National Aeronautics and Space Administration
President's FY 2005 Budget Request

(Budget authority, $ in millions)	FULL COST						Chapter Number
By Appropriation Account By Enterprise By Theme	Est. Conf. Rept. FY 2004	**FY 2005**	FY 2006	FY 2007	FY 2008	FY 2009	
Exploration, Science & Aeronautics	7,830	7,760	7,869	8,320	8,900	9,091	ESA-SUM 1
Space Science	**3,971**	**4,138**	**4,404**	**4,906**	**5,520**	**5,561**	ESA 1
Solar System Exploration	1,316	1,187	1,202	1,300	1,392	1,438	ESA 2
Mars Exploration	595	691	724	944	1,188	1,268	ESA 3
Lunar Exploration		70	135	280	375	420	ESA 4
Astronomical Search for Origins	899	1,067	1,196	1,212	1,182	927	ESA 5
Structure & Evolution of the Universe	406	378	365	382	425	457	ESA 6
Sun-Earth Connections	755	746	781	788	958	1,051	ESA 7
Earth Science	**1,613**	**1,485**	**1,390**	**1,368**	**1,343**	**1,474**	ESA 8
Earth System Science	1,522	1,409	1,313	1,290	1,266	1,397	ESA 9
Earth Science Applications	91	77	77	77	77	77	ESA 10
Biological & Physical Research	**985**	**1,049**	**950**	**938**	**941**	**944**	ESA 11
Biological Sciences Research	368	492	499	496	500	502	ESA 12
Physical Sciences Research	357	300	220	210	210	210	ESA 13
Research Partnerships & Flight Support	260	257	232	232	231	232	ESA 14
Aeronautics*	**1,034**	**919**	**957**	**938**	**926**	**942**	ESA 15
Aeronautics Technology	1,034	919	957	938	926	942	ESA 16
Education Programs	**226**	**169**	**169**	**171**	**170**	**170**	ESA 17
Education Programs	226	169	169	171	170	170	ESA 18
Exploration Capabilities	7,521	8,456	9,104	9,465	9,070	8,911	EC-SUM 1
Exploration Systems*	**1,646**	**1,782**	**2,579**	**2,941**	**2,809**	**3,313**	EC 1
Human & Robotic Technology	679	1,094	1,318	1,317	1,386	1,450	EC 2
Transportation Systems	967	689	1,261	1,624	1,423	1,863	EC 3
Space Flight	**5,875**	**6,674**	**6,525**	**6,524**	**6,261**	**5,598**	EC 4
International Space Station	1,498	1,863	1,764	1,780	1,779	2,115	EC 5
Space Shuttle	3,945	4,319	4,326	4,314	4,027	3,030	EC 6
Space Flight Support	432	492	435	430	456	453	EC 7
Inspector General	27	28	29	30	31	32	IG 1
TOTAL	15,378	16,244	17,002	17,815	18,001	18,034	
Year to year increase		5.6%	4.7%	4.8%	1.0%	0.2%	

*In FY 2004 Aeronautics and Exploration Systems will become separate Enterprises

NOTE: May not add due to rounding

Table of Contents

Table of Contents

Table of Contents

Table of Contents

Table of Contents

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

Summary of

FY 2005 BUDGET REQUEST

CONTENTS

N A T I O N A L   A E R O N A U T I C S   A N D   S P A C E   A D M I N I S T R A T I O N

Summary of

FY 2005 BUDGET REQUEST

CONTENTS

Overview

On January 14, 2004, President Bush established a new vision for U.S. space exploration that is bold and forward-thinking yet practical and responsible – one that seeks answers to longstanding questions of importance to science and society; develops revolutionary technologies and capabilities for the future; and genuinely inspires our nation, the world, and the next generation, while maintaining good stewardship of taxpayer dollars. The President's vision is documented in *A Renewed Spirit of Discovery, The President's Vision for U.S. Space Exploration*. To support the vision, NASA is simultaneously releasing the FY 2005 Congressional budget justification, the *FY 2005 Budget Estimates*, and another document, *The Vision for Space Exploration*, that links NASA's programs plans and the FY 2005 Budget request to the exploration vision. The material below provides a summary of both documents.

NASA's FY 2005 Budget request aligns with the goals set forth in *The President's Vision for U.S. Space Exploration* and provides a robust yet responsible five-year budget plan for achieving these goals. The programs supported by this budget will yield remarkable new scientific insights, stimulate American innovation, and inspire young and old alike, while supporting the Administration's goal of cutting the budget deficit in half within the next five years.

Policy Goals

The fundamental goal of the new exploration vision is to advance U.S. scientific, security, and economic interests through a robust space exploration program. In support of this goal, NASA, in cooperation with its partners in other Federal agencies, academia, the private sector, and the international community, will:

- Implement a sustained and affordable human and robotic program to explore the solar system and beyond;
- Extend human presence across the solar system, starting with a human return to the Moon by the year 2020, in preparation for human exploration of Mars and other destinations;
- Develop the innovative technologies, knowledge, and infrastructures both to explore and to support decisions about destinations for human exploration; and
- Promote international and commercial participation in exploration to further U.S. scientific, security, and economic interests.

Guiding Principles for Exploration

NASA does not undertake exploration merely for the sake of adventure, however exciting that may be. In pursuit of the exploration vision, NASA has identified six guiding principles:

Pursue Compelling Questions – Exploration of the solar system and beyond will be guided by compelling questions of scientific and societal importance. NASA exploration programs will seek profound answers to questions about the origins of our solar system, whether life exists beyond Earth, and how we could live on other worlds.

Across Multiple Worlds – NASA will make progress across a broad front of destinations, starting with a return to the Moon to enable future human exploration of Mars and other worlds. Consistent with recent discoveries, NASA will focus on possible habitable environments on Mars, the moons of Jupiter, and in other solar systems. Where advantageous, NASA will also make use of destinations like the Moon and near-Earth asteroids to test and demonstrate new exploration capabilities.

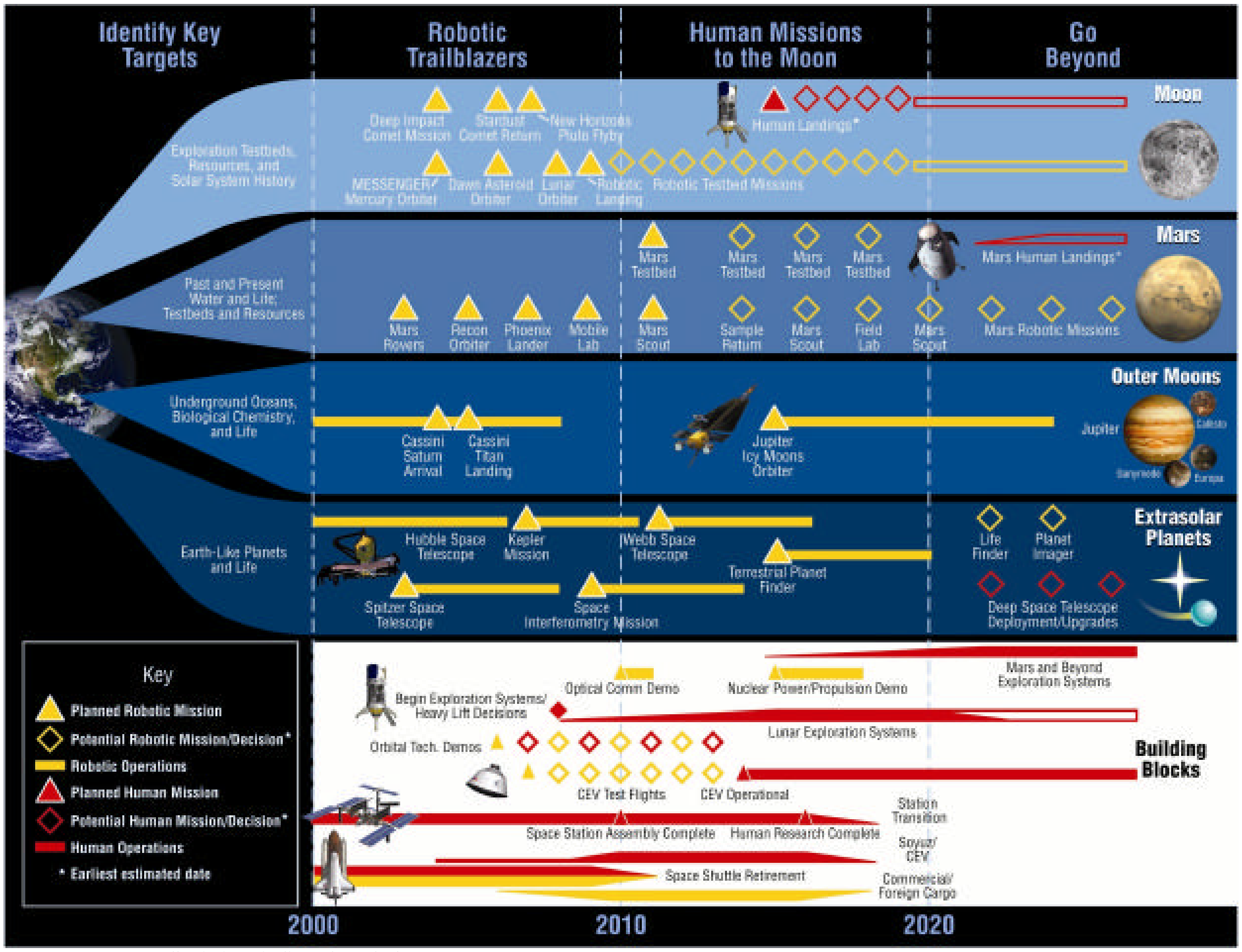
Employ Human and Robotic Capabilities – NASA will send human and robotic explorers as partners, leveraging the capabilities of each where most useful. Robotic explorers will visit new worlds first, to obtain scientific data, assess risks to our astronauts, demonstrate breakthrough technologies, identify space resources, and send tantalizing imagery back to Earth. Human explorers will follow to conduct in-depth research, direct and upgrade advanced robotic explorers, prepare space resources, and demonstrate new exploration capabilities.

For Sustainable Exploration – NASA will pursue breakthrough technologies, investigate lunar and other space resources, and align ongoing programs to develop sustainable, affordable, and flexible solar system exploration strategies.

Use the Moon as a Testing Ground For Mars and Beyond – Under this new Vision, the first robotic missions will be sent to the Moon as early as 2008 and the first human missions as early as 2015 to test new approaches, systems and operations for sustainable human and robotic missions to Mars and beyond.

Starting Now – NASA will pursue this Vision as our highest priority. Consistent with the FY 2005 Budget, NASA will immediately begin to realign programs and organization, demonstrate new technical capabilities, and undertake new robotic precursor missions to the Moon and Mars before the end of the decade.

Exploration Roadmap for the Solar System and Beyond



Note: All missions indicate launch dates.

Exploration Program Elements

Consistent with *The President's Vision for U.S. Space Exploration*, NASA has set a new course for exploration and discovery, as summarized in the exploration roadmap above. Implementation of the exploration vision will be informed by the recommendations of the Aldridge Commission.

Enhance Robotic Trailblazers – Over the next two decades, NASA will send increasingly advanced robotic probes to explore our solar system and beyond, including our Earth's Moon, Mars, the moons of Jupiter, and other outer planets, and launch new space telescopes to search for planets beyond our solar system. The stunning images we are now receiving from the *Spirit* and *Opportunity* rovers at Mars are just the beginning. In this decade alone, NASA plans to launch at least two robotic missions to the Moon, five robotic missions to Mars, three space telescopes that will expand our search for planets circling other stars, and four missions to other planets, comets, and asteroids. Starting at the Moon in 2008 and at Mars in 2011, NASA will launch dedicated robotic missions to demonstrate new technologies that will pave the way for more capable robotic and eventually human missions. Next decade, new classes of robotic missions are planned, including telescopes capable of characterizing planets beyond the solar system, a mission to demonstrate advanced power and propulsion capabilities while mapping oceans on Jupiter's moons, and missions that will return samples from the surface of Mars.

Finish the Space Station and Accelerate Research to Support Exploration – NASA will meet U.S. commitments on the International Space Station by completing Station assembly by the end of the decade. NASA research aboard the Space Station will be focused on developing the knowledge and countermeasures necessary to support human exploration campaigns. NASA will augment its bioastronautics research with the goal of having these tools in hand by 2016.

Develop New Crew Transport Capabilities – To support Space Station assembly, NASA will return the Space Shuttle to flight as soon as possible, according to the recommendations of the *Columbia* Accident Investigation Board. The Shuttle's main purpose through the end of this decade will be Space Station assembly. With its job complete, the Space Shuttle will be retired from service when Space Station assembly is finished planned for the end of the decade. This will allow us to put crew and cargo on different launches, a safer approach to crew transport, and free up resources for exploration activities.

For future crew transport, NASA will undertake *Project Constellation* to develop a Crew Exploration Vehicle (CEV). The CEV will be developed in stages, with the first automated test flight in 2008, more advanced test flights soon thereafter, and a fully operational capability no later than 2014. The design of the CEV will be driven by the needs of future human exploration missions, but the CEV may also supplement international and commercial transportation systems to the Space Station.

Return to the Moon and Demonstrate Sustainable Exploration Capabilities – The President has set a goal of returning human explorers to our Moon as early as 2015 and no later than 2020 to demonstrate capabilities that will enable increasingly deep and more advanced exploration of our solar system. Human missions to the Moon will serve as precursors for human missions to Mars and other destinations, testing sustainable exploration approaches such as space resource utilization, pre-positioned propellants, robotic networks, and modular and reusable systems. They will also demonstrate human-scale exploration systems such as surface power, habitation and life support, and planetary mobility. Additionally, human lunar missions will pursue scientific investigations on the Moon, such as uncovering geological records of our early solar system. The scope and types of human lunar missions and systems will be determined by their support to furthering science, developing and testing new approaches, and their applicability to supporting sustained human space exploration to Mars and other destinations.

Go Beyond – The first human mission beyond the Moon will be determined on the basis of available resources, accumulated experience, and technology readiness. Potential candidates that might be considered include circumnavigating Mars, visiting a near-Earth asteroid, or erecting or upgrading a deep space telescope. The timing of the first human research missions to Mars will depend on discoveries from robotic explorers, the development of techniques to mitigate Mars hazard, advances in capabilities for sustainable exploration, and available resources.

Organizational Changes

To successfully execute the exploration vision, NASA will focus its organization, create new offices, align ongoing programs, experiment with new ways of doing business, and tap the great innovative and creative talents of our Nation.

To develop the Crew Exploration Vehicle and other exploration systems and technologies, NASA has created a new Exploration Systems Enterprise. Relevant elements of the Aerospace Technology, Space Science, and Space Flight Enterprises have been transferred to the Exploration Systems Enterprise. The Aerospace Technology Enterprise has been renamed the Aeronautics Enterprise to reflect its new focus.

