma systems.**

*Outcome 5.14.1 Support exploration of the fundamental physical processes of space plasma systems.*

4SEC10 Successfully demonstrate progress in discovering how magnetic fields are created and evolve and how charged particles are accelerated. Progress towards achieving outcomes will be validated by external review.

4SEC11 Successfully demonstrate progress in understanding coupling across multiple scale lengths and its generality in plasma systems. Progress towards achieving outcomes will be validated by external review.

## Mission III: To Inspire the Next Generation of Explorers

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

**Obj. 6.1 Improve student proficiency in science, technology, engineering and mathematics by creating a culture of achievement using educational programs, products and services based on NASA's unique missions, discoveries and innovations.**

*Outcome 6.1.1 Kindergarten through graduate students will be more proficient in science, technology, engineering, and mathematics (STEM).*

4ED1 Develop/implement customized education program for pilot cohort of 40 schools to improve student STEM proficiency. Progress will be validated through external evaluation conducted according to accepted professional standards.

4ED2 Develop at least 3 ethnic-focused space exploration teaching tools in FY04 that target Hispanic/Latino, African American, and Native American K-12 students in order to improve student proficiency in STEM. Identify institutions/schools that enroll at least 60% of the targeted population to implement these tools no later than FY05. Progress will be validated through external evaluation conducted according to accepted professional standards.

4ED3 Support the achievement of education objectives as established by state and local education authorities through the coordinated application of NASA assets, conducting activities for educators and students as requested. Progress will be assessed through a standards-based, external evaluation, validated by an external panel.

4PSR4 Engage students in inquiry-based learning experiences through development and distribution of classroom activities that simulate biological and physical sciences space research investigations. These activities will align with standards-based curriculum.

4BSR2 Engage students in inquiry-based learning experiences through development and distribution of classroom activities that simulate biological and physical sciences space research investigations. These activities will align with standards-based curriculum.

4MSM15 Provide at least 4 products that deliver or facilitate the delivery of NASA science and engineering content into formal and informal educational institutions. Disseminate educational products to at least 1,000 schools, educators, or students. Provide remote access of educational materials into the classroom via advanced information technologies. Support NASA presence at educational workshops, conferences or symposiums. Support development of academic course material in Aerospace Technology. Progress will be validated in FY04 through external evaluation conducted according to accepted professional standards. (CICT, RMCS & ECT)

4SSE14 Provide opportunities for students to work directly with NASA space science missions, facilities, and data.

4SEU13 Provide opportunities for students to work directly with NASA space science missions, facilities, and data.

4ASO12 Provide opportunities for students to work directly with NASA space science missions, facilities, and data.

4MEP12 Provide opportunities for students to work directly with NASA space science missions, facilities, and data.

4SEC12 Provide opportunities for students to work directly with NASA space science missions, facilities, and data.

4SSP4 Ensure the development & distribution of OSF content for curricular use in NASA Explorer Schools and in the Educator Mission Specialist Program.

4ISS5 Ensure the development & distribution of OSF content for curricular use in NASA Explorer Schools and in the Educator Mission Specialist Program.

4SFS7 Ensure the development & distribution of OSF content for curricular use in NASA Explorer Schools and in the Educator Mission Specialist Program.

4SLI18 An instructional video program and standards-based lesson guide highlighting applications of science, technology, engineering and mathematics will be produced for the 'NASA CONNECT" series to help student proficiency in these technical fields.

**Obj. 6.2 Motivate K-16+ students from diverse communities to pursue science and math courses and ultimately college degrees in science, technology, engineering, and mathematics.**

*Outcome 6.2.1 More students from diverse communities motivated to pursue careers in STEM.*

4ED4 Provide educational assistance, through competitive scholarships and fellowships, to at least 400 undergraduate and 200 graduate students from diverse communities to pursue degrees in STEM disciplines. A longitudinal database will be developed to track career development paths.

4ESA6 Education: Integrate NASA-reviewed Earth science education results through partnerships into "Revolution" blueprint for Earth Science Education.

4ESA7 Education: Select at least 50 new graduate fellowships to contribute to human capital for Earth science community.

4SSE15 Provide new opportunities for participation in the space science program by an increasingly diverse population, including opportunities for minorities and minority universities to compete for and participate in space science missions, research, and education programs.

4SEU14 Provide new opportunities for participation in the space science program by an increasingly diverse population, including opportunities for minorities and minority universities to compete for and participate in space science missions, research, and education programs.

4ASO13 Provide new opportunities for participation in the space science program by an increasingly diverse population, including opportunities for minorities and minority universities to compete for and participate in space science missions, research, and education programs.

4MEP13 Provide new opportunities for participation in the space science program by an increasingly diverse population, including opportunities for minorities and minority universities to compete for and participate in space science missions, research, and education programs.

4SEC13 Provide new opportunities for participation in the space science program by an increasingly diverse population, including opportunities for minorities and minority universities to compete for and participate in space science missions, research, and education programs.

4SSP5 Increase by 10%, students participating in OSF research and development opportunities that enhances their academic experience, strengthens their professional skills, and supports their successful transition into scientific and technical workforce.