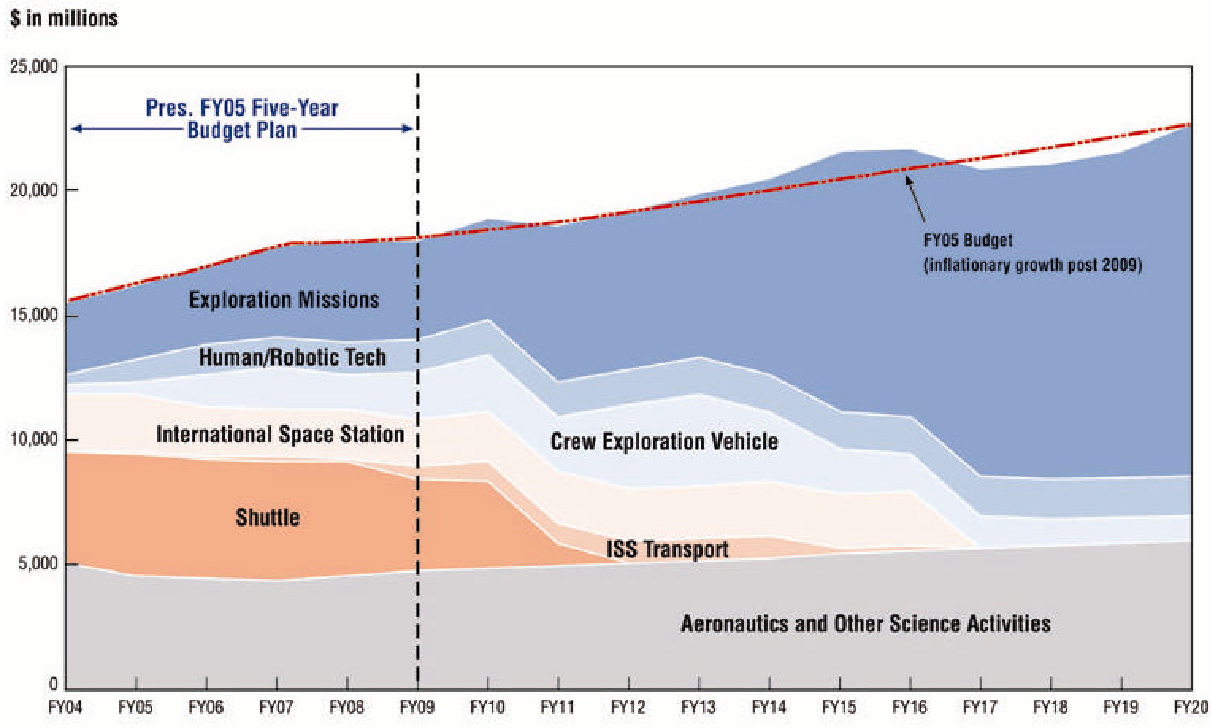
As human explorers prepare to join their robotic counterparts, increased coordination and integration will be necessary. The Exploration Systems Enterprise will work closely with the Space Science Enterprise to use the Moon as a testing ground for solar system exploration vehicles and technologies.

NASA's Space Science Enterprise will have responsibility for carrying out robotic testbeds on the Moon and Mars and will also demonstrate key exploration technologies in other missions to Mars and the outer moons. NASA's Space Science Enterprise will eventually integrate human capabilities into Mars science planning, and potentially deep space observatory and outer moon planning.

Many other elements of the NASA organization will be focused to support this new direction. NASA's Biological and Physical Research Enterprise will put much greater emphasis on bioastronautics research to enable human exploration of other worlds. NASA's Office of the Space Architect will be responsible for integrating the exploration activities of NASA's different Enterprises and for maintaining exploration roadmaps and coordinating high-level requirements.

As we move outward into the solar system, NASA will look for innovative ideas from the private sector and academia to support activities in Earth orbit and future exploration activities. NASA will actively seek international partners and lead the space agencies of these partners in executing exploration activities. NASA will also invigorate its workforce, focus its facilities, and revitalize its field Centers. The new NASA workforce flexibility legislation recently passed by Congress will be key to meeting future organizational challenges to exploration.

Exploration Strategy Based on Long-Term Affordability



Budget

The exploration vision is affordable in both the short term and the long term. NASA's FY 2005 Budget request is fiscally responsible and consistent with the Administration's goal of cutting the budget deficit in half within the next five years. NASA's FY 2005 Budget increases by 5.6 percent, followed by five percent annually the next two years and about one percent for the following two years. In the next decade, retiring the Space Shuttle will free up over $5 billion per year, enabling full-scale development and operation of human missions to the Moon.

The budget strategy supporting the exploration vision places a premium on avoiding balloon payments for future Congresses and Administrations (see chart above). Unlike previous major civil space initiatives, the approach is intentionally flexible, with adjustable exploration milestones and investments in sustainable exploration approaches to maintain affordability. As the President stated in his speech, we are embarking on a journey, not a race.

Budget Structure

NASA's budget accounts are renamed to reflect the President's exploration vision, with appropriation accounts entitled *Exploration, Science, & Aeronautics* (ESA), , and *Exploration Capabilities* (EC), which includes programs that enable the ESA activities to succeed. For the second year, all program budgets are presented in full cost. This means institutional activities, such as personnel and facilities, are included in the benefiting program's budget, reflecting the true cost of the program and enabling managers to make better economic decisions.

Below is a list of NASA's five-year budget broken down by three appropriation accounts, seven Enterprises, and 18 Themes. (NOTE: FY 2004 column represents the enacted budget.)

By Appropriation Account By Enterprise By Theme	FY 2004	**FY 2005**	FY 2006	FY 2007	FY 2008	FY 2009
Exploration, Science & Aeronautics	**7,831**	**7,760**	**7,869**	**8,320**	**8,900**	**9,091**
Space Science	**3,943**	**4,138**	**4,404**	**4,906**	**5,520**	**5,561**
Solar System Exploration	1,302	1,187	1,202	1,300	1,392	1,438
Mars Exploration	595	691	724	944	1,188	1,268
Lunar Exploration		70	135	280	375	420
Astronomical Search for Origins	894	1,067	1,196	1,212	1,182	927
Structure & Evolution of the Univ.	404	378	365	382	425	457
Sun-Earth Connections	749	746	781	788	958	1,051
Earth Science	**1,526**	**1,485**	**1,390**	**1,368**	**1,343**	**1,474**
Earth System Science	1,451	1,409	1,313	1,290	1,266	1,397
Earth Science Applications	74	77	77	77	77	77
Biological & Physical Research	**965**	**1,049**	**950**	**938**	**941**	**944**
Biological Sciences Research	356	492	499	496	500	502
Physical Sciences Research	350	300	220	210	210	210
Research Partnerships & Flight Supt	259	257	232	232	231	232
Aeronautics	**946**	**919**	**957**	**938**	**926**	**942**
Aeronautics Technology	946	919	957	938	926	942
Education	**164**	**169**	**169**	**171**	**170**	**170**
Education	164	169	169	171	170	170
Earmarks**	**287**					
Exploration Capabilities	**7,521**	**8,456**	**9,104**	**9,465**	**9,070**	**8,911**
Exploration Systems*	**1,563**	**1,782**	**2,579**	**2,941**	**2,809**	**3,313**
Human & Robotic Technology	655	1,094	1,318	1,317	1,386	1,450
Transportation Systems	909	689	1,261	1,624	1,423	1,863
Space Flight	**5,857**	**6,674**	**6,525**	**6,524**	**6,261**	**5,598**
Space Station	1,497	1,863	1,764	1,780	1,779	2,115
Space Shuttle	3,928	4,319	4,326	4,314	4,027	3,030
Space Flight Support	432	492	435	430	456	453
Earmarks**	**101**					
Inspector General	**27**	**28**	**29**	**30**	**31**	**32**
TOTAL	**15,378**	**16,244**	**17,002**	**17,815**	**18,001**	**18,034**
year to year increase		5.6%	4.7%	4.8%	1.0%	0.2%

* In FY 2004 Exploration Systems replaces Crosscutting Technologies
**FY 2004 budget column does not allocate earmarks across Enterprises
NOTE: May not add due to rounding

President's Management Agenda

	Human Capital	Competitive Sourcing	Financial Performance	E-Government	Budget and Performance Integration
Status	🟢 ⇧	🟡 ⇧	🔴	🟡 ⇧	🟢 ⇧
Progress	🟢	🟢	🟡	🟢	🟢

Arrow indicates change in status rating since evaluation of September 30, 2003.

NASA is a leading agency in the implementation of the President's Management Agenda (PMA). This is evidenced by the fact that NASA is the first and only agency that is green in either Human Capital or in Budget and Performance Integration. In addition, NASA was recently honored by the President's Quality Awards with an honorable mention for Budget and Performance Integration efforts in FY 2003 – the only such award for Budget and Performance Integration.

The *President's Vision for U.S. Space Exploration* has been enabled by NASA's progress in strengthening our management foundation and agency credibility in PMA and other areas. As of 2003, NASA has received top scores in the key President's Management Agenda areas of human capital management and budget and performance integration. NASA has also successfully implemented management reforms as demonstrated in programs such as the International Space Station.

NASA has made major progress in 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 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 PMA area champions. Since last year, NASA has improved status in four out of five initiatives, achieving green in both Human Capital and Budget and Performance Integration and yellow in both Competitive Sourcing and E-Government.

- Human Capital: NASA implemented our first human capital plan, established an accountability system to track the associated results, and demonstrated our ability to make distinctions in employee performance using a comprehensive awards system. **NASA is the first government agency to achieve green for this initiative.**

- Competitive Sourcing: NASA has a competitive sourcing plan and has announced two standard competitions involving more than 230 positions.

- Financial Performance: NASA has taken significant steps toward resolving inconsistencies in financial reporting and issues relating to valuation of contractor-held property by implementing the Core Financial Module of the Integrated Financial Management Program. Data reconciliation issues due to the conversion from the old to the new systems, however, have presented us with challenges in preparing our 2003 financial statements.

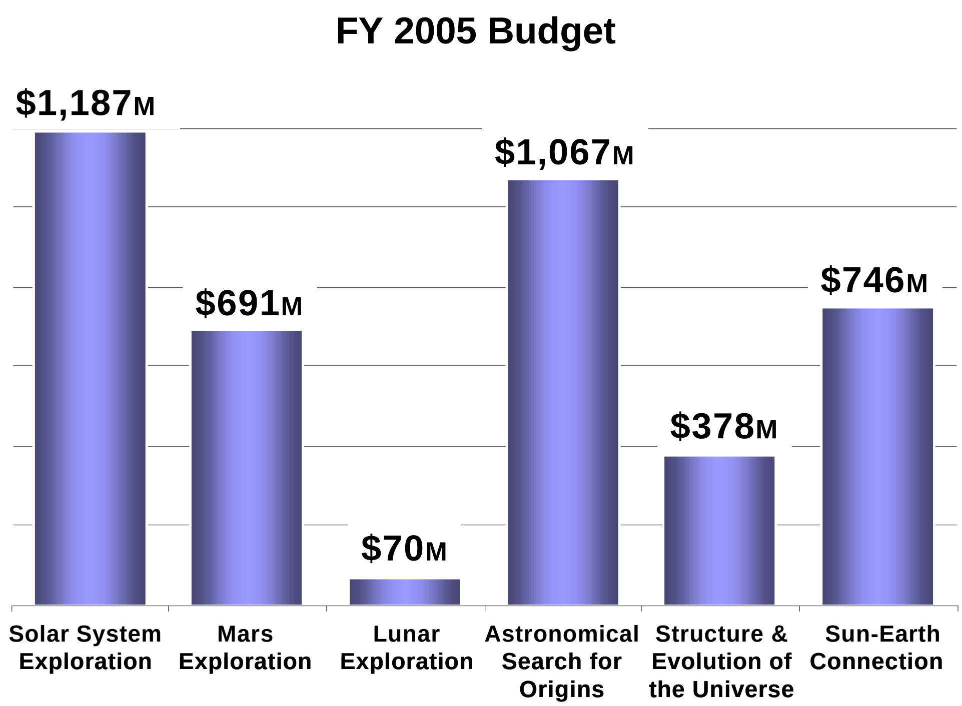
- E-Government: NASA has an information technology (IT) architecture in place to guide our investments and strengthen our IT security. All NASA IT systems are now operating within 10 percent of planned budget and schedule.

- Budget & Performance Integration: NASA used performance information and full-cost considerations to develop our FY05 budget request and to inform our management decisions. **NASA is the first government agency to achieve green for this initiative.**

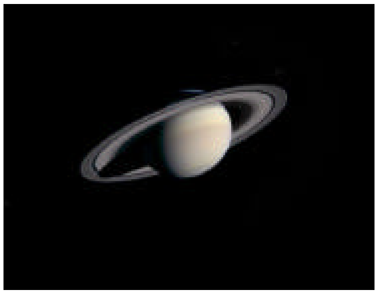
Space Science Enterprise

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. 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 profound questions: How did the universe begin and evolve? How did we get here? Where are we going? Are we alone?

Now, in support of the exploration vision, orbiting observatories and planetary probes will be joined by human explorers in seeking answers to these questions. Robotic scouts will blaze the trail, reconnoitering the planets, moons, asteroids, and comets of the solar system in advance of human expeditions, as observatories monitor the sun and its effects on its planetary retinue. The Space Science Enterprise will work with the new Exploration Systems Enterprise to develop and deploy new technologies, first on automated spacecraft and then on human missions. The Space Science Enterprise is comprised of six Themes described below.



Solar System Exploration



This Theme seeks to understand how our own solar system formed and evolved and whether there might be life in the solar system beyond Earth. In support of the President's new vision of space exploration, the robotic spacecraft dedicated to answering these questions will serve as trailblazers for the future human exploration of the solar system. 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 2005 include:

Overall budget
FY 2005 budget request is $1,187 million for Solar System Exploration, including funding to support missions to Saturn and Saturn's moon Titan; investigate evidence of oceans on Jupiter's icy moons; visit Mercury and Pluto; and orbit the largest asteroids and crack open the interior of a comet. Funding in this Theme includes:

- $94 million for the Dawn mission to orbit two asteroids and the Deep Impact mission to probe below the surface of a comet;
- $116 million for the New Horizons mission to Pluto and the Kuiper Belt;
- $164 million for an In-Space Power and Propulsion program, which includes an effort to develop a new radioisotope power system to enable greatly extended mission lifetimes;
- $75 million for Astrobiology research to improve the ability to find and identify life on other planets;
- $261 million for operation of the Deep Space Mission System; and
- Transfer of Project Prometheus to the new Exploration Systems Enterprise (except for some Space Science-unique elements).

Major Events in 2005

- Deep Impact will launch in December 2004. The spacecraft will release a small (820 lbs.) impactor directly into the path of comet Tempel 1 in July 2005. The resulting collision is expected to produce a small impact crater on the surface of the comet's nucleus, enabling scientists to investigate the composition of the comet's interior.
- Onboard the Cassini orbiter is a 703-pound scientific probe called Huygens that will be released in December 2004, beginning a 22-day coast phase toward Titan, Saturn's largest moon; Huygens will reach Titan's surface in January 2005.

Mars Exploration

This Theme explores the mysteries of the history and present conditions on Mars. Dry and cold today, the Martian surface shows 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 will be critical for future human exploration. The FY 2005 program includes multiple efforts to build upon the recent success of the Mars Exploration Rover program. Highlights for FY 2005 include:

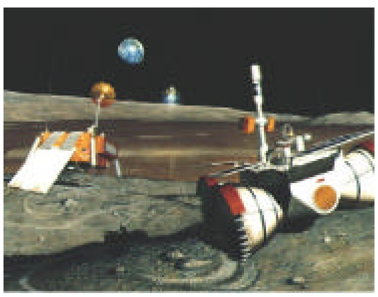
Overall budget
FY 2005 budget request is $691 million for Mars Exploration. This represents a $96 million, or 16 percent, increase over FY 2004. By FY 2009, spending is planned to double to $1.3 billion. The budget funds the operations of: four spacecraft currently at Mars; four new spacecraft through 2010; technology for science missions after 2010; and a new line of testbed missions to support future human and robotic Mars exploration, with first launch in 2011. Funding in this Theme includes:

- $104 million for development of 2005 Mars Reconnaissance Orbiter, an orbiter that will map Martian surface features as small as a basketball (20-30 cm).
- $103 million (nearly four times the FY 2004 funding level) for the 2007 Scout Mission called Phoenix, a competitively selected mission to land on the Martian plains and analyze surface and subsurface samples of water and ice;
- $175 million (a 49 percent increase above FY 2004) for the 2009 Mars Science Laboratory, 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;

- $25 million (nearly three times the FY 2004 funding level) for the 2009 Mars Telesat Orbiter (MTO), a multi-band (X-, Ka-, and UHF band) spacecraft that will provide communications relay support for assets at Mars and will also provide entry, descent, and landing, and Mars orbit insertion support for the 2009 Mars Science Laboratory; and
- $56 million for an optical communication technology demonstration, which will help develop technology to increase communication data rate and improve the cost-per-bit of data returned. This technology will be demonstrated on the 2009 MTO.

Major Events in 2005
- The Mars Reconnaissance Orbiter (MRO) will launch in August 2005. MRO will observe the atmosphere, surface, and subsurface of Mars in unprecedented detail.
- Development of the 2007 Mars Scout mission will continue. This mission, the first in the competitively selected Mars Scout Program, is called Phoenix, and will land in and explore the ice-rich terrain of the high northern latitudes of Mars.

Lunar Exploration



The new Lunar Exploration (LE) Theme will undertake lunar exploration activities that enable sustained human and robotic exploration of Mars and other bodies in the solar system, through the development of new approaches, technologies, and systems. The major focus of the LE Theme will be demonstrating capabilities to conduct sustained research on Mars as well as deeper and more advanced explorations of our solar system. The specifics of lunar missions and systems will be driven by the requirements of future human and robotic explorations of Mars and other solar system destinations, as well as by research results from ongoing robotic missions in the solar system. Lunar missions will also pursue scientific investigations on the Moon, such as uncovering geological records of our early solar system. Robotic lunar missions will begin in 2008, with human lunar missions following as early as 2015. Highlights for FY 2005 include:

Overall budget
FY 2005 budget request is $70 million for Lunar Exploration. By FY 2009, spending will increase six-fold to $420 million. Funding supports a new line of robotic missions to demonstrate sustainable solar system exploration, including: a lunar orbiter planned for launch in 2008; a lunar landing planned for launch in 2009; and up to one lunar mission per year thereafter to demonstrate new exploration capabilities.

Major Events in 2005
- Lunar Exploration will be established as a new Theme for FY 2005, in response to the *President's Vision for U.S. Space Exploration*. Major activities for FY 2005 will be developed prior to the start of FY 2005.
- Space Science will conduct preliminary work in support of the 2008 lunar mission.

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 seek to understand the building blocks of life, the conditions necessary for life to persist, and the signatures of life that might be detectable from Earth. 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 2005 include:

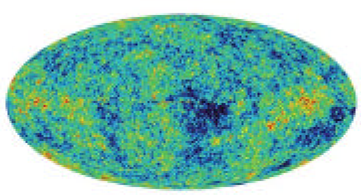
Overall budget
FY 2005 budget request is $1.1 billion for the Astronomical Search for Origins. This represents a $168 million, or 19 percent, increase over FY 2004. These increases support techniques to extend the Hubble Space Telescope's lifetime, James Webb Space Telescope development, Spitzer Space Telescope operation, and two additional space observatories. Funding in this Theme includes:

- $130 million for Hubble Space Telescope operations and data analysis, as well as funding for a robotic mission to safely deorbit the telescope when it ends operations;
- $318 million (a 26 percent increase above the FY 2004 amount) for development of the James Webb Space Telescope planned for launch about 2011, promising to build on the legacy of Hubble Space Telescope; and
- $155 million (more than double the FY 2004 funding level) for development of the Space Interferometry Mission planned for launch in late 2009 to detect planets around other stars.

Major Events in 2005

- The Spitzer Space Telescope (formerly SIRTF, the Space Infrared Telescope Facility) will begin its second cycle of science proposals.
- The Stratospheric Observatory for Infrared Astronomy (SOFIA), an aircraft-based infrared telescope, will be delivered for final science testing.
- James Webb Space Telescope (JWST) will undergo its System Definition Review.

Structure and Evolution of the Universe



This Theme seeks to understand the nature and phenomena of the universe, the fundamental laws of space, time, and energy, and to trace the cycles that created the conditions for our own existence. Strategies include observing signals from the Big Bang, mapping the extreme distortions of space-time near black holes, investigating galaxies, and analyzing the most energetic events in the universe. Highlights for FY 2005 include:

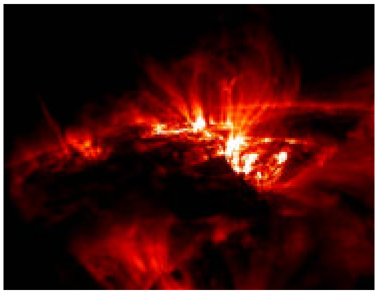
Overall budget
FY 2005 budget request is $378 million for Structure and Evolution of the Universe missions. This funding supports operation of the Chandra X-ray Observatory, development of the Gamma-ray Large Area Space Telescope (GLAST) mission, and development of two future missions. Funding in this Theme includes:

- $103 million for development of Gamma-ray Large Area Space Telescope (GLAST), a mission to study high-energy objects like black holes;
- $31 million for continued technology development for two missions: Laser Interferometer Space Antenna (LISA) and Constellation-X. 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. As a result of the reprioritized agency activities, development will be slowed down, and launch dates for Con-X and LISA will be deferred; and
- $210 million (a 12 percent increase over the FY 2004 amount) for research into the structure and evolution of the universe.

Major Events in 2005

- Astro-E2, a powerful x-ray observatory developed jointly by the U.S. and Japan, will be launched.
- A host of missions, including the Chandra X-Ray Observatory, WMAP, and GALEX, will continue their operations and science investigations.

Sun-Earth Connection



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, whose variability profoundly affects Earth. Changes in its long-term brightness cause ice ages, and its 11-year cycle of activity causes aurora and other disturbances on Earth. Solar flares affect the upper atmosphere and can damage satellites and disable the power distribution grid on the ground. As our nearest star, the Sun is also an ideal laboratory for basic physics and learning about other stars. Highlights for FY 2005 include:

Overall budget

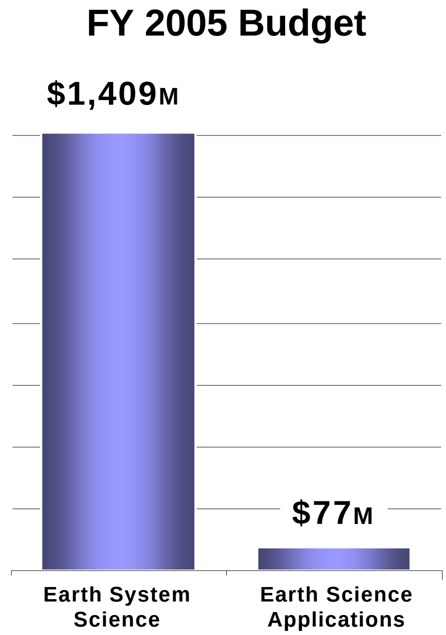
The FY 2005 budget request is $746 million for Sun-Earth Connection missions. This funding supports the Solar Dynamics Observatory (SDO), development of the Solar-Terrestrial Relations Observatory (STEREO) mission, and other Living With a Star and Solar-Terrestrial Probe missions. Funding in this Theme includes:

- $74 million for development of STEREO;
- $158 million (more than double the FY 2004 funding level) for SDO, a cornerstone mission in the Living With a Star program that will study the Sun's magnetic field and the dynamic processes that influence space weather;
- $47 million for future flight missions in the Living With a Star program; and
- $195 million for research in SEC (a 10 percent increase over the FY 2004 level).

Major Events in 2005

- STEREO will be prepared for launch in FY 2006. STEREO will use two identically equipped spacecraft to provide revolutionary three-dimensional imaging of Coronal Mass Ejections.

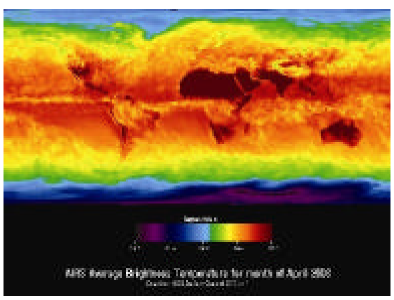
Earth Science Enterprise



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 enables us to improve prediction of climate, weather, and natural hazards. NASA brings to this endeavor the unique vantage point of space, allowing global views of Earth system change. NASA provides scientific information in the form of observations, research, modeling, and integrated solutions to meet national priorities. NASA has been studying Earth from space since its beginnings as an Agency. NASA research and development of aerospace science and technology has resulted in deployment of the first series of Earth Observing System (EOS) satellites, which monitor the major interactions of the land, oceans, atmosphere, ice, and life that comprise the Earth system.

ESE works to provide scientific answers to the fundamental question: How is Earth changing and what are the consequences for life on Earth?

Earth System Science



This Theme is deploying and operating the first phase of an integrated constellation of Earth observation research satellites that will reveal interactions among Earth's continents, atmosphere, oceans, ice, and life. These Earth processes produce the conditions that sustain life on Earth. Data from NASA Earth observation satellites enable researchers to understand the causes and consequences of global change and inform the decisions made by governments, industry, and citizens to improve our quality of life. Highlights for FY 2005 include:

Overall budget

The FY 2005 request is $1,408.5 million:

- $54 million for the Climate Change Research Initiative, making NASA's Earth Science Enterprise the largest contributor to the interagency Climate Change Science Program (CCSP) in FY05;
- $141 million (a 36 percent increase above FY 2004) for development of the NPOESS Preparatory Project (NPP), in partnership with the National Oceanic and Atmospheric Administration and the Department of Defense;
- $560 million for research in Earth System Science (a 7 percent increase above FY 2004), allowing NASA to take advantage of data from 80 sensors on 18 operating satellites by supporting a steady level of competitive, world-class research; and
- $240 million for missions in formulation (a 37% increase above FY 2004) including such missions as Orbiting Carbon Observatory, Aquarius, and Hydros.

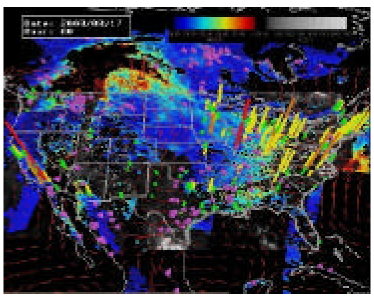
Major Events in 2005

- Several Explorer missions (Orbiting Carbon Observatory, Aquarius) begin implementation in FY05.
- NASA remote sensing and modeling research in the North American Carbon Program will be supporting major intensive field campaigns, very likely in the mid-continental United States and in one or more

coastal regions, with the exact regions to be identified through peer review processes occurring in 2004. Also, NASA, the Department of Energy, and the National Oceanic and Atmospheric Administration will be completing the preparation and release of the first State of the Carbon Cycle Report, a Carbon Cycle Science Plan Synthesis and Assessment product.

- Cloudsat and CALIPSO will launch in FY05 and will begin providing key measurements to improve climate predictions. Specifically, these satellites will observe the roles of clouds in Earth's climate, and the role of clouds and aerosols in Earth's radiation budget.
- NASA's next generation Earth-observing satellite, Aura, will begin supplying the most complete information yet on the health of Earth's atmosphere. The data flowing from these global observations will help scientists track the sources and processes controlling global and regional air quality, quantify the impact of aerosols, tropospheric ozone and upper tropospheric water vapor on Earth's climate, and answer other key scientific questions.
- The first phase of the Earth System Modeling Framework will be completed. With the completion of ESMF, new science will be enabled and the collaboration between the Earth system modeling centers will be enhanced.

Earth Science Applications



Within this Theme, NASA works with other Federal agencies to apply Earth Science research results and information products to 12 applications of national priority and to serve national priorities in education. NASA partner agencies' decision support systems are being improved due to NASA-sponsored scientific research and technological innovations. Examples include the Federal Aviation Administration (FAA) National Airspace System and the U.S. Department of Agriculture (USDA) Crop Assessment Data Retrieval and Evaluation (CADRE) system. NASA and its partners benchmark the enhancements that result from delivering Earth science research results through integrated system solutions, leading to increased use of NASA information and technology for both domestic and international decision support systems and education projects. Highlights for FY 2005 include:

Overall budget

The FY 2005 request is $76.9 million:

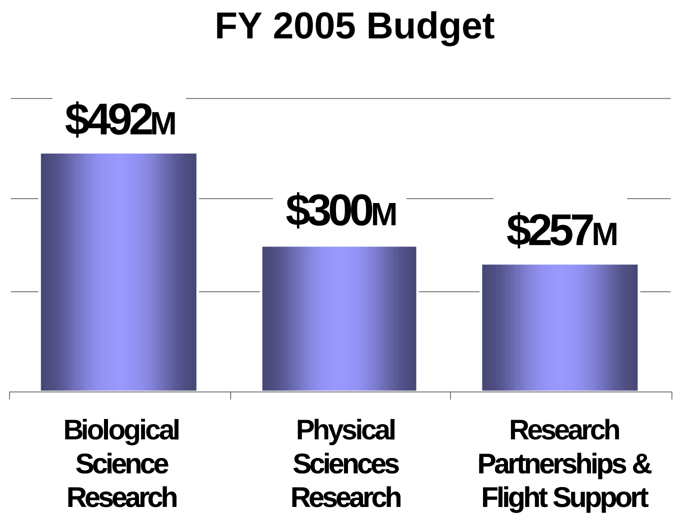
- The request includes funding for benchmarking the use of Earth observations from nine NASA Earth observatories into decision support tools through partnerships with eight Federal agencies for air quality, agricultural efficiency, aviation, carbon management, coastal management, disaster management, ecological forecasting, energy management, invasive species, public health, and water management.
- $14.3 million for an enhanced outreach and education program to communicate significant Earth science research and application results, and to expand the Digital Earth Virtual Environment and Learning Outreach Project (DEVELOP). The request will sponsor over 150 projects to develop post-graduate, graduate, K-12, and informal education capacity for extending the use of Earth system science research results to serve society.

Major Events in 2005

- ESA will continue participation in Joint Agency Commercial Imagery Evaluation (JACIE) to provide Earth scientists with verification of the performance of commercial data, thereby optimizing the value to the government of private sector investments
- ESA will expand the Digital Earth Virtual Environment and Learning Outreach Project (DEVLOP) in an effort to develop human capital that will meet the future needs of the Earth Science Enterprise and the Applications program. This will be accomplished through student-centered programs that serve communities in at least 26 states.

Biological and Physical Research Enterprise

The Biological and Physical Research (BPRE) Enterprise has a unique role in support of NASA's Vision and Mission. In concert with the new exploration vision, BPRE will refocus research on activities that prepare human explorers to travel beyond low Earth orbit, such as the development of countermeasures against space radiation and the long-term effects of reduced gravity.



Coordinated strategic research thrusts address topics such as radiation health and protection, biomedical countermeasures, bio-regenerative life support, and engineering research supporting the technologies required for sustained human exploration of space.

If we are to venture safely into space, NASA must provide the same kind of safe cocoon for space explorers that Earth provides for its inhabitants. Understanding how humans and other life forms adapt to the environment of space is a critical BPRE role.

The Enterprise's contributions to realizing NASA's Vision address five questions that provide a framework for all Enterprise activities: (1) How can we assure the survival of humans traveling far from Earth? (2) How does life respond to gravity and space environments? (3) What new opportunities can research bring to expand understanding of the laws of nature and enrich lives on Earth? (4) What technology must we create to enable the next explorers to go beyond where we have been? (5) How can we educate and inspire the next generation to take the journey?

The FY05 budget will allow BPRE to complete and launch a wide range of research facilities to the ISS over the next five years that will enable exploration-focused research in biology and technology development. The FY05 budget fully supports increased BPRE research on ISS following return to flight. Four major facilities are completed and will be launched on the first two missions to ISS. BPRE will be conducting a thorough review of all research activities to achieve full alignment with and support of the new exploration vision.

Biological Sciences Research

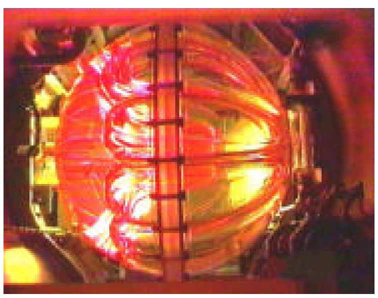
Within this Theme, we determine ways to support a safe human presence in space. Space flight exposes humans to physiological and psychological health risks from radiation, reduced gravity, and isolation. We are carrying out research to define and control these risks and to improve the performance of life support systems. The Biological Sciences Research Theme also pursues fundamental biological questions on scales ranging from cell to tissues to whole organisms to ecosystems. These results will advance human exploration of space, understanding of biological systems, and improve human health on Earth.