4ISS6 Increase by 10%, students participating in OSF research and development opportunities that enhances their academic experience, strengthens their professional skills, and supports their successful transition into scientific and technical workforce.

4SFS8 Increase by 10%, students participating in OSF research and development opportunities that enhances their academic experience, strengthens their professional skills, and supports their successful transition into the scientific and technical workforce.

**Obj. 6.3 Enhance science, technology, engineering and mathematics instruction with unique teaching tools and experiences that only NASA can provide, that are compelling to teachers and students.**

*Outcome 6.3.1 Improve quality of STEM instruction.*

4ED5 Engage K-12 educators in the Educator Astronaut Program to provide unique teaching resources to the STEM teaching profession. Progress will be validated through external evaluation conducted according to accepted professional standards.

4ED6 Establish engaging, interactive web-based teaching resources for educators that support STEM instruction. Progress will be assessed using standards-based evaluation techniques.

4ED7 Provide opportunities for minority institutions to enhance their capacity to prepare both pre-service and in-service teachers to teach mathematics and science. Program effectiveness will be measured by tracking the number of teachers who obtain certification to teach mathematics and science and who are then employed to teach.

4ED8 Provide financial resources and NASA research data to enable interdisciplinary teams from university teacher education programs to develop innovative courses for pre-service teachers. Outcomes will be evaluated by university faculty and graduate students through a multi-faceted protocol.

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

4PSR5 Develop collaborations with Professional Education Associations directed to enhancement of educator proficiency in use of space research content and classroom, educational hardware focused on standards-based curriculum.

4PSR6 Develop and train facilitators for dissemination of 3 comprehensive Educator Professional Development Seminar packages focused on biological and physical sciences research that coordinates with standard's based science, math, and technology concepts.

4BSR3 Develop collaborations with Professional Education Associations directed to enhance educator proficiency in use of space research content and classroom educational hardware focused on standards-based curriculum.

4BSR4 Develop and train facilitators for dissemination of 3 comprehensive Educator Professional Development Seminar packages focused on biological and physical sciences research that coordinates with standard's based science, math, and technology concepts.

4RPFS4 Develop collaborations with Professional Education Associations directed to enhancement of educator proficiency in use of space research content and classroom, educational hardware focused on standards-based curriculum.

4RPFS5 Develop and train facilitators for dissemination of 3 comprehensive Educator Professional Development Seminar packages focused on biological and physical sciences research that coordinates with standard's based science, math, and technology concepts.

4SSE16 Provide high quality educational materials and teacher training based on Theme content and focused on national curriculum standards.

4SSE17 Provide exhibits, materials, workshops, and personnel at national and/or regional education and outreach conferences.

4SEU15 Provide high quality educational materials and teacher training based on Theme content and focused on national curriculum standards.

4SEU16 Provide exhibits, materials, workshops, and personnel at national and/or regional education and outreach conferences.

4ASO14 Provide high quality educational materials and teacher training based on Theme content and focused on national curriculum standards.

4ASO15 Provide exhibits, materials, workshops, and personnel at national and/or regional education and outreach conferences.

4MEP14 Provide high quality educational materials and teacher training based on Theme content and focused on national curriculum standards.

4MEP15 Provide exhibits, materials, workshops, and personnel at national and/or regional education and outreach conferences.
4SEC14 Provide high quality educational materials and teacher training based on Theme content and focused on national curriculum standards.
4SEC15 Provide exhibits, materials, workshops, and personnel at national and/or regional education and outreach conferences.
4ESS13 Make Earth science information products available to curricula developers.
4SSP6 Reach and expose, through both formal and informal education venues, 800 in-service and pre-service teachers, university teacher education faculty and students to mathematics and science careers and to OSF's unique educational resources.
4SSP7 During the academic year 2003-2004, increase by 2 the number of pre-college programs for students participation in OSF center sponsored education enrichment activities that promote their interest in and knowledge of mathematics, science, engineering and technology career fields.
4ISS7 Reach and expose, through both formal and informal educations venues, 800 in-service and pre-service teachers, university teacher education faculty and students to mathematics and science careers and to OSF's unique educational resources.
4ISS8 During academic year 2003-2004, increase by 2 the number of pre-college programs for students participation in OSF center sponsored education enrichment activities that promotes their interest in and knowledge of mathematics, science, engineering and technology career fields.
4SFS9 Reach and expose, through both formal and informal educations venues, 800 in-service and pre-service teachers, university teacher education faculty and students to mathematics and science careers and to OSF's unique educational resources.
4SFS10 During academic year 2003-2004, increase by 2 the number of pre-college programs for students participation in OSF center sponsored education enrichment activities that promotes their interest in and knowledge of mathematics, science, engineering and technology career fields.