Overall budget
The FY 2005 request is $492 million, a $123.5 million (34 percent) increase above FY 2004, and a $353 million (12 percent) increase over 5 years:

- $343 million (a 61 percent increase above FY 2004) for Bioastronautics Research, including the Human Research Initiative, to perform research and develop technology for systems that will enable humans to live and work safely and effectively in space. These research activities are aligned with the Bioastronautics Critical Path Roadmap, which identifies the critical risks associated with long-term human space travel; and
- $149 million for Fundamental Space Biology to focus on research on life's responses to space environments at all levels including cell sciences and genomics, physiological adaptation and developmental biology, ecosystem interactions and multigenerational studies, and the development of hardware for the Centrifuge Accommodation Module.

Major Events in 2005
- BSR will systematically explore the utility of Artificial Gravity as a multi-system countermeasure in ground based venues using test subjects deconditioned by bed rest.
- BSR will improve ability to predict risks associated with exposure to radiation by using the National Space Radiation Laboratory.
- BSR will complete preliminary study of Advanced Integration Matrix.
- BSR will continue development of Sabatier technology to help close the water recovery cycle on the International Space Station (ISS).
- BSR will complete readiness of Habitat Holding Rack No. 2, and the Japanese Aerospace Exploration Agency (JAXA) provided Life Sciences Glovebox.

Physical Sciences Research



This Theme supports research that uses the unique environment of space to expand our understanding of the fundamental laws of nature and to advance industrial and technological applications on Earth. This Theme also supports applied physical science and engineering research to develop reduced gravity technologies critical to human space exploration, such as radiation shielding, microgravity fire safety, and those elements of spacecraft power and propulsion systems that are gravity dependent. The Physical Sciences Research program develops technologies for space crew health programs and new processes to produce life-sustaining resources in a reduced-gravity remote environment.

Overall budget
The FY 2005 request is $300 million to continue important research in physical sciences.

The request covers the development of hardware for inserts to be used with the ISS Research Facilities such as:
- Sample Cartridge Development,
- Lab-on-a-Chip Application Development,
- Multi-user Gaseous Fuel Apparatus,
- Granular Flow Module,
- Space Acceleration Measurement System,
- Microgravity Acceleration Measurement System, and
- Primary Atomic Reference Clock in Space.

Major Events in 2005

- PSR will complete three (3) Microgravity Science Glovebox experiments.
- PSR will initiate an Advanced Life Support research flight experiment development.
- PSR will initiate design of an In-space Fabrication and Repair experiment.
- PSR will publish STS-107 research results together with International Space Station (ISS) flight experiments.

Research Partnerships and Flight Support

This Theme establishes policies and allocates space resources to support space flight research and also encourage development of research partnerships in the pursuit of NASA missions and Enterprise scientific objectives. This research supports product development on Earth and accelerates progress in our strategic research areas. Ultimately, research partnerships may support development of an infrastructure that can be applied to human exploration. This Theme also funds ISS research planning, integration, and operations, as well as development and maintenance of research hardware that is used across multiple research disciplines such as the Express Rack and refrigerator/freezers.

Overall budget

The FY 2005 request is $257 million.

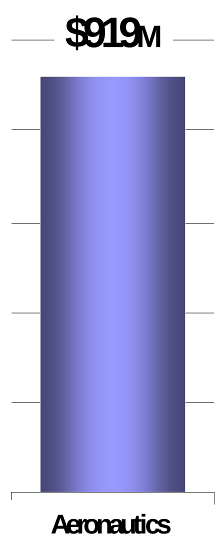
Major Events in 2005

- RPFS will develop new research partnerships with other divisions of BPRE, other NASA enterprises and other federal agencies.
- RPFS will start work on four new realignment initiatives that directly address NASA's mission and involve the RPC industrial partners.
- RPFS will expand education and outreach activities to engage the public in NASA's missions, discoveries and technology.
- The ISS Downlink Enhancement Architecture will demonstrate 150 megabyte per second communication for ISS research.
- The ISS will have the capability for –80 C cold stowage of research samples upon launch of the Minus Eighty-Degree Laboratory for ISS freezer unit in FY2005.
- Mid-deck locker size units will be developed to provide additional volume for storing research samples at +4 C, -20 C and –180 C.

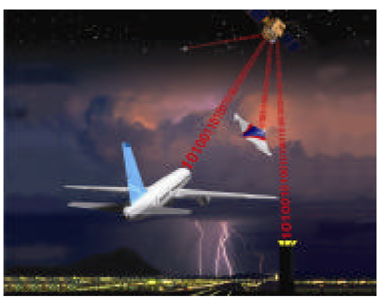
Aeronautics Enterprise

Aviation is an indispensable part of our Nation's transportation system, providing unequaled speed and mobility for people and goods. The Aeronautics Enterprise 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 Enterprise also enhances the Nation's security through its partnerships with the Department of Defense, the Department of Homeland Security, and the Federal Aviation Administration (FAA). Research areas include advanced propulsion technologies, lightweight high-strength adaptable structures, revolutionary display and control systems, adverse weather countermeasures, 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.

FY 2005 Budget



Aeronautics Technology



Aeronautics Technology consists of three integrated programs. The Aviation Safety and Security Program directly addresses the safety and security research and technology development needs of the nation's aviation system, to either prevent unintentional and intentional actions that would cause damage, harm, and loss of life or mitigate the consequences when these types of situations occur. The Airspace Systems Program conducts research and technology development that will enable 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 air traffic management system. The Vehicle Systems Program develops enabling technologies that will produce future vehicles that are environmentally friendly, quieter, faster, more efficient, and technologically superior and supports science missions and commercial applications requiring high altitude, long endurance, and remote operations. Highlights for FY 2005 include:

Overall budget
The FY 2005 request is $919 million:

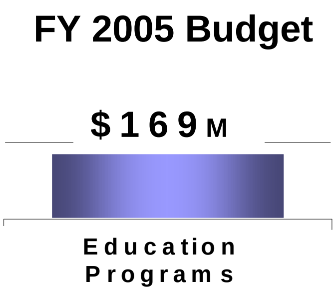
- $7 million to study technologies and concepts that may enable planetary aircraft in support of the new vision;
- $188 million (a 4 percent increase above FY 2004) for Aviation Safety and Security projects aimed at reducing accident and fatality rates reducing the vulnerability of the aviation system to terrorist and criminal threat;
- $154 million for Airspace Systems projects to provide technologies that can dramatically increase the capacity and mobility of the nation's air transportation system;
- $209 million to reduce the emissions and enhance the efficiency of aircraft, improving our environment;
- $133 million for flight and systems demonstration of enabling aeronautics technologies;
- $75 million increase through 2009 for rotorcraft research; and
- $72 million (an 11 percent increase above FY 2004) to reduce the noise made by aircraft, improving the quality of life around airports.

Major Events in 2005

- NASA will demonstrate 70 percent reduction in nitrous oxides emissions in full-scale tests of combustor configurations suitable for a large subsonic vehicle.
- NASA will demonstrate integrated technologies and polices that would allow routine un-piloted vehicle flight operations in the National Airspace System above an altitude of 40,000 feet.
- NASA will complete Human in the Loop concept and technology evaluation of shared aircraft separation.
- NASA will conduct experimental flight evaluation of key Small Airplane Transportation System enabling technologies.
- NASA will accomplish its objective of developing technologies that will enable a 50 percent reduction in the fatal accident rate from the 1991-1996 level.

Education Enterprise

The Education 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 Enterprise unifies the educational programs in NASA's other Enterprises and at the 10 field centers under a *One NASA Education* vision. NASA Education will 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 missions. Students and educators will be able to work with NASA and university scientists to use real data to study Earth, explore Mars, and conduct 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. To ensure diversity in NASA's workforce, the Education Enterprise's programs pay particular attention to under-represented groups. NASA Education will support the 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.

Overall budget

The FY 2005 request is $168.5 million:

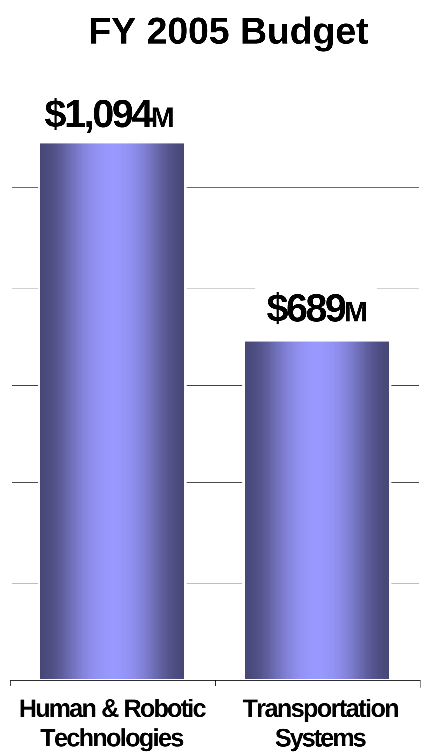
- $10 million for the newly authorized Science and Technology Scholarship program to ensure NASA's pipeline of new scientists and engineers includes the best of the best;
- $13.7 million for the NASA Explorer Schools program, which enters its third phase, selecting 50 new schools for a total of 150 participating schools;
- $91 million for minority university research and education (a 2 percent increase above FY 2004) to expand NASA's scientific and technical base through partnerships with Historically Black Colleges and Universities (HBCUs), Hispanic Serving Institutions (HSIs), Tribal Colleges and Universities (TCUs), and Other Minority Universities (OMUs); and
- Another estimated $70 million in education-related funding, managed by the other NASA Enterprises in coordination with the Education Enterprise.

Major Events in 2005

- The NASA Explorer Schools program enters its third phase, selecting 50 new schools for a total of 150 participating schools.
- The first class of students will be selected for the Science and Technology Scholarship program.
- NASA will capitalize on the ongoing training of the new class of Educator Astronauts by developing learning modules for K-12 students and teachers.
- The Explorer Institute program will move into its first full year of implementation, building relationships with, and professional development opportunities for, museums, science centers, planetaria, and other informal education institutions across the country.

Exploration Systems Enterprise

The relationship between discovery and exploration has driven human curiosity throughout U.S. and global history. New World pioneers demonstrated the value of exploration, as they obtained knowledge, technology, resources, and inspiration for our nation. At the beginning of the 21st century, we stand at a unique time in our exploration of the heavens. The exploratory voyages of the next few decades have the potential – within our lifetimes – to answer age-old questions about how life begins, whether life exists elsewhere, and how humans will exist in the future.



These voyages will not be easy. Mars is 100,000 times farther away from Earth than is the International Space Station. At the moons of Jupiter, the power supplied by sunlight is 27 times weaker than on Earth. Radiation presents an ever-present challenge to human and robotic explorers. Using existing systems and technology, it takes over a decade and a half to reach the boundaries of our solar system.

To enable an effective and exciting program of solar system exploration, the constraints of distance, energy, and time must be overcome. Meeting these challenges will require innovative approaches, new vehicles, and breakthrough technologies. The new Exploration Systems Enterprise has been allocated $13.4 billion over the next five years for developing and demonstrating the strategies and systems that will allow human and advanced robotic exploration of other worlds.

The Exploration Systems Enterprise includes two new Themes that will function cooperatively to enable sustainable exploration and scientific discovery in the solar system: Human and Robotic Technology and Transportation Systems.

Human and Robotic Technology

The Human and Robotic Technology (HRT) Theme is responsible for developing innovative technologies to enable sustainable exploration of our solar system. Through applied technology research, focused technology maturation, and timely technology transition, the HRT Theme will develop technologies that can be integrated into LE Theme missions and applied in the exploration activities of other NASA Enterprises.

For sustainable solar system exploration, NASA requires safe, affordable, effective, and flexible architectures, vehicles, and systems. This may require systems that can be reused, systems that are highly reliable and require limited maintenance and support, systems that can be applied to more than one destination, systems that can operate intelligently without human control, and architectures that use space resources to improve efficiency. NASA plans to invest in a number of new approaches and technologies for exploration that could enable these kinds of architectures, vehicles, and systems. These technologies will be demonstrated on the ground, at the Space Station and other locations in Earth orbit, and at the Moon starting this decade and into the next. Where they provide for safety, affordability, effectiveness, and flexibility in architectures, these new tools will be incorporated in full-scale, operational exploration systems.

The HRT Theme consists of five programs: Centennial Challenges, Project Prometheus, Technology Maturation, Advanced Space Technology, and Innovative Technology Transfer Partnerships.

Overall budget
The FY 2005 request is $1,093.7 million, including:
- $438 million for Project Prometheus to develop advanced nuclear technologies for power and propulsion.
- $115 million (growing to $500 million by FY 2009) in new funding for Technology Maturation to identify and develop the technologies and building blocks necessary in pursuit of the exploration vision; and
- $20 million in new funding for Centennial Challenges to provide awards to non-traditional innovators in academia, industry, and the public who can provide novel solutions to the technical challenges of solar system exploration and other NASA priorities.

Transportation Systems

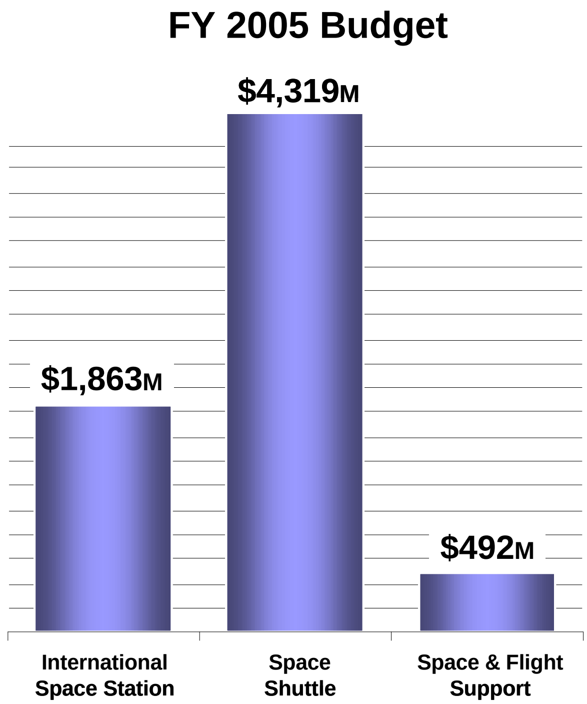
The Transportation Systems (TS) Theme will provide crew transfer and other NASA-unique space transportation capabilities to support exploration of the solar system. The TS Theme will be focused on development and demonstration of a crew exploration vehicle under Project Constellation that can transport and support human crews traveling to destinations beyond low Earth orbit. The TS Theme will also be responsible for planning for potential future NASA-unique space transportation needs, such as heavy lift launch, that cannot be met through commercial or international partner capabilities.

The TS Theme includes transition and closeout activities for the Orbital Space Plane and Next Generation Launch Technology programs.

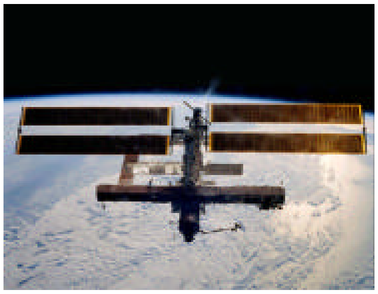
Overall budget
The FY 2005 request is $688.8 million, including:
- $428 million ($6.6 billion over five years) for Project Constellation to develop a crew exploration vehicle that will take humans back out of low Earth orbit, by 2014. By leveraging existing technologies and lessons learned from past programs, NASA will ensure rapid demonstration and deployment, including a first test flight in 2008.

Space Flight Enterprise

The Space Flight Enterprise programs ensure that the Nation will have reliable, safe, and affordable access to space for NASA's human and robotic explorers and open new exploration and research opportunities through the extension of human presence in Space. The Space Flight Enterprise enables research by providing transportation systems such as the Space Shuttle, operational research facilities in space such as the International Space Station (ISS), and space communications systems and supporting space infrastructure. The Enterprise also provides the unique system–the human system–necessary to open the space frontier to the broadest extent possible. The Space Flight Enterprise does this through three Themes described below.



International Space Station



This Theme supports activities for establishing a research facility in Earth orbit aboard the ISS. The ISS provides a long-duration habitable laboratory for science and research activities primarily to support future human and robotic exploration of the solar system. The ISS can also support unique, long-duration, space-based research in cell and developmental biology, plant biology, fluid physics, combustion science, materials science, and fundamental physics. It provides a unique platform for observing Earth's surface and atmosphere, the Sun, and other astronomical objects.

All U.S. Core assembly flight elements and the first International Partner Laboratory have been delivered to the launch site. Upon completion of final ground integration, all assembly launch packages will be placed in protected stowage awaiting the Shuttle's return to flight. Highlights for FY 2005 include:

Overall budget
The FY 2005 request is $1.9 billion (a 24 percent increase above FY 2004) for the International Space Station to continue assembly and operations:
- $140 million in new funding (increasing to $500 million in FY 2009) for crew and cargo services to improve research productivity this decade and for transition from Shuttle as it is phased out; and
- $30 million in FY 2005 for funding Node 3 and the Environmental Closed Life Support System.
- This reflects Administration approval to proceed beyond the U.S. Core configuration following the program's successful completion of program management and cost control reforms.

Major Events in 2005
- NASA will increase the ISS crew size to three persons after Shuttle returns to flight.
- ISS Assembly will resume after the Shuttle returns to flight

Space Shuttle

The Shuttle, first launched in 1981, provides the only capability in the United States for human access to space. The Shuttle is also a versatile cargo launch vehicle and serves as a platform to support construction activities in space. The Shuttle's primary role is to complete the assembly of the International Space Station. The Shuttle's retirement is planned for the end of the decade, following the completion of its role in the ISS assembly. Highlights for FY 2005 include:

Overall budget

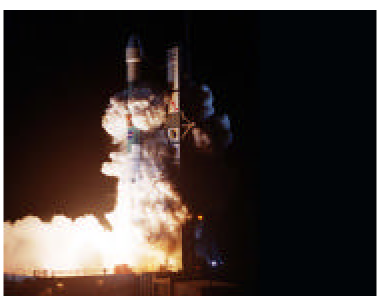
The FY 2005 request is $4.3 billion (a 9 percent increase above FY 2004) for Space Shuttle to return to flight and continue assembly of the ISS:

- $680 million to the Shuttle program through FY 2007, including more than $200 million in FY 2005, dedicated for return to flight activities.
- This includes high-priority mission assurance projects for safety, supportability, and infrastructure to combat obsolescence of vehicle, ground systems, and facilities.

Major Events in 2005

- Space Station assembly missions will resume.
- Space Shuttle Main Engine Advanced Health Management System will be completed.
- NASA will prepare for the planned retirement of the Space Shuttle following completion of its role in Space Station assembly.

Space and Flight Support



This Theme encompasses space communications, launch services, rocket propulsion testing, and environmental clean-up. Space communications supports the Space Shuttle, ISS, expendable launch vehicles, and research aircraft, and provides telecommunications services for flight support networks, mission control centers, 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. The two environmental clean-up initiatives (Plum Brook Reactor Facility and Environmental Compliance and Restoration) 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. Highlights for FY 2005 include:

Overall budget

The FY 2005 request is $492 million:

- $196 million (a 57 percent increase above FY 2004) for the Space Communications budget;
- $146 million (a 3 percent increase above FY 2004) for oversight of expendable launch vehicle flights and supporting payload carriers for Shuttle launches;
- $67 million (an 8 percent increase above FY 2004) for rocket propulsion testing;
- $77 million for environmental compliance (including $46 million for Plum Brook cleanup), an increase of 22% over five years to meet increasing environmental requirements; and
- $10 million in new funding for flight demonstration initiative to pursue launch services with emerging launch systems.

Major Events in 2005

- FY 2005 will include the first full year of service for the Space Mission Communications and Data Service contract, the follow-on to the Consolidated Space Operations Contract.

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 and Administrative (G&A) charges. These areas are included in the summary below to provide visibility into the resources provided for these activities. Due to the new exploration vision, NASA will be reviewing its institutional needs and may adjust the FY 2005 estimates below upon completion.

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 2005 highlights include:

- $1.2 billion total for FY 2005 allocated as shown below;
- Includes $17 million additional funding for enhanced security; and
- $34 million for Center Investment Accounts.

($ in millions)	FY 2005
Ames Research Center	124
Glenn Research Center	106
Dryden Flight Research Center	53
Goddard Space Flight Center	183
Johnson Space Center	185
Kennedy Space Center	243
Langley Research Center	120
Marshall Space Flight Center	143
Stennis Space Center	44
Total, Center G&A	1,201

Corporate G&A

Corporate G&A costs include Headquarters operations and Agency-wide functions. FY 2005 highlights include:

- $848 million total for FY 2005, as shown in the table below;
- Includes $119 million for the Integrated Financial Management Program (IFMP);
- $27 million for Independent Verification and Validation Facility (IV&V);
- $22 million for Space Architect; and
- $77 million for the NASA Engineering and Safety Center.

($ in millions)	FY 2005
Headquarters Corporate Activities	373
Corporate IFMP/HQ IFM	120
Agency Operations	69
Chief Information Officer	38
Chief Engineer	28
Safety & Mission Assurance	48
NASA Engineering & Safety Center	77
Chief Health & Medical Officer	5
Space Architect	22
Security Management	8
Corporate CofF	12
Center-Based Corporate G&A	21
Independent Verif. & Valid. Facility	27
Total Corporate G&A	848

Workforce

FY 2005 highlights include:

- $2.307 billion for salaries and benefits and $69.0 million for travel.

Construction of Facilities

FY 2005 highlights include:

- $208 million for Construction of Facilities (CoF);
- Includes $55 million for program direct CoF, carried in program budgets;
- Includes $143 million for non-programmatic CoF, carried within Center G&A; and
- 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 2005 highlights include:

- $76.5 million for environmental compliance, including $30.5 million for Plum Brook cleanup.

Reference: Document Format Overview and FY 2005 Changes

DOCUMENT FORMAT

For the FY 2004 President's Budget submission, NASA began using a new budget structure and presentation format. Both are designed to be easy to navigate and to present the costs and benefits of budget items consistently and clearly. The new format also integrates the budget request and annual performance plan into one document.

Budget Levels

There are three budget levels. At the first level are the Enterprises, NASA's primary areas of activity. At the second are Themes, programmatic subdivisions of Enterprises that function as program "investment portfolios." At the third level, individual programs within the Themes are discussed according to four categories based on the stage of effort: Development, Operations, Research, and Technology and Advanced Concepts. At each of the three budget levels, the document presents consistent types of information to allow comparison across the budget at that budget level and to facilitate document navigation.

LEVEL 1

Level 1 sections present the Enterprise's purpose, recent and planned accomplishments, and descriptions of each Theme for which the Enterprise is responsible.

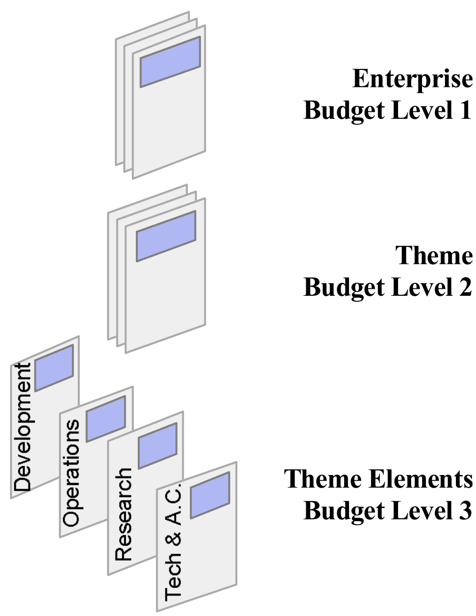
LEVEL 2

To facilitate evaluation of the Theme as an investment, Level 2 sections present the "business case" for each Theme, display the budget request, and discuss it in terms of the President's Research and Development Investment Criteria (relevance, quality, and performance). Theme sections include data on the programs and projects that comprise the Theme, including their content, methodology, period of performance, and accountable manager. Also included are performance plan data, the outcomes and annual performance goals that the Theme will accomplish.

LEVEL 3

At this level, programs and projects are assigned to four categories: Development, Operations, Research, and Technology and Advanced Concepts. (An exception is the Education Theme, which includes Education Activities at Level 3.) The document describes the program or project, its purpose, its contribution to the Theme and to the Agency's strategic and performance plans, and its technical commitments. It also addresses implementation aspects, such as the acquisition strategy, partnering agreements, and independent reviews, and specifies the budget request, including the complete life cycle cost where pertinent.

Programs and projects in all of the categories--Development, Operations, Research, and Technology and Advanced Concepts--work together to achieve the Theme's goals. For example, a Research project may investigate Theme questions using data collected from flight projects built under Development and flown under Operations. Technology and Advanced Concepts activities seek the cutting-edge capabilities needed to develop new operational projects.



The budget is presented according to three levels: Enterprises, Themes, and Theme Elements (programs and projects in the Development, Operations, Research, and Technology and Advanced Concepts phases).

Development

Development includes design, development, testing, and evaluation. During this phase, a program or project must meet specific technical requirements and substantiate its life cycle cost projections. For a spacecraft, Development begins with a Program Commitment Agreement signature and continues through launch.

Operations

Operations includes the activities required to operate something (e.g., a facility, spacecraft, or instrument). Examples of programs and projects in the Operations phase are facilities on board the International Space Station, orbiting spacecraft, and instruments onboard the spacecraft.

Research

Research includes basic and applied research experiments and includes analysis of data from facilities or instruments in the Operations phase. Because there are so many Principal Investigators conducting experiments and data analysis, Research activities are discussed only at the portfolio level.

Technology and Advanced Concepts

These programs focus on activities to bring new technologies and advanced concepts to the point of yielding practical benefits. Technologies are rated according to readiness level. A table identifies the technology's intended application, if it is targeted to support a specific mission. Advanced Concepts projects typically move to the Development phase once certified as mature.

CHANGES FROM FY 2004

The budget changed dramatically with the introduction of the new integrated budget and performance approach last year. In the FY 2005 budget, there some changes to improve the IBPD such as, a new Risk Mitigation section that has been added to Level 3. The risk section presents a brief snapshot at high-level risk issues that are regularly monitored throughout the year, including—cost, benefit, and risk.

Another improvement this year is greater data continuity. The new format introduced in the FY 2004 budget featured consistent information at each budget level to allow comparison of the relative costs and benefits of various programs. It is now possible to compare a program's past and projected cost and benefits

Reference: How to Read a Data Sheet

READING DATA SHEETS IN THE NEW BUDGET FORMAT

Level 1 (Enterprise) Data Sheets

The large Enterprise image and the smaller Theme images are consistent icons providing a visual navigation aid. Each Enterprise section includes the icons for the Themes that the Enterprise carries out. Icons depict actual or planned Enterprise or Theme achievements.

Level 2 (Theme) Data Sheets

Theme sections justify the budget request in terms of relevance, quality, and performance, and state the performance commitment for which the Theme is accountable. They use the Theme icon introduced in the Enterprise section.

OVERVIEW

This section provides a broad picture of Theme activities. It answers the question, “What is the investment and what are its benefits?” It also synopsizes prior year program highlights. Since each Theme contributes to achievement of the Agency’s strategic goals and objectives, each Theme includes in its overview a table that excerpts the Plan and shows the long-term objectives that the Theme is responsible for achieving. For each objective, there are contributing lower-level performance measures through which the Theme must demonstrate annual progress toward the objective.

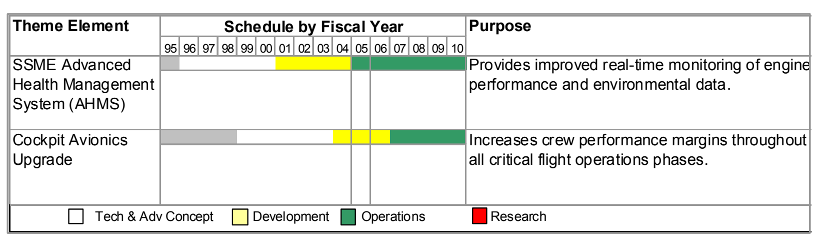
RELEVANCE

Relevance, quality, and performance are Research and Development (R&D) Investment Criteria established by the White House Office of Science and Technology Policy (OSTP) and the Office of Management and Budget (OMB). R&D investments must have clear plans; be relevant to national priorities, agency missions, and relevant fields; and justify their claim on taxpayer resources.

Each Theme includes a narrative demonstrating the Theme’s relevance to national priorities, the NASA Strategic Plan, and the scientific community. Relevance to education and public benefits are discussed separately. Every Theme contributes to educational outreach initiatives. Each Theme also must articulate its public benefits by answering the question, “How will NASA's exploration and investigations change the way we live in and view our world?” Relevance must be verifiable by the independent reviews listed at the Theme and lower levels.

IMPLEMENTATION

The implementation chart is a strategic roadmap showing how the Level Three programs and projects help achieve Theme goals and objectives. Programs and projects are color-coded according to whether they are Development, Operations, Research, or Technology and Advanced Concepts efforts. A vertical bar highlights the budget request year. The column on the right shows the purpose of each element and indicates how elements work together.



STATUS

This section reports noteworthy Theme accomplishments of the previous fiscal year. This discussion is general, not focused on specific performance measures. Also included is the score that the Theme earned on the Performance Assessment Rating Tool (PART), an OMB-developed mechanism to assess programs across the government according to common criteria. For an in-depth discussion of FY 2003 performance, see NASA’s *Fiscal Year 2003 Performance and Accountability Report.*

Reference: How to Read a Data Sheet

PERFORMANCE MEASURES

This section states the Theme's performance measures, which include both multiyear outcomes and annual performance goals (APGs). APGs contribute to achievement of outcomes, and both measures contribute to achieving objectives. Numbering for strategic objectives and outcomes is consistent with the numbering for goals and objectives in the Strategic Plan. For APGs, the first part of the number signifies the year of performance, the second part is the standard abbreviation of the Theme name, and the third part is the number of the measure within the Theme. For example, 4MEP9 is the ninth metric in the Mars Exploration Program Theme for the FY04 Performance Plan. Themes are also accountable for uniform metrics (consistent across all Themes) that, in the aggregate, help assess overall Agency performance on criteria such as cost control and competitive contract awards.

INDEPENDENT REVIEW

Relevance and quality are verified through independent reviews listed at the Theme and lower levels. A review is identified as retrospective, focused on ongoing efforts, or a prospective evaluation of planning and implementation. If there are no reviews at the Theme level, project level reviews are listed; for these reviews, refer to the appropriate page.

BUDGET

The budget tables present the proposed FY 2005 budget, including prior year numbers for FY 2003 and (likely enacted) for FY 2004. All of the Themes' Level 3 programs and projects are shown as Development, Operations, Research, or Technology and Advanced Concepts.

Budget Authority ($ millions)	FY03	FY04	Change	FY05	Comments
Space Shuttle	3,301.4	3,945.0	+374.2	4,319.2	
Development	96.8	96.3	-9.1	87.2	
Checkout and Launch Control System (CLCS)	13.1				

Level 3 (Program and Project) Data Sheets

Level 3 data sheets describe a program or project in one of four phases: Development, Operations, Research, and Technology and Advanced Concepts, and include the following sections.

PURPOSE

States what the program or project is to accomplish, links this purpose to the Strategic Plan's Objectives, and states a commitment to specific performance Outcomes and APGs from the Theme sheet (above).

OVERVIEW

The Overview explains the elements of the activity and summarizes the work being performed.

PROGRAM MANAGEMENT

NASA manages its programs and projects according to internal policies and procedures specified in NASA Procedures and Guidelines (NPG) 7120.5B. The budget document indicates whether each program is compliant with NPG 7120.5B and specifies its accountable management officials, primary points of contact, and responsible Centers.

Technical Commitment

This section states NASA's specifications and schedule commitments. The dated baseline appears directly under the section heading for easy reference.

For Development efforts, the baseline takes the form of a documented agreement, in most cases a NASA Program Commitment Agreement with precise, fixed requirements. The data sheet typically displays these at a top level. For spacecraft, schedule commitments include launch dates.

For Operations efforts, this section states the elements to be operated and key schedule milestones, particularly those scheduled for FY 2005. For Research efforts, this section describes the portfolio and notes planned periodic research announcements.