**Obj. 6.4 Improve higher education capacity to provide for NASA's and the Nation's future science and technology workforce requirements.**

*Outcome 6.4.1 More students prepared to enter the STEM workforce.*

4ED9 Provide education and research opportunities to a diverse cohort of students and faculty in STEM disciplines that support human resources needs of the science and technology workforce (NASA, contractors, and/or universities). A longitudinal database to track students' career paths will be used to determine the number of graduates from NASA student programs who enter the science and technology workforce (NASA, contractors, and/or universities).
4ED10 Provide Minority Institutions with information and technical assistance on strategies that enhance STEM program development, management, and sustainability. Progress toward the outcome will be reviewed by an external panel.
4ED11 Develop partnerships and programs that strengthen research in NASA-related fields that enhance academic and research infrastructure at Minority Institutions. Progress toward the outcome will be reviewed by an external panel.
4ED12 Involve universities in states underrepresented in their share of competitively awarded grants, in NASA related research. An evaluation of the quality of research results will be conducted.
4SSE18 Provide higher education opportunities offered through OSS research awards and other NASA research and education programs.
4SEU17 Provide higher education opportunities offered through OSS research awards and other NASA research and education programs.
4ASO16 Provide higher education opportunities offered through OSS research awards and other NASA research and education programs.
4MEP16 Provide higher education opportunities offered through OSS research awards and other NASA research and education programs.
4SEC16 Provide higher education opportunities offered through OSS research awards and other NASA research and education programs.
4SSP8 During academic year 2003-2004, increase by 4% the number of undergraduate & graduate students & faculty researchers exposed & gaining hands-on experience in OSF's state-of-the-art research instrumentation & methodologies.
4SSP9 Host 2 forums to strengthen OSF partnership with the minority university community & to more fully engage faculty & students from this community in OSF's mission.
4ISS9 During the Academic year 2003-2004, increase by 4% the number of undergraduate and graduate students and faculty researchers exposed and gaining hands-on experience in OSF's state-of-the-art research instrumentation and methodologies.
4ISS10 Host 2 forums to strengthen OSF partnership with the minority university community to more fully engage faculty and students from this community in OSF's mission.
4SFS11 During academic year 2003-2004, increase by 4% the number of undergraduate and graduate students and faculty researchers exposed and gaining hand-on experience in OSF's state-of-the art research instrumentation and methodologies.
4SFS12 Host 2 forums to strengthen OSF partnership with the minority university community and to more fully engage faculty and students from this community in OSF's mission.

4ITTP2 Engage at least four institutions of higher education in the NASA mission in FY '04 by providing opportunities and experience for students to help prepare them for successful careers in the field of technology management through NASA intern experience.

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

**Obj. 7.1 Improve the capacity of science centers, museums, and other institutions, through the development of partnerships, to translate and deliver engaging NASA content.**

*Outcome 7.1.1 Improve the capacity of science centers, museums, and other institutions, through the development of partnerships, to translate and deliver engaging NASA content.*

4ED13 Establish a collaboration with the Association of Science and Technology Centers, in addition to partnerships with at least five major science centers or museums. Provide the science centers and museums with mechanisms to motivate students to pursue STEM subjects and to share with the public NASA's research, mission, and discoveries.

4SSE19 Through partnerships with major science museums or planetariums, put on display or on tour major exhibitions or planetarium shows based on Theme content.

4SSE20 Provide materials and technical expertise to support the development of exhibits and programs at science museums and planetariums.

4SEU18 Through partnerships with major science museums or planetariums, put on display or on tour major exhibitions or planetarium shows based on Theme content.

4SEU19 Provide materials and technical expertise to support the development of exhibits and programs at science museums and planetariums.

4ASO17 Through partnerships with major science museums or planetariums, put on display or on tour major exhibitions or planetarium shows based on Theme content.

4ASO18 Provide materials and technical expertise to support the development of exhibits and programs at science museums and planetariums.

4MEP17 Through partnerships with major science museums or planetariums, put on display or on tour major exhibitions or planetarium shows based on Theme content.

4MEP18 Provide materials and technical expertise to support the development of exhibits and programs at science museums and planetariums.

4SEC17 Through partnerships with major science museums or planetariums, put on display or on tour major exhibitions or planetarium shows based on Theme content.

4SEC18 Provide materials and technical expertise to support the development of exhibits and programs at science museums and planetariums.

**Obj. 7.2 Improve science literacy by engaging the public in NASA missions and discoveries, and their benefits, through such avenues as public programs, community outreach, mass media, and the internet.**

*Outcome 7.2.1 Engage the public in NASA missions and discoveries through such avenues as public programs, community outreach, mass media, and the Internet.*

4SSE21 Seek out and capitalize on special events and particularly promising opportunities in the Theme science program to bring space science to and involve the public in the process of scientific discovery.

4SEU20 Seek out and capitalize on special events and particularly promising opportunities in the Theme science program to bring space science to and involve the public in the process of scientific discovery.

4ASO19 Seek out and capitalize on special events and particularly promising opportunities in the Theme science program to bring space science to and involve the public in the process of scientific discovery.

4MEP19 Seek out and capitalize on special events and particularly promising opportunities in the Theme science program to bring space science to and involve the public in the process of scientific discovery.