Technology and Advanced Concepts efforts may be listed individually or combined, depending on how they are to be managed and used. For Technology efforts, a table identifies the future mission applications to be supported. A Technology Readiness Level (TRL) roadmap shows progress of and plans for the technology's maturation and associated funding. Advanced Concepts sections list preliminary requirements. The table on this page shows definitions of increasing levels of technology readiness used in the TRL tables throughout this document.

Technical Specifications		FY 2005 President's Budget						
		FY03	FY04	FY05	FY06	FY07	FY08	FY09
Develop and demonstrate technologies that prevent unsafe flight situations due to breakdown between human and machine interface. (In formulation/Safety Follow-on)	**TRL**				3	3	4	5
	$M				35.80	35.50	42.80	39
Develop safety relevant technologies to detect and/or eliminate natural hazards that could compromise safe ATS operations. (In formulation/Safety Follow-on)	**TRL**				2	3	4	4
	$M				17.60	18.50	20.40	19.90

Technology Readiness Level	
↑ 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

Programs and projects use various procurement strategies; for example, research procurements differ from spacecraft development procurements both in how they are solicited and in the type of procurement vehicle used (e.g., grants versus cost-plus contracts). Research and data analysis efforts are predominantly grants selected through peer review and most of the work occurs at universities. Spacecraft development contracts are usually competitively awarded to private industry. Whatever the strategy, the discussion in this section for each program and project must include certain standard procurement data on the direct procurement funding, based on the most recent fiscal year for which data are available.

First, a general discussion presents highlights of and changes to the acquisition strategy and lists key performing organizations. Next, a current acquisitions table characterizes the budget according to type, selection method, and performing organization. Another table addresses future acquisitions, including major planned announcements. This table is general and not intended to be exhaustive; it provides a snapshot and a means to compare near-term strategies across Themes. The tables specify selection time frames and acquisition goals (e.g., full and open competition) to the extent that they are currently known. This can entail specifying the month, but in some cases only the year is available.

Risk Mitigation

This section shows key known risks. The general categories across the top of the table refer to data in other parts of the Level 3 data sheet and indicate the current or possible future impact of risk mitigation on each category. Color-coded stoplight indicators denote the level of attention a risk requires, the probability of its occurrence, the severity of an occurrence, and the state of the mitigation plan. The stoplight colors indicate

Top Risks	G Overall	G Cost	Y Schedule	G Technical	Probability	Impact	Mitigation Plan
Y	Flight issue may divert contractor resources from AHMS tasks				Low	Moderately High	
R	Initial DCU/DSP software delivery may not be suitable for hot-fire test				Moderately High	Moderately High	
Y	Software requirements volatility				Medium	Medium	

G	Green	Mitigation plan is working.
Y	Yellow	Mitigation plan is not working as intended, but no management attention is required.
R	Red	Mitigation plan is not working as intended, and management attention is required.

Agreements

This section lists significant internal or external agreements associated with the program or project. “Internal” means internal to NASA (i.e., cross-Theme or cross-Enterprise). “External” denotes agreements between NASA and outside organizations such as other U. S. Government agencies or foreign entities.

Independent Review

This section identifies the independent reviews that will verify program or project relevance and quality. These may also be listed at the Theme level and at Level 3. Information includes the topics covered, whether it is a relevance or a quality review, and the review’s timing: retrospective, concurrent with the effort under review, or prospective.

Budget and Life Cycle Cost

This section presents the FY 2005 budget request. For Development efforts, it includes the life cycle cost, comprised of all prior years and the budget-to-complete (BTC). For Operations, Research, and Technology and Advanced Concepts it includes funding for FY 2003 and FY 2004.

Acronyms

AA	Associate Administrator
AAH	Advanced Animal Habitat
AATT	Advanced Air Transportation Technologies
ACE	Advanced Composition Explorer
ACRIMSAT	Active Cavity Radiometer Irradiance Monitor Satellite
ACS	Advanced Camera for Surveys
AEDC	Arnold Engineering Development Center
AESP	NASA Aerospace Education Services Program
AFRL	Air Force Research Laboratory
AHMS	Advanced Health Management System
AHST	Advanced Human Support Technology
AIM	Aeronomy of Ice in the Mesosphere
AIRS	Atmospheric Infrared Sounder
AIST	Advanced Information Systems Technology
ALICE	FIX from Code s Small Development Projects
ALTV	Approach and Landing Test Vehicle
AMS	Alpha Magnetic Spectrometer
AMSR	Advanced Microwave Scanning Radiometer
AMSU	Advanced Microwave Sounding Unit
AO	Announcement of Opportunity
AOC	Airline Operations Center
AOS	Airspace Operations Systems
APL	Applied Physics Laboratory (John Hopkins)
APMC	Agency Program Management Council
APS	Advanced Polarimeter Sensor
APT	Advanced Platform Technology
ARC	Ames Research Center
ARIS	Active Rack Isolation System
AS	Airspace Systems
ASC	Aviation System Capacity
ASEB	Aeronautics and Space Engineering Board
ASF	Alaska SAR Facility
ASI	Agenzia Spaziale Italiana or Italian Space Agency
ASO	Astronomical Search for Origins
ASP	Airspace Systems Programs
ASVM	Aircraft & Systems Vulnerability Mitigation
AT	Aeronautics Technology
ATAC	Air Transport Association of Canada
ATC	Air Traffic Control
ATCSCC	Air Route Traffic Control Center
ATI	Advanced Technology Initiatives
ATLO	Assembly, Test, Launch Operations
ATM	Air Traffic Management
ATMS	Advanced Technology Microwave Sounder
ATP	Authority to Proceed
ATS	Air Transportation System
AU	Astronomical Unit
AVC	Advanced Vehicle Concepts
AvSSP	Aviation Safety and Security Program
BAT	Burst Alert Telescope
BATC	Ball Aerospace and Technology Corporation
BCP	Ball Commercial Platform
BNL	Brookhaven National Laboratory
BPRAC	Biological & Physical Science Research Committee
BPRE	Biological & Physical Research Enterprise
BPS	Biomass Production System
BR	Bioastronautics Research
BR&C	Biomedical Research and Countermeasures
BRP	Biological Research Projects
BSM	Booster Separation Motors (?)
BSR	Biological Sciences Research
BSTC	Biospecimen Temperature Controller
BTF	Biotechnology Facility
BTR	Biotechnology Refrigerator
BVT	Breakthrough Vehicle Technologies
BoR	Bureau of Reclamation
CA	Cooperative Agreements
CAASD	Center for Advanced Aviation System Development
CADRE	Crop Assessment Data Retrieval and Evaluation
CAIB	Columbia Accident Investigation Board
CALIPSO	Cloud – Aerosol Lidar and Infrared Pathfinder Satellite Observations
CAM	Centrifuge Accommodations Module
CAMEX	Convection And Moisture Experiment
CAN	Cooperative Agreement Notice
CAPPS	Checkout and Payload Processing Services
CARA	California Association for Research in Astronomy

Acronyms

CARD	Cost Analysis Requirements Document
CAS	Commercial Advisory Subcommittee
CAU	Cockpit Avionics Upgrade
CBTM	Commercial Biomedical Testing Module
CCAD	Center for Computer – Aided Design
CCD	Charge – Coupled Device
CCRI	Climate Change Research Initiative
CCSP	Climate Change Science Program
CCTP	Climate Change Technology Program
CCU	Cell Culture Unit
CDC	Center for Disease Control
CDR	Critical Design Review
CENR	Committee on Environment and Natural Resources Research
CEOS	Committee on Earth Observation Satellites
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CEV	Crew Exploration Vehicle
CFC	Chlorofluorocarbon
CFO	Chief Financial Officer
CFR	Code of Federal Regulations
CGBA	Commercial Generic Bioprocessing Apparatus
CHIPS	Cosmic Hot Interstellar Plasma Spectrometer
CICT	Computing, Information, and Communications Technology
CINDI	Coupled Ion Neutral Dynamics Investigation
CIPA	Curriculum Improvement Partnership Awards
CIR	Combustion Integrated Rack
CLCS	Checkout and Launch Control System
CMAQ	Community Multi – scale and Air Quality
CMC	Ceramic Matrix Composite
CME	Coronal Mass Ejection
CNES	Centre Nationale D'Etudes Spatiale or French Space Agency
CNIS	Communication, Network, and Information Security
CNS	Communication, Navigation & Surveillance
CO	Colorado
CO 2	Carbon Dioxide
COS	Cosmic Origins Spectrograph
COTF	Classroom of the Future
CPCG – H	Commercial Protein Crystal Growth – High Density
CPCG - V	Commercial Protein Crystal Growth - Video
CPR	Cloud Profiling Radar
CR	Centrifuge
CRV	Crew Return Vehicle
CSA	Canadian Space Agency
CSOC	Consolidated Space Operations Contract
CTV	Crew Transfer Vehicle
CXO	Chandra X - Ray Observatory
CY	Calendar Year
CalTech	California Institute of Technology
CoF	Construction of Facilities
CoTF	Classroom of the Future
CrIS	Cross - Track Infrared Sounder
DA	Data Analysis
DAA	Deputy Associate Administrator
DARA	See DLR
DARPA	Defense Advanced Research Projects Agency
DART	Demonstration of Autonomous Rendezvous Technology
DCU	Digital Control Unit
DDR&E	Director, Defense Research and Engineering
DDT&E	Design Development Test and Evaluation
DES	Dewar and Enclosure Subsystem
DEVELOP	Digital Earth Virtual Environment and Learning Outreach Program
DFRC	Dryden Flight Research Facility
DHS	Department of Homeland Security
DLR	German Aerospace Center
DNA	Deoxyribose Nucleic Acid
DOD	Department of Defense
DOE	Department of Energy
DOT	Department of Transportation
DRUMS	Dynamically Responding Ultrasonic Matrix System
DSMS	Deep Space Mission System
DSN	Deep Space Network
DSP	Digital Signal Processing
DSS	Decision Support Systems
DST	Decision Support Tool
DYNAMX	Critical Dynamics in Microgravity
DoD	Department of Defense
DoE	Department of Energy

Acronyms

DoT	Department of Transportation
E&PO	Education and Public Outreach
EA 92	Energy Act of 1992
EAS	Efficient Aircraft Spacing
EASI	Efficient Aerodynamic Shapes & Integration
ECHO	EOSDIS Clearinghouse
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
EDG	EOSDIS Data Gateway
EDL	Entry, Descent, and Landing
EFMP	Efficient Flight Path Management
EFPM	Efficient Flight Path Management
EHTN	Environmental Health Tracking Network
EIS	Executive Information System
ELV	Expendable Launch Vehicle
ELVIS	Expendable Launch Vehicle Integrated Support
EM	Experiment Module
EMD	Engineering, Manufacturing and Development
EMPC	Enterprise Program Management Council
ENR	Energetics
EOS	Earth Observing System
EOSDIS	Earth Observing System Data and Information System
EPA	Environmental Protection Agency
EPMC	Enterprise Program Management Council
EPO	Education and Public Outreach
EPPS	Energetic Particle and Plasma Spectrometer
EPSCoR	Experimental Program to Stimulate Competitive Research
ERAST	Environmental Research Aircraft and Sensor Technology
ERBS	Earth Radiation Budget Satellite
ESA	Earth Science Applications
ESDIS	Earth Science Data and Information System
ESE	Earth Science Enterprise
ESMF	Earth Science Model Framework
ESMO	Earth Science Mission Operations
ESS	Earth System Science
ESSAAC	Earth System Science Applications Advisory Committee
ESTO	Earth Science Technology Office
ESTP	Earth Science Technology Program
ET	External Tank
ETA	External Tank Assembly
EUMETSAT	European Organization for the Exploitation of Meteorological
EUSO	Extreme Universe Space Observatory
EUV	Extreme Ultraviolet
EVA	Extravehicular Activity
EVE	Extreme Ultraviolet Variability Experiment
EXPRESS	Expedite the Processing of Experiments to the Space Station (Pallet)
FAA	Federal Aviation Administration
FACI	First Article Configuration Inspection
FAD	Formulation Authorization Document
FAR	Faculty Awards for Research
FAST	Fast Auroral SnapshoT
FAT	Final Assembly and Test
FCF	Fluids and Combustion Facility
FEMA	Federal Emergency Management Agency
FFP	Firm Fixed Price
FHA	Flight Hardware Available
FIR	Fluids Integrated Rack
FL	Florida
FL 180	Flight Level
FL 400	Flight Level
FPOSE	Focused Physical Oceanography and Solid Earth
FPP	Freon Pump Package
FR	Flight Rule
FRAM	Flight Releasable Attachment Mechanism
FRCS	Forward Reaction Control System
FRGF	Flight Releasable Grapple Fixture
FSB	Fundamental Space Biology
FSW	Flight Software
FUSE	Far Ultraviolet Spectroscopic Explorer
FUV	Far Ultraviolet
FY	Fiscal Year
GA	General Aviation
GALEX	Galaxy Evolution Explorer
GASMAP	Gas Analyzer System for Metabolic Analysis Physiology

Acronyms

GBM	GLAST Burst Monitor
GE	General Electric
GEC	Global Electrodynamics Connection
GEMS	Great Explorations in Math and Science
GEO	Geosynchronous Earth Orbit
GFDL	Geophysical Fluid Dynamics Laboratory
GFE	Government Furnished Equipment
GHz	Gigahertz
GIFTS	Geosynchronous Imaging Fourier Transform Spectrometer
GIFTS – IOMI	Geosynchronous Imaging Fourier Transform
GIS	Geographic Information System
GISS	Goddard Institute for Space Science
GLAS	Geoscience Laser Altimeter System
GLAST	Gamma – ray Large Area Space Telescope
GLOBE	Global Learning & Observations to Benefit the Environment
GM – ITM	Geospace Mission – Ionosphere – Thermosphere Mapper
GOJ	Government of Japan
GP – B	Gravity Probe – B
GPM	Global Precipitation Measurement
GPMC	Governing Program Management Council
GPS	Global Positioning System
GRACE	Gravity Recovery and Climate
GRB	Gamma Ray Burst
GRC	Glenn Research Center
GRNS	Gamma – Ray and Neutron Spectrometer
GRS	Gamma Ray Spectrometer
GSA	General Services Administration
GSFC	Goddard Space Flight Center
GSRP	Graduate Student Research Program
GST	Global Sciences and Technology, Inc.
GWAC	Government – Wide Agency Contracts
GeV	Giga – Electron – Volt
HALE	High – Altitude, Long – Endurance
HAZUS	Hazards U. S.
HBCU	Historically Black Colleges and Universities
HDMAX	High Definition TV Camera
HETE – 2	High Energy Transient Explorer
HHR	Habitat Holding Rack
HIRDLS	High Resolution Dynamic Limb Sounder
HMF	Hypergolic Maintenance Facility
HMI	Helioseismic and Magnetic Imager
HMP	Human Measures and Performance
HQ	Headquarters
HRF	Human Research Facility
HRI	High Resolution Imager
HRT	High Resolution Tracker
HSB	Humidity Sounder Brazil
HSI	Hispanic Serving Institutions
HST	Hubble Space Telescope
HVPS	High Voltage Power Supply
HW	Hardware
HyGEIA	Hyperspectral Sensor for Global Environmental Imaging and Analysis
IAA	International Academy of Astronautics
IATCS	Internal Active Thermal Control System
IC	Institutional Committee
ICAO	International Civil Aviation Organization
ICE	Independent Cost Estimate
ICESat	Ice, Cloud and Elevation Satellite
IDEA	ISS Downlink Enhancement Architecture
IES	Ion Electron Spectrometer
IGA	Intergovernmental Agreement
IIR	Independent Implementation Review
IIRT	Independent Implementation Review Team
IMAGE	Imager for Magnetopause – to – Aurora Global Exploration
IMPACT	In situ Measurements of Particles and CME Transients
INTEGRAL	International Gamma Ray Astrophysics Laboratory
INTEX	Intercontinental Chemical Transport Experiment
IPAO	Independent Program Assessment Office
IPD	Integrated Powerhead Demonstrator
IPO	Integrated Program Office
IPS	Integrated Planning System
IPS	Intelligent Propulsion Systems
IR	Infrared
IRA	Institutional Research Awards
IRC	Initial Confirmation Review
IRT	Independent Review Team
IS	Implementing Strategies
ISAS	Institute of Space and Astronautical Science
ISIS	International Subrack Interface Standard