4SEC19 Seek out and capitalize on special events and particularly promising opportunities in the Theme science program to bring space science to and involve the public in the process of scientific discovery.

*Outcome 7.2.2 Engage the public in NASA's scientific exploration of Earth from space.*

4ESA8 Provide in public venues at least 50 stories on the scientific discoveries, practical benefits, or new technologies sponsored by the Earth Science Enterprise.

4ESS14 Post the most exciting imagery and explanations about Earth science on the Earth observations/ESE website.

*Outcome 7.2.3 Use OSF unique facilities, education resources, formal and informal venues (conferences, workshops, science centers, museums) and print, web and TV media, to reach and engage an increasing number or percent of the public in exploration and space development activities.*

4SSP10 Increase by 10%, OSF venues (educational, commercial, and political) that provide "hands-on" opportunities for the public to experience and become more knowledgeable of OSF benefits and contributions, particularly ISS.

4SSP11 Increase the number of visits to the Space Flight website.

4SFS13 Increase by 10%, OSF venues (educational, commercial, and political) that provide "hands-on" opportunities for the public to experience and become more knowledgeable of OSF benefits and contributions, particularly ISS.

4SFS14 Increase the number of visits to the Space Flight website.

4ISS11 Increase by 10% venues (education, and commercial) that provides "hands-on" opportunities for the public to experience and become more knowledgeable of benefits and contributions, particularly the International Space Station.

4ISS12 Increase the number of visits to the Space Flight website.

*Outcome 7.2.4 Broaden OBPR research information to diverse audiences.*

4BSR5 Increase distribution of the Space Research newsletter by 5,000 over FY 03 circulation in order to further educate the general public, industry and academia on space-based research.

4BSR6 Establish and sustain a series of media presentations of OBPR research, through collaboration with PAO, to convey important space-based research results to the general public, industry and academia.

4BSR7 OBPR will expand its involvement in reaching minority and under-represented sectors of the public, through participation in conferences and community events that reflect cultural awareness and outreach. There will be at least one new venue more, associated with a minority and/or under-represented community, then outreach efforts taking place in FY 03.

4PSR7 Increase distribution of the Space Research newsletter by 5,000 over FY 03 circulation in order to further educate the general public, industry and academia on space-based research.

4PSR8 Establish and sustain a series of media presentations of OBPR research, through collaboration with PAO, to convey important space-based research results to the general public, industry and academia.

4PSR9 OBPR will expand its involvement in reaching minority and under-represented sectors of the public, through participation in conferences and community events that reflect cultural awareness and outreach. There will be at least one new venue more, associated with a minority and/or under-represented community, then outreach efforts taking place in FY 03.

4RPFS6 Increase distribution of the Space Research newsletter by 5,000 over FY 03 circulation in order to further educate the general public, industry and academia on space-based research.

4RPFS7 Establish and sustain a series of media presentations of OBPR research, through collaboration with PAO, to convey important space-based research results to the general public, industry and academia.

4RPFS8 OBPR will expand its involvement in reaching minority and under-represented sectors of the public, through participation in conferences and community events that reflect cultural awareness and outreach. There will be at least one new venue associated with a minority and/or under-represented community over outreach efforts taking place in FY 03.

**Obj. 7.3 Increase public awareness and understanding of how research and innovations in aerospace technology affect and improve the quality of life.**

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

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

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

4MSM16 Maintain publicly-available websites at the Program and Project levels. Publish at least 10 articles or papers on key innovations. Support at least 2 conferences or exhibits highlighting research in Aerospace Technology. (CICT, RMCS & ECT)

4SLI19 Space transportation technical exhibits will be sponsored for at least five events reaching over 50,000 participants to improve public appreciation of the ongoing activities and benefits of NASA's space transportation research and technology development efforts.

## Enabling Capabilities

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

**Obj. 8.1 Assure safe, affordable, and reliable U.S.-based crew access and return from the International Space Station.**

*Outcome 8.1.1 An Orbital Space Plane that provides safe, affordable and reliable access to and from the International Space Station (ISS). (OSP)*

4SLI4 The OSP Program Plan will be approved and the OSP Level 2 Requirements will be established and approved.

4SLI5 A conceptual design of the Orbital Space Plane will be completed with sufficient cost, schedule, technical, and risk definition to enable a full-scale development decision.

4SLI6 The X-37 Approach and Landing Test Vehicle will be certified for flight demonstration, establishing it as a test platform for technology demonstrations supporting the OSP.

4SLI7 The Demonstration of Autonomous Rendezvous Technology flight article will be certified for flight demonstration, establishing it as a test platform for demonstrating key technologies required to enable an autonomous (no pilot in the loop) approach of an OSP to the International Space Station.

**Obj. 8.2 Improve the safety, affordability and reliability of future space transportation systems.**

*Outcome 8.2.1 Technology development and risk reduction results that open up the Nation's access to space by demonstrating substantial improvements in safety, reliability, and cost as compared to current space transportation systems. (NGLT)*

4SLI8 The Next Generation Launch Technology (NGLT) Program Plan will be approved, aligning the Program implementation approach with the Space Transportation strategic objectives.

4SLI9 The preliminary design of a reusable hydrocarbon prototype rocket engine will be completed, demonstrating the design's applicability to a reusable launch vehicle.

4SLI10 A LOx/LH2 full flow staged combustion engine cycle will be operationally demonstrated to determine its applicability to a reusable launch vehicle.

4SLI11 The preliminary design of a Rocket Based Combined Cycle (RBCC) ground testbed will be completed, paving the way toward ground demonstration of a hypersonic air-breathing propulsion system.

4SLI12 The preliminary design of a Mach 4 ground turbine testbed will be completed, leading to the development of the primary element of a turbine-based combined-cycle hypersonic air-breathing propulsion system.

4SLI13 The fabrication of the X-43C Mach 5 Multi-Module Flowpath Propulsion Demonstrator will be completed, enabling the ground demonstration of a hydrocarbon dual-mode scramjet powered vehicle applicable for a reusable launch vehicle.

4SLI14 The testing and analysis of a light weight ceramic composite cooled panel in a scramjet test article will be completed, demonstrating a critical propulsion technology needed for development of an air-breathing reusable launch vehicle.

4SLI15 The design and fabrication of a Mach 15 hypersonic scramjet model platform will be completed, leading to the demonstration of a scramjet engine at high Mach number.

**Obj. 8.3 Improve the accessibility of space to better meet research, Space Station assembly, and operations requirements.**

*Outcome 8.3.1 Assure public, flight crew, and workforce safety for all Space Shuttle operations and safely meet the FY04 manifest and flight rate commitment.*

4SSP12 Achieve zero type A (damage to property at least $1M or death) or B (damage to property at least $250K or permanent disability or hospitalization of 3 or more persons) mishaps in FY2004.

4SSP13 Achieve an average of 8 or fewer flight anomalies per Space Shuttle mission.

4SSP14 Provide safe, reliable space transportation and/or a space-based platform that allows our customers to achieve 100% on-orbit mission success for all flights in FY 2004. For this metric, mission success criteria are those provided to the prime contractor (SFOC) for purposes of determining successful accomplishment of the performance incentive fees in the contract.

4SSP15 Perform annual critical review of requirements, priorities, risks, and progress to effectively support Shuttle service life extension.

**Obj. 8.4 Assure capabilities for world-class research on a laboratory in low Earth orbit.**

*Outcome 8.4.1 Provision of a well-managed program that is safe, reliable, and affordable.*

4ISS13 Achieve reduced costs and improved accountability through the reduction in the number of direct ISS Program Office contracts.

4ISS14 Assure zero Type A or Type B on-orbit mishaps in FY04 as defined in the OSF Contingency Action Plan.

4ISS15 Achieve 90% success and accomplishment for planned on-orbit ISS assembly and logistical activities on the Space Shuttle missions scheduled for FY2004.

**Obj. 8.5 Provide services for space communications, rocket propulsion testing, and launch in support of NASA, other government agencies and industry.**

*Outcome 8.5.1 Provide reliable launch services on Expendable Launch Vehicles to meet agency requirements.*

4SFS15 Maintain NASA success rate at or above a running average of 95% for missions noted on the Expendable Launch Vehicle (ELV) manifest.

*Outcome 8.5.2 Provide reliable communications and mission control systems for every flight mission.*

4SFS16 Achieve at least 95% of planned data delivery for the International Space Station, each Space Shuttle mission, and low-Earth orbiting missions in FY04.

*Outcome 8.5.3 Minimize technical, cost, and schedule risk to NASA, DoD and Commercial test customers by ensuring safe and efficient operations of NASA test facilities.*

4SFS17 Achieve zero mishaps that constitute a major breach of safety.

4SFS18 Achieve positive feedback from a minimum of 95% of all test customers.

**Obj. 8.6 Create concepts, technologies and capabilities for transportation beyond LEO, and define plans to enable affordable future infrastructures.**

*Outcome 8.6.1 Advance future human and robotic exploration and development of space objectives.*

4SFS19 Define and provide Level 1 OSF requirements related to future human and robotic exploration and development of space to NASA programs pursuing improvements in access to space.

4SFS20 Identify key concepts (near term to far term) and technology road maps for space transportation capabilities, focusing on future human & robotic space exploration and development.

**Goal 9: Extend the duration and boundaries of human space flight to create new opportunities for exploration and discovery.**

**Obj. 9.1 Understand and control the human health risks of space flight.**

*Outcome 9.1.1 Identify and test biomedical countermeasures that will make space flight safer for humans.*

4BSR8 Use ground-based and space-based research to address risk areas related to long duration phenomena such as bone loss, psychological adaptation to isolation and confinement, and the biological effects of radiation as described in the Critical Path Roadmap. Progress toward accomplishing this performance goal will be reviewed by an advisory committee.

4BSR9 Publish results of Bioastronautics experiments conducted during early ISS Increments (1 through 8) and preliminary results from Increments 9 and 10. Progress toward accomplishing this performance goal will be reviewed by an advisory committee.