Acronyms

ISP	In – Space Propulsion
ISPR	International Standard Payload Rack
ISS	International Space Station
ISSRC	International Space Station Research Capabilities
ISTP	Integrated Space Transportation Plan
IT	Information Technology
ITAS	Integrated Tailored Aerostructures
ITF	Integrated Training Facility
ITM	Ionspheric/Thermospheric/Mesospheric
ITS	Impactor Target Sensor
ITSR	Information Technology Strategic Research
ITTP	Innovative Technology Transfer Partnerships
IV&V	Independent Verification and Validation
IVHM	Intelligent Vehicle Health Management
JACIE	Joint Agency Committee for Imagery Evaluation
JAXA	Japanese Aerospace Exploration Agency
JEM	Japanese Experiment Module
JHU	John Hopkins University
JIMO	Jupiter Icy Moons Orbiter
JPL	Jet Propulsion Laboratory
JSC	Johnson Space Center
JSRA	Joint Sponsored Research Agreement
JSRDA	Joint Sponsored Research and Development Agreement
JWST	James Webb Space Telescope
KSC	Kennedy Space Center
LASP	Laboratory for Atmospheric and Space Physics
LAT	Large Area Telescope
LBTI	Large Binocular Telescope Interferometer
LCC	Launch Control Center
LDCM	Landsat Data Continuity Mission
LE	Lunar Exploration
LEAP	Low Emissions Alternative Power
LEO	Low Earth Orbiting
LGF	Large Gradient Furnace
LH 2	Liquid Hydrogen
LISA	Laser Interferometer Space Antenna
LMA	Lockheed Martin Astronautics
LMM	Light Microscopy Module
LOA	Letter of Agreement
LOX	Liquid Oxygen
LPL	Lunar and Planetary Laboratory, University of Arizona
LRA	Laser Retroreflector Array
LRD	Launch Readiness Date
LSAS	Life Sciences Advisory Subcommittee
LSG	Life Sciences Glovebox
LSTO	Launch Services Task Order
LT	Long Term
LTMPF	Low Temperature Microgravity Physics Facility
LWS	Living With a Star
LaRC	Langley Research Center
MAG	Magnetometer
MAP	Missions Assurance Program
MAPGEN	Mixed Initiative Activity Planning Generator
MARES	Muscle Atrophy and Resistive Exercise System
MARSIS	Mars Advanced Radar for Subsurface and Ionospheric Sounding
MASCS	Mercury Atmospheric and Surface Composition Spectrometer
MC	Master Controller
MCC	Mission Control Center
MCC – H	Mission Control Center – Houston
MCC – M	Mission Control Center – Moscow
MCR	Mission Confirmation Review
MDAP	Mars Data Analysis Program
MDCA	Multi – user Droplet Combustion Apparatus
MDIS	Mercury Dual Imaging System
MDS	Modular and Distributed Systems
MELFI	Minus Eighty (Degrees Celsius) Laboratory Freezer for ISS
MEP	Mars Exploration Program
MEPAG	Mars Exploration Program Analysis Group
MER	Mars Exploration Rover
MER – CIP	Mars Exploration Rover Collaborative Information Portal
MERBoard	Mars Exploration Rovers Board
MERLIN	Microgravity Experiment Research Locker/Incubator
MESSENGER	Mercury Surface, Space Environment, Geochemistry and Ranging
MFR	Mars Fundamental Research

Acronyms

MGS	Mars Global Surveyor
MIB	Mishap Investigation Board
MIDEX	Medium - Size Explorer
MIDP	Mars Instrument Development Program
MIRO	Microwave Instrument for Rosetta Orbiter
MIT	Massachusetts Institute of Technology
MLA	Mercury Laser Altimeter
MLS	Microwave Limb Sounder
MMO	Multi - Mission Operations
MMR	Modular Multispectral Radiometer
MMRTG	Multi - Missions Radioisotope Thermoelectric Generators
MMS	Magnetospheric Multiscale
MO	Missions of Opportunity
MO&DA	Mission Operations & Data Analysis
MOA	Memorandum of Agreement
MODIS	Moderate - resolution Imaging Spectroradiometer
MOMS	Mission Operations and Mission Services
MOU	Memorandum of Understanding
MPLM	Multi - Purpose Logistic Modules
MRA	Mars Research and Analysis
MRI	Medium Resolution Imager
MRO	Mars Reconnaissance Orbiter
MSFC	Marshall Space Flight Center
MSL	Mars Science Laboratory
MSL - EM	Materials Science Laboratory Experiment Module
MSM	Mission and Science Measurement
MSMT	Mission and Science Measurement Technology
MSRF	Materials Science Research Facility
MSRR	Materials Science Research Rack
MTO	Mars Telesat Orbiter
MUREP	Minority University Research and Education Program
MUSES - C	Mu Space Engineering Spacecraft-C
MUSS	Multi - User Systems and Support
McTMA	Multi - Center Traffic Management Advisor
MeV	Million Electron Volts
MoA	Memorandum of Agreement
MoU	Memorandum of Understanding
NAC	NASA Advisory Committee
NACA	National Advisory Committee for Aeronautics
NAI	National Aerospace Initiative
NAPA	National Academy of Public Administration
NAR	Non – Advocacy Review
NAS	National Airspace System
NASA	National Aeronautics and Space Administration
NASBO	NASA Alliance for Small Business Opportunity
NASDA	National Space Development Agency of Japan
NAVAIR	Naval Air Systems Command
NBL	Neutral Buoyancy Lab
NCEP	National Centers for Environmental Prediction
NENS	Near Earth Networks Services
NEXT	NASA Exploration Team
NExTNAS	NASA Exploratory Technologies for the National Airspace System
NFFP	NASA Faculty Fellowship Program
NGLT	Next Generation Launch Technology
NGST	Next Generation Space Telescope
NIAC	NASA Institute of Advanced Concepts
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
NMP	New Millennium Program
NOAA	National Oceanic and Atmospheric Administration
Nox	Nitrogen Oxide
NPOES	National Polar – orbiting Operational Environmental Satellite
NPOESS	National Polar – orbiting Operational Environmental Satellite System
NPP	NPOESS Preparatory Project
NPR	NASA Procedural Requirement
NRA	NASA Research Announcement
NRC	Nuclear Regulatory Commission
NSBRI	National Space Biomedical Research Institute
NSCORS	NASA Specialized Centers of Research
NSF	National Science Foundation
NSI	Nuclear Systems Initiative (Program)
NSRL	NASA Space Radiation Laboratory

Acronyms

NSTAR	NASA Solar Electric Propulsion Technology Application Readiness
NTTC	National Technology Transfer Center
Nd YAG	Neodymium (3+) – Doped Yttrium Aluminum Garnet Laser
OAT	Office of Aerospace Technology
OBPR	Office of Biological and Physical Research
OBSS	Orbiter Boom Sensor System
OCO	Orbiting Carbon Observatory
OGA	Oxygen Generation Assembly
OH	Ohio
OIG	Office of Inspector General
OMB	Office of Management and Budget
OMI	Ozone Measuring Instrument
OMM	Orbiter Major Modifications
OMPS	Ozone Mapping and Profiler Suite
OMU	Other Minority Universities
ONR	Office of Naval Research
OPF	Orbiter Processing Facility
ORR	Operations Readiness Review
ORU	Orbital Replacement Unit
OSF	Office of Space Flight
OSP	Orbital Space Plane
OSS	Office of Space Science
OSTM	Ocean Surface Topography Mission
PACE	Precollege Awards for Excellence
PAD	Pad Abort Demonstrator
PAM	Prospecting Autonomous Nano – Technology Swarm Missions
PAO	Public Affairs Office
PARCS	Primary Atomic Reference Clock in Space
PART	Program Assessment Rating Tool
PB	Plum Brook
PBRF	Plum Brook Reactor Facility
PBS	President's Budget Submit
PCA	Program Commitment Agreement
PCBM	Passive Common Berthing Mechanism
PCS	Physics of Colloids in Space
PDR	Preliminary Design Review
PDS	Passive Dosimeter System
PER	Pre – Environmental Review
PGBA	Plant Generic Bioprocessing Apparatus
PI	Principal Investigator
PIMC	Program Institutional Management Council
PIU	Payload Interface Unit
PLASTIC	PLAsma and SupraThermal Ion and Composition
PMC	Program Management Council
PMSR	Preliminary Mission System Review
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 Integration Function
PPARC	Particle Physics CNES
PPM	Parts Per Million
PRU	Plant Research Unit
PSO	Primary Science Orbit
PSR	Physical Sciences Research
PSU	Pennsylvania State University
PU	Plutonium
PW	Pratt & Whitney
PaRIS	Passive Rack Isolation System
QAT	Quiet Aircraft Technology
QMI	Quench Module Insert
RASC	Revolutionary Aero Space Concepts
RBM	Radiation Belt Mapper Mission
RCC	Reinforced Carbon Carbon
RCRA	Resource Conservation and Recovery Act
REASoN	Research, Education and Applications Solutions Network
ReMAP	Research Maximization and Prioritization Task Force
RETScreen	Renewable Energy Technology (Renewable Energy Project Analysis Software)
RF	Radio Frequency
RHESSI	Reuven Ramaty High Energy Solar Spectroscopic Imager
RHU	Radioactive Heater Units
RI	Research Institution
RIPS	Runway Incursion Prevention System
RLV	Reusable Launch Vehicle
RMS	Remote Manipulator System
ROA	Remotely Operated Aircraft
ROSINA	Rosetta Orbiter Spectrometer for Ion and Neutral Analysis
ROSS	Research Opportunities In Space Science

Acronyms

RP	Rocket Propellant
RPC	Research Partnership Center
RPFS	Research Partnerships and Flight Support
RPT	Rocket Propulsion Test
RSA	Russian Space Agency
RSB	Rudder Speed Brake
RSRM	Reusable Solid Rocket Motor
RSS	Rack Support Systems
RTF	Return To Flight
RXTE	Rossi X – Ray Timing Explorer
ReMAP	Research Maximization and Prioritization Task Force
S&MA	Safety and Mission Assurance
SAA	Space Act Agreement
SAGAT	Situation Awareness Global Assessment Technique
SAGE	Stratospheric Aerosol and Gas Experiment
SAIC	Science Applications International Corporation
SAMPEX	Solar Anomalous and Magnetospheric Particle Explorer
SAMS	Space Acceleration Measurement System
SAO	Smithsonian Astrophysical Observatory
SAR	Synthetic Aperture Radar
SATS	Small Aircraft Transportation System
SATSLab	Small Aircraft Transportation System Laboratory
SAU	Strategic Airspace Usage
SB	Small Business
SBIR	Small Business Innovative Research
SBT	Space – Based Technology
SC	Spacecraft
SCU	Santa Clara University
SDMAC	Space Department Management Committee
SDO	Solar Dynamics Observatory
SDR	System Design Review
SE&I	Systems Engineering and Integration
SEC	Sun – Earth Connection
SECAS	Sun – Earth Connection Advisory Subcommittee
SECCHI	Sun - Earth Connection Coronal and Heliospheric Investigation
SEEDS	Strategic Evolution of ESE Data Systems
SEMAA	Science, Engineering, Mathematics and Aerospace Academy
SEU	Structure and Evolution of the Universe
SFE	Space Flight Enterprise
SFLC	Space Flight Leadership Council
SFOC	Space Flight Operations Contract
SFS	Space and Flight Support
SHARAD	Shallow Radar
SHARP	Slender Hypervelocity Aerothermodynamic Research Probes
SHARPP	Solar Heliospheric Activity Research and Prediction Program
SIM	Space Interferometry Mission
SIPS	Science Investigator - Led Processing System
SIRTF	Space Infrared Telescope Facility
SLEP	Shuttle Service Life Extension Program
SLI	Space Launch Initiative
SLTL	Space Transfer & Launch Technology
SLWT	Super Lightweight Tank
SM 4	Servicing Mission 4
SMCDS	Space Mission Communications and Data Services
SMEX	Small Explorer
SMO	Systems Management Organization
SMPMC	Systematic Measurements Program Management Council
SMS	Science Measurement Systems
SOA	State of the Art
SOFIA	Stratospheric Observatory for Infrared Astronomy
SOHO	Solar Heliospheric Observer
SORCE	Solar Radiation and Climate Experiment
SPD	Space Product Development
SPD – EM	Space Product Development - Experiment Module
SPF	Software Production Facility
SPIDR	Spectroscopy and Photometry of the Intergalactic Medium's Diffuse Radiation
SPP	Science Power Platform
SPRL	Space Physics Research Laboratory
SQF	Solidification Quench Furnace
SRB	Solid Rocket Booster
SSAC	Space Science Advisory Committee
SSB	Space Studies Board
SSBRP	Space Station Biological Research Project
SSC	Stennis Space Center

Acronyms

SSE	Solar System Exploration
SSES	Solar System Exploration Subcommittee
SSME	Space Shuttle Main Engines
SSMO	Space Sciences Mission Operations
SSP	Space Shuttle Program
SSPCM	Solid State Power Control Module
SSRMS	Space Station Remote Manipulator System
SSTF	Space Station Training Facility
STEM	Science, Technology, Engineering and Mathematics
STEREO	Solar Terrestrial Relations Observatory
STLT	Space Transfer & Launch Technology
STP	Solar Terrestrial Probes
STS	Space Transportation System
STScI	Space Telescope Science Institute
STTR	Small Business Technology Transfer Program
SUMO	Superconducting Microwave Oscillator Experiment
SVA	Strategic Vehicle Architecture
SVD	System Vulnerability Detection
SVS	Synthetic Vision System
SW	Software
SWAVES	STEREO/WAVES
SWEPT	System – Wide Evaluation and Planning Tool
SpaceDRUMS	Space – Dynamically Responding Ultrasonic Matrix System
SpoRT	Short – term Prediction Research and Transition
SwRI	Southwest Research Institute
TBCC	Turbine Based Combined Cycle
TBD	To Be Determined
TBD	To Be Determined
TCAT	21st Century Aircraft Technology Project
TCU	Tribal Colleges and Universities
TDRS	Tracking and Data Relay Satellite
TDRSS	Tracking and Data Relay Satellite System
TEB	Technology Executive Board
TES	Troposphere Emission Spectrometer
TFM	Traffic Flow Management
THEMIS	Thermal Emission Imaging System
TIMED	Thermosphere, Ionosphere, Mesosphere, Energetics and Dynamics
TMCO	Technical, Management, Cost and Other Program Factors
TOMS	Total Ozone Mapping Spectrometer
TOPEX	Ocean Topographic Experiment
TPF	Terrestrial Planet Finder
TPS	Thermal Protection System
TRACE	Transition Region and Coronal Explorer
TRL	Technology Readiness Level
TRMM	Tropical Rainfall Measuring Mission
TRW	Northrop Grumman Space Technology
TS	Transportation Systems
TSA	Transportation Security Administration
TSC	Telecommunications Support Center
TSI	Total Solar Irradiance
TTA	Technical Task Agreements
TTP	Technology Transfer Partnerships
TWINS	Two Wide – angle Imaging Neutral – atom Spectrometers
UARS	Upper Atmosphere Research Satellite
UAV	Unmanned Aerial Vehicle
UCAR	University Corporation for Atmospheric Research
UCLA	University of California, Los Angeles
UEET	Ultra – Efficient Engine Technology
UHF	Ultra High Frequency
UK	United Kingdom
ULF	Utilization and Logistics Flight
UNESCO	United Nations Educational, Scientific and Cultural Organization
URC	University Research Center
URETI	University Research Engineering, and Technology Institute
US	United States
USA	United States of America
USACE	United States Army Corps of Engineers
USAF	United States Air Force
USAID	United States Agency for International Development
USBoR	United States Bureau of Reclamation
USDA	United States Department of Agriculture
USFS	United States Forest Service
USGS	United States Geological Survey
USN	United States Navy
USRA	Universities Space Research Association

Acronyms

USRP	Undergraduate Student Research Program
UV	Ultraviolet
UVOT	UltraViolet/Optical Telescope
VAB	Vehicle Assembly Building
VAMS	Virtual Airspace Modeling and Simulation
VAST	Virtual Airspace Simulation Technology
VIIRS	Visible – Infrared Imager Radiometer Suite
VIPeR	Vehicle Integrated Performance Team
VPCAR	Vapor Phase Catalytic Ammonia Removal
VS	Vehicle Systems
VSP	Vehicle Systems Program
VST	Virtual Silicon Technology Inc .
TOL	Vertical Take Off and Landing
WFC 3	Wide Field Camera 3
WGA	Western Governors Association
WISE	Widefield Infrared Survey Explorer
WMAP	Wilkinson Microwave Anisotropy Probe
WORF	Window Observational Facility
WPA	Water Processor Assembly
WRS	Water Recycling System
WSOA	Wide Swatch Ocean Altimeter
WSTF	White Sands Test Facility
WakeVAS	Wake Vortex Advisory System
XMM	X - Ray Multi - Mirror Mission
XRS	X - Ray Spectrometer
XRT	X - Ray Telescope
XUV	Soft X - Ray
kW	Kilowatt
keV	Kilo - Electron Volt

FULL COST BUDGETING

In the FY 2004 budget request, NASA introduced a new full cost budgeting approach. "Full cost" means that each program and project budget estimate includes all of the program or project's direct and indirect costs, including all civil service salaries and other infrastructure costs. Full cost budgeting directly links each program and project with the infrastructure it uses. Before full cost, only the project unique procurement costs for a given program or project were included in that program's or project's budget.