4BSR10 Maintain productive peer-reviewed research program in Biomedical Research and Countermeasures including a National Space Biomedical Research Institute that will perform team-based, focused countermeasure-development research. Progress toward accomplishing this goal will be reviewed by an advisory committee.

*Outcome 9.1.2 Acquire physics and biology database required to predict radiation risk in space with accuracy sufficient to enable astronauts to accomplish three 180-day missions on ISS without exceeding career radiation limits, at a 95% confidence level.*

4BSR11 Expand the space radiation research science community to involve cutting edge researchers in related disciplines by soliciting, selecting, and funding high quality research.

4BSR12 Complete 2 experimental campaigns ("runs") using recently completed Booster Applications Facility (BAF) at Brookhaven National Laboratory (BNL) to measure survival, genetic mutation (mutagenesis), and chromosome aberrations in cells and tissues to improve understanding of the biological effects of the space radiation environment. Progress toward accomplishing this performance goal will be reviewed by an advisory committee.

4BSR13 Evaluate radiation risks to astronauts by continued and careful analysis of past radiation exposures, results of medical follow up, and comparison with appropriately chosen control population not exposed to similar levels of radiation. Make experimental data available for operational use on ISS and other space-related activities where appropriate. Progress toward accomplishing this performance goal will be reviewed by an advisory committee.

*Outcome 9.1.3 Advance understanding of the role of gravity in biological processes to support biomedical research for human exploration.*

4BSR14 Solicit ground-based research in appropriate Fundamental Biology disciplines to lay the ground work for advanced understanding of the role of gravity in biological processes associated with the human health risks of space flight. Progress toward accomplishing this performance goal will be reviewed by an advisory committee.

4BSR15 Plan for increased early utilization for basic biology research in 2005 to take advantage of evolving ISS capabilities. Progress toward accomplishing this performance goal will be reviewed by an advisory committee.

4BSR16 Maintain a competitive, productive peer-reviewed research program to advance understanding of the role of gravity in biological processes. Progress toward accomplishing this performance goal will be reviewed by an advisory committee.

**Obj. 9.2 Develop knowledge and technologies to make life support systems self sufficient and improve human performance in space.**

*Outcome 9.2.1 Identify & test technologies to reduce total mass requirements for Life Support.*

4BSR17 Demonstrate, through vigorous research and technology development, a 50% reduction in the projected mass of a life support flight system compared to the system baselined for ISS. Progress toward reducing the mass requirements for life support will be evaluated by an advisory committee.

*Outcome 9.2.2 Develop knowledge and technologies to make life support systems self-sufficient and improve human performance in space.*

4MSM1 Demonstrate ground test of a Mobile Intelligent Vehicle Health Management (IVHM) system for internal spacecraft operations that will provide environmental sensing capabilities and knowledge management services. The Mobile IVHM will perform independent calibration checks for environmental sensors; autonomously replace or substitute for failed environmental sensors; hunt down and isolate gas leaks and temperature problems; and provide a range of crew personal data assistant functions. (RMCS)

**Obj. 9.3 Resolve fundamental low-gravity issues affecting technologies for human space travel beyond low-Earth orbit.**

*Outcome 9.3.1 Increase research database with results from radiation measurements, microgravity combustion and heat transport investigations.*

4PSR10 Extend the available database on radiation effects in materials using the newly commissioned Booster Application Facility at Brookhaven. Progress will be reviewed b y an advisory committee.

4PSR11 Analyze results of ISS and Space Shuttle (STS 107) investigations on fire safety and microgravity combustion. Progress will be reviewed by an advisory committee.

4PSR12 Prepare for and carry out microgravity heat exchange investigation on ISS. Progress will be reviewed b y an advisory committee.

**Obj. 9.4 Demonstrate the ability to support a permanent human presence in low Earth orbit as a stepping-stone to human presence beyond.**

*Outcome 9.4.1 Operation of the ISS as an on-going research facility to further human experience and develop technology for self-sustaining systems.*

4ISS16 Maintain to within 90%, the predicted maintenance and logistics hardware replacement schedule.

4ISS17 Provide 100% of the logistics required to sustain the permanent crew living aboard the ISS.

*Outcome 9.4.2 Further the capability of humans to live and work safely in space by transporting crews to ISS for longer on-orbit durations.*

4SSP17 Achieve 100% on-orbit mission success for all Shuttle flights to ISS in FY 2004. For this metric, mission success criteria are those provided to the prime contractor (SFOC) for purposes of determining successful accomplishment of the performance incentive fees in the contract.

**Obj. 9.5 Create innovative approaches and concepts to inform future decisions concerning systems, infrastructures and missions for human and robotic exploration of space.**

*Outcome 9.5.1 Enable safer, more affordable and more effective future human activities beyond LEO.*

4SFS21 Identify 4-7 innovative system and infrastructure concepts (and associated technologies) in support of ambitious future human activities beyond LEO.

4SFS22 Identify 5-9 alternative human exploration mission options based on these innovative concepts.

4SFS23 Develop and review technology maturation road maps and investment strategies necessary to realize these transformational capabilities.

*Outcome 9.5.2 Develop innovative approaches and concepts to inform future decisions concerning systems, infrastructures and missions for human and robotic exploration of space.*

4MEP20 Develop advanced concepts for Mars missions where human intervention can significantly increase the scientific return, and develop a technology roadmap for critical technologies that can be demonstrated effectively in the core robotic program.

*Outcome 9.5.3 An established space transportation investment strategy that is responsive to the Agency's science-driven missions. (NGLT)*

4SLI16 The systems assessment of the Next Generation Launch Technology needs, priorities, and technical performance metrics will be completed, providing an integrated roadmap for space launch technology investments.

**Goal 10: Enable revolutionary capabilities through new technology.**

**Obj. 10.1 Improve the capability to assess and manage risk in the synthesis of complex systems.**

*Outcome 10.1.1 Enable new technologies to identify and reduce mission risk.*

4MSM2 Develop a Prototype Concept Design Risk Workstation that provides the capability to identify, track, and trade-off risk in the conceptual design phase of missions. The workstation will integrate databases, visualization modules, solicitation routines, system simulations, and analysis programs that support an interactive system design process. (RMCS)

**Obj. 10.2 Create new system concepts and demonstrate new technologies that enable new science measurements.**

*Outcome 10.2.1 Identify high-payoff mission enabling technologies to guide program investment decisions.*

4MSM3 Develop a process for assessing the system-level benefits of new technologies, and complete technology assessments on 3 representative mission classes selected by the Technology Executive Board. A mission class is a set of missions with similar scientific objectives, such as large space-based astronomical observatories. The technology assessment will be concluded when the mission enabling technologies have been identified, and system-level performance goals for these technologies have been established. (ECT)

*Outcome 10.2.2 Reduce trip time for interplanetary missions*

4MSM4 Demonstrate lightweight, sub-kilowatt ion engine for small spacecraft to reduce interplanetary trip time by 30%. (ECT)

*Outcome 10.2.3 Enable new science measurements*

4MSM5 Develop bio-molecular probe to detect specific biomarker signature in-vitro for disease detection and astronaut health monitoring. Demonstrate a molecular probe that detects at least one specific biomarker in cells. (CICT)

4MSM6 Demonstrate > 5% efficiency for 2-micron laser transmitter. State-of-the-art laser transmitters have about 3% efficiency. Higher efficiency will enable smaller, lighter space-based lidar instruments for active sensing of the Earth's atmosphere. (ECT)

4MSM7 Develop 1,000-element array of superconducting transition edge sensors to enable astronomical imaging in the unexplored submillimeter region of the spectrum. (ECT)

4MSM8 Develop miniature chromatography system for separation and detection of organic materials to enable the search for life on other planets. (ECT)

*Outcome 10.2.4 Enable revolutionary spacecraft systems for distributed science collection and lower mission cost.*

4MSM9 Demonstrate by simulation millimeter precision formation flying. The simulation will validate sensors and control algorithms needed to enable constellations of spacecraft for distributed science measurements. (ECT)

4MSM10 Develop microspacecraft ground testbed that incorporates micro navigation subsystem, micro thrusters, and multifunctional structure. By integrating miniaturized spacecraft subsystems, the testbed will demonstrate a factor of 2 to 3 reduction in spacecraft mass, which will result in lower mission costs. (ECT)

*Outcome 10.2.5 Increased capabilities to acquire and return scientific data.*

4MSM11 Develop critical spacecraft networking technologies. Demonstrate spacecraft communications technologies achieving 1Gbps or greater for near Earth, and 1Mbps or greater for deep space applications. Develop related protocols and software for Internet-like space computing and communications. High bandwidth communications and networking technologies will increase scientific return. (CICT)

4MSM12 Demonstrate in a laboratory environment deployment and rigidization of a jointed inflatable truss to enable modular assembly of large apertures. In-space assembly will enable a factor of 10 increase in aperture size to increase scientific return. (ECT)

*Outcome 10.2.6 Enable intelligent and autonomous systems for science exploration missions.*

4MSM13 Complete simulated autonomous science exploration mission - Demonstrate a successful analogue science mission (terrestrial rover or simulated spacecraft) with key autonomy technologies in planning/scheduling, science data priority assignment, system executives, and diagnostic systems, enabling goal-directed systems for science exploration missions. (CICT)

**Obj. 10.3 Create breakthrough information and communication systems to increase our understanding of scientific data and phenomena.**

*Outcome 10.3.1 Reduce the time required to design and operate future missions.*

4MSM14 Develop collaborative science and engineering technologies for integrated simulation and information management, enabling reductions in set-up and management times for aerospace engineering, science simulations, and mission status awareness of remote exploration missions. Demonstrate standardized protocols and specifications for interoperability of simulation components and heterogeneous data sources; provide visual assembly of workflow components and tools; provide applications-oriented process management; and demonstrate heterogeneous database access technology that can automatically access distributed, heterogeneous data sources. (CICT)

**Obj. 10.4 Create novel aerospace concepts in support of future human and robotic exploration and development of space.**

*Outcome 10.4.1 Accelerate the development of new revolutionary technologies by enabling better investment decisions.*

4SFS24 Define and provide Level 1 OSF requirements related to future human and robotic exploration and development of space to NASA and other Agency programs pursuing improvements in future revolutionary space capabilities.

4SFS25 Identify 8-10 concepts for transformational space capabilities, focusing on future human & robotic space exploration and development, in areas including space assembly, maintenance and servicing, space utilities and power, and self-sufficient space systems.

4SFS26 Develop technology road maps and formulation of investment options to enable these capabilities.

**Obj. 10.5 Create novel aerospace concepts to support Earth and space science missions.**

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

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

*Outcome 10.5.2 Develop and demonstrate technologies required for routine Unmanned Aerial Vehicle operations in the National Airspace System at and above Flight Level 180.*

4AT19 Deliver a validated set of requirements for UAV access at and above FL400, and a preliminary set of requirements for access at and above FL180. (Vehicle Systems)

**Obj. 10.6 Enhance NASA's Mission by leveraging partnerships between NASA Enterprises, U.S. industrial firms, and the venture capital community for innovative technology development.**

*Outcome 10.6.1 Improve NASA's Mission by leveraging partnerships with non-aerospace industry and academia, and facilitate NASA's use of commercially available technology.*

4ITTP3 Promote and develop innovative technology partnerships between NASA, venture capital firms and U.S. industry for the benefit of all Enterprise mission needs.

4ITTP4 Align SBIR/STTR with priorities contributing to NASA mission and vision.

4ITTP5 Review and rank all SBIR/STTR proposals within 100 days of the solicitation closure date.

# **SPECIAL ISSUES:** Performance Plan Summary

## Implementing Strategies

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

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|---|---|
| Obj. IS-1.1 | Attract and maintain a workforce that is representative of the Nation's diversity and includes the competencies that NASA needs to deliver the sustained levels of high performance that the Agency's challenging Mission requires. |
| Obj. IS-1.2 | Define and adopt procedures to improve the competitive acquisition of programs, services, and assets to benefit the NASA Mission and the American taxpayer. |
| Obj. IS-1.3 | Improve and streamline the NASA financial management system to enhance accuracy, timeliness, and accountability. |
| Obj. IS-1.4 | Unify the processes for strategic and budget planning, budget reporting, and performance planning and reporting. |
| Obj. IS-1.5 | Beginning in early 2003, provide an integrated and user-friendly NASA-wide Internet portal that will provide improved public access to NASA Mission results and other products, improved visibility into NASA plans and programs, and enhanced communication among NASA employees and contractors. |
| Obj. IS-1.6 | Improve the institutional management of capital assets to ensure that NASA's real property, personal property, processes, and systems are sustained and optimized to support NASA's missions and the capabilities required for today and tomorrow. |

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

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|---|---|
| Obj. IS-2.1 | By 2005 provide all NASA operations with secure, highly reliable, interoperable information systems. |
| Obj. IS-2.2 | By 2005 enable NASA people to communicate across an integrated, low-cost information technology infrastructure. |
| Obj. IS-2.3 | By 2005 design and operate a One NASA network to improve organizational interactions and foster improved collaboration and sharing of accumulated NASA knowledge assets. |
| Obj. IS-2.4 | By 2005 establish systems to deliver superior information services to consumers, educators, students, researchers, and the general public, as well as to Government agencies, NASA contractors and suppliers, and other businesses. |

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

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|---|---|
| Obj. IS-3.1 | Implement collaborative engineering capabilities and integrated design solutions to reduce the life-cycle cost and technical, cost, and schedule risk of major programs. |
| Obj. IS-3.2 | Apply methods and technologies to ensure that designs are safe and have a high likelihood for success. |
| Obj. IS-3.3 | Improve our systems engineering capability and ensure that all NASA programs follow systems engineering best practices throughout their life cycles. |
| Obj. IS-3.4 | Establish a process management approach that can be tailored to the needs of all projects and programs based on safety, scope, complexity, cost, and acceptable risk. |
| Obj. IS-3.5 | Use peer review to ensure that NASA's scientific research is of the highest quality. |

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

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| Obj. IS-4.1 | Prevent injuries from occurring during the course of NASA activities on NASA facilities or in the use of NASA equipment. |
| Obj. IS-4.2 | Work closely with other Government agencies and local authorities to identify and try to remove all security threats to NASA people, facilities, and information. |
| Obj. IS-4.3 | Protect NASA's physical assets from damage or theft. |
| Obj. IS-4.4 | Eliminate the incidence of occupational health problems for the NASA workforce. |
| Obj. IS-4.5 | Eliminate environmental incidents, toxic chemical use, hazardous waste, and environmental liability at all NASA sites. |

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

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| Obj. IS-5.1 | Provide tools, techniques, and expertise that will enable all elements of the Agency to make well-informed decisions on matters of critical Mission importance. |
| Obj. IS-5.2 | Improve processes for cost estimation and the management of major NASA projects and programs. |