On October 1, 2003, NASA implemented its full cost initiative, of which full cost budgeting was the first step. NASA is now for the first time operating in a total full cost environment: managing programs and projects in terms of their total costs; accounting for all costs as either direct or as General and Administrative (G&A); and budgeting for a program or project's full costs.

Implementing full cost has been crucial to NASA's success to integrate budget and performance as called for in the President's Management Agenda (PMA). NASA is the first agency to receive the coveted "green" rating. An account of this achievement and NASA's overall PMA progress is provided in the "PMA Update" section of this document.

HOW FULL COST WORKS – THE BASICS

In full cost, each program and project budget includes three types of costs: Direct Costs, Center G&A Costs, and Corporate G&A Costs. The full cost of a program/project is the sum of these costs. Exhibit 1 depicts in detail the cost components for each NASA full cost program/project.

Direct Costs

(1) Direct costs are related to a project at the time the costs are incurred. They include purchased goods and services, contracted support, and direct civil service salaries/benefits/travel; and

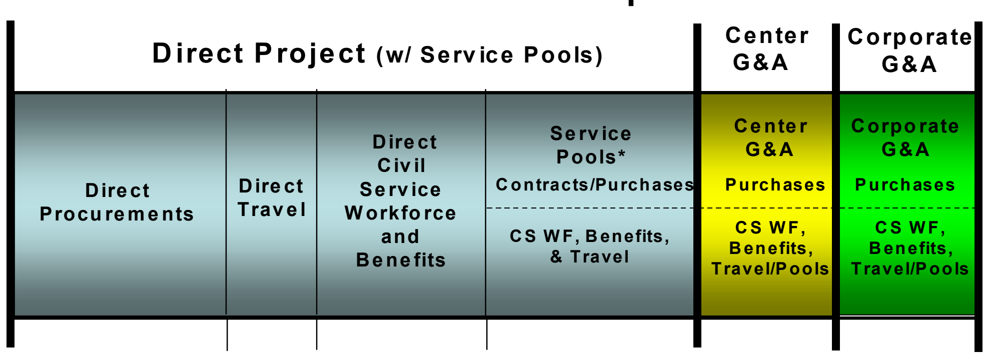
(2) Service pool costs are infrastructure capabilities supporting multiple programs and projects at NASA Centers. They are services whose costs can be linked to specific programs and projects based on usage. There are six standard service pools established for use by NASA Centers: Facilities and Related Services; Information Technology; Science and Engineering; Fabrication; Test Services; and Wind Tunnel Services. During budget formulation, the Center's total demand for a service (based on projected usage by programs) and the pool's funding requirements are identified through negotiations with program and project managers and service providers. The total full cost budget request for each program and project includes its projected service pool bill.

Center G&A Costs

These are Center costs that cannot be accurately allocated to specific programs and projects based on usage. These costs are instead allocated to each Center program and project based on how many civil servants and on-site contractors work on the given program or project.

Each Center develops the total budget request for the center's G&A costs based on Agency guidance and with NASA Agency-level approval. Center G&A costs include the salaries and benefits of Center civil servants in G&A functions, their travel, Center training and awards, security, grounds maintenance, pavement and roads, fire protection, libraries, business computing, public affairs, non-program construction of facilities (CoF), transportation services, legal, human resources services, procurement support, budgeting, accounting, equal opportunity, educational outreach, medical services, and logistics services.

Exhibit 1: Full Cost Components

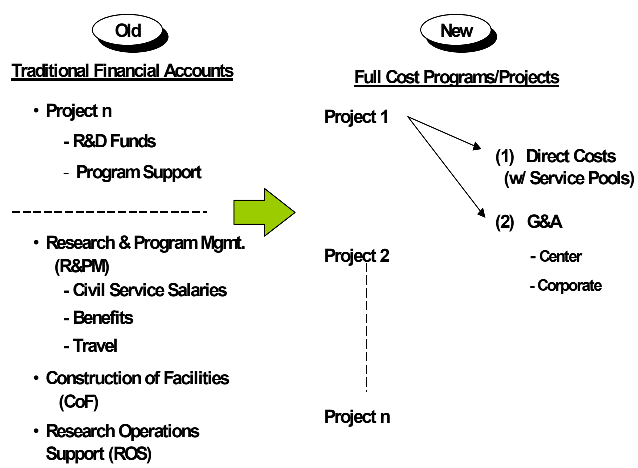


* - Costs of services provided to projects based on on use/ consumption

Corporate G&A Costs

These include two types of costs: NASA Headquarters operating costs and Agency-wide G&A costs (including costs of Corporate G&A functions performed at NASA Centers on behalf of the Agency). Examples of activities covered are the NASA Administrator's office, Enterprise management, Headquarters operations, and the functional offices that govern Agency-wide matters, such as public affairs and procurement and human resources policy and practice. Corporate G&A costs are allocated to all NASA programs and projects based on their share of NASA's total direct cost (including service pool costs).

Exhibit 2: Traditional vs. Full Cost Budgets



TRADITIONAL VS. FULL COST BUDGETING

Exhibit 2 compares NASA's traditional budget structure (used for FY 2003 and prior) with the full cost structure (started in FY 2004). Before full cost, Agency program and project budget estimates included only the Direct Research and Development (R&D) Costs. Direct R&D Costs consisted primarily of contract costs plus certain supporting costs labeled Program Support. They did not include civil service workforce costs or travel dollars; these were instead budgeted under Research and Program Management (R&PM). Other institutional infrastructure costs, such as Research Operations Support (ROS) (business management functions and basic center operations), were similarly separate from program and project costs.

Full cost, by contrast, allocates the entire Agency budget among programs and projects. Program and project managers now have visibility over and manage all program and project resources. Their budgets reflect the full cost of a given program or project effort.

BENEFITS OF FULL COST

Full cost budgets allow more informed decisions on the most optimal use of all resources (dollars, workforce, and facilities). Full cost facilitates full disclosure of Agency costs, enables linkage of resources to results, and supports accountability to taxpayers. Full cost practices promote efficient, optimal use of institutional resources. Specifically, full cost:

- Allows justification of the entire budget on a program and project basis;
- Allocates the civil service workforce by program/project need;
- Bases institutional resources on program and project requirements;
- Eliminates "free" infrastructure resources for program managers, and gives managers more insight and role in defining institutional capabilities;.
- Links services with customers, basing service pool funding on user demand, not a parametric formula;
- Sharpens management focus (at NASA Headquarters Enterprise, Center, and program levels) on G&A infrastructure and sources of support capabilities, revealing underutilized institutional resources and cost-effective alternatives;
- Encourages competitively selecting support capabilities, benchmarking NASA services against non-NASA services, and reducing unneeded government infrastructure;
- Strengthens ties among mission components, among programs and projects, and among parts of the budget request; and
- Motivates and helps program and project managers be more efficient in managing their programs and optimizing the use of their budgeted resources (both dollars and workforce).

PERFORMANCE EVALUATION OF SELECT PROGRAMS

In 2003, OMB reviewed seven NASA Themes for performance effectiveness using the Performance Assessment Rating Tool (PART). The results are summarized in the following table. For details on performance assessments of the Themes listed here, see www.whitehouse.gov/OMB/ budget. PART recommendations are also discussed in individual Theme summary pages in this document.

The PART is an evaluation tool developed by the White House Office of Management and Budget (OMB) to assess the effectiveness of Federal programs. It will be phased in across all Federal Agencies. In its first year of use, 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. As a result, three NASA Themes were reviewed in 2002. For 2003, the percent to be reviewed increased to 40%, so seven NASA Themes were reviewed.

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. Programs previously assessed using the PART will be reassessed and their scores raised or lowered depending on changes in performance

Program (Theme)	**Rating**	**Explanation**	**Recommendation**
Mars Exploration	Effective	The program is well-defined and well-managed and is making excellent progress towards achieving its science goals.	Augment the program to accelerate the search for life on Mars and prepare for future human exploration.
Solar System Exploration	Effective	Well-defined and well-managed, the program has a clear purpose and ties directly to NASA's mission.	Continue to support a diverse mission portfolio, including missions to search for habitable environments and life.
Mission and Science Measurement Technology	Moderately Effective	Responsiveness to external review and effective management has resulted in an improved program.	Leverage the program as a foundation for a new exploration technology program.
Biological Sciences Research	Results Not Demonstrated	The selection and prioritization of scientific research has improved; however, additional work is needed to develop suitable performance goals and demonstrate results.	Refocus the program to support the new exploration vision.
Earth Science Applications	Results Not Demonstrated	The program has taken the right steps to establish a viable strategy but will require additional time to demonstrate results.	Continue to focus on implementation and fully develop products and partnerships.
Space Shuttle	Results Not Demonstrated	The program lacks good performance measures. The hiatus that has followed the *Columbia* tragedy has prevented the program from achieving results.	Increase return-to-flight funding to improve results in future years. Plan to retire the Shuttle by the end of the decade, once its role in Station assembly is complete.
Space Station	Results Not Demonstrated	The program lacks good long-term performance measures and has been unable to achieve goals due to Shuttle unavailability.	Reduce dependence on problematic crew and cargo transfer systems. Redirect the program to bring it into alignment with the new exploration vision.

UPDATE ON THE PRESIDENT'S MANAGEMENT AGENDA (PMA)

NASA has made significant progress in 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 indicates success. 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. Since last year, NASA has improved in 4 out of our 5 initiatives, getting to green in both Human Capital and Budget and Performance Integration, and yellow in both Competitive Sourcing and E-Government.

Last year, NASA implemented our first human capital plan, established an accountability system to track the associated results, and demonstrated our ability to make distinctions in employee performance using a comprehensive awards system. NASA used performance information and full-cost considerations to develop our budget requests and to inform our management decisions. NASA has a competitive sourcing plan and has announced two standard competitions involving more than 230 positions. NASA has an information technology architecture in place to guide our investments and strengthen our IT security. All NASA IT systems are now operating within 10% of planned budget and schedule. NASA has taken significant steps toward resolving inconsistencies in financial reporting and issues relating to valuation of contractor-held property by implementing the Core Financial Module of the Integrated Financial Management Program. Data reconciliation issues due to the conversion from the old to the new systems, however, have presented us with challenges in preparing our 2003 financial statements

	Human Capital	**Competitive Sourcing**	**Financial Performance**	**E-Government**	**Budget and Performance Integration**
Status					
Progress					

FY 2004 Performance Plan Update

Introduction

This is a revision of NASA's Fiscal Year 2004 (FY 2004) Performance Plan, originally published as part of the NASA Integrated Budget and Performance Document, titled *FY 2004 Budget Estimates* and subsequently updated on September 30, 2004. NASA has made several strategic changes in the FY 2005 President's Budget submittal. Some of these changes will be implemented immediately, and thus impact the FY 2004 Performance Plan.

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.

Objective 1.1 Understand how the Earth is changing, better predict change and understand the consequences for life on Earth.

Outcome 1.1.1 *Enable prediction of polar and global stratospheric ozone recovery (amount and timing) to within 25% by 2014.*

Outcome 1.1.2 *Predict the global distribution of tropospheric ozone and the background concentration in continental near-surface air to within 25% by 2014.*

Outcome 1.1.3 *Enable extension of air quality forecasts for ozone and aerosols from 24 to 72 hours by 2010.*

APG 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. Progress toward achieving outcomes will be validated by external review. (Outcome 1.1.1, 1.1.2, 1.1.3)

Outcome 1.1.4 *Use satellite data to help enable decreased hurricane landfall uncertainty from +/- 400 km to +/- 100 km in the three-day forecasts by 2010.*

Outcome 1.1.5 *Use satellite data to help extend more accurate regional weather forecasting from 3 days to 5 days by 2010.*

APG 4ESS8 Weather - Improve predictive capabilities of regional models using satellite-derived localized temperature and moisture profiles and ensemble modeling. Progress toward achieving outcomes will be validated by external review. (Outcome 1.1.4, 1.1.5)

Outcome 1.1.6 *Develop projections of future atmospheric concentrations of carbon dioxide and methane for 10-100 years into the future with improvements in confidence of >50% by 2014.*

Outcome 1.1.7 *By 2014, develop in partnership with other agencies, credible ecological forecasts that project the sensitivities of terrestrial and aquatic ecosystems to global environmental changes for resource management and policy-related decision-making.*

Outcome 1.1.8 *Report changes in global land cover, productivity, and carbon inventories with accuracies sufficient for use in the food industry, in evaluating resource management activities, and in verifying inventories of carbon emissions and storage.*

APG 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. Progress toward achieving outcomes will be validated by external review. (Outcome 1.1.6, 1.1.7, 1.1.8)

Outcome 1.1.9 *Enable development of seasonal precipitation forecasts with > 75% accuracy by 2014.*

Outcome 1.1.10 *Improve estimates of the global water and energy cycles by 2012 to enable balancing of the global and regional water and energy budgets to within 10%.*

APG 4ESS10 Water and Energy Cycle - Enhance land surface modeling efforts, which will lead to improved estimates of soil moisture and run-off. Progress toward achieving outcomes will be validated by external review. (Outcome 1.1.9, 1.1.10)

Outcome 1.1.11 *Reduce uncertainty in global sea level change projections by 50% by the year 2014, and include regional estimates of deviation from global mean.*

Outcome 1.1.12 *Enable 10-year or longer climate forecasts by the year 2014 with a national climate modeling framework capable of supporting policy decision-making at regional levels.*

APG 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. Progress toward achieving outcomes will be validated by external review. (Outcome 1.1.11, 1.1.12)

Outcome 1.1.13 *Enable 30-day volcanic eruption forecasts with > 50% confidence by 2014.*

Outcome 1.1.14 *Enable estimation of earthquake likelihood in North American plate boundaries with > 50% confidence by 2014.*

APG 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. Progress toward achieving outcomes will be validated by external review. (Outcome 1.1.13, 1.1.14)

Objective 1.2 Expand and accelerate the realization of economic and societal benefits from Earth science, information, and technology.

Outcome 1.2.1 *By 2012, benchmark the assimilation of observations (geophysical parameters, climate data records) provided from 20 of the 80 remote sensing systems deployed on the flotilla of 18-22 NASA Earth observation research satellites.*

Outcome 1.2.2 *By 2012, benchmark the assimilation of 5 specific types of predictions resulting from Earth Science Model Framework (ESMF) of 22 NASA Earth system science models.*

Outcome 1.2.3 *By 2012, benchmark the assimilation of observations and predictions resulting from NASA Earth Science research in 8-10 decision support systems serving national priorities and the missions of federal agencies.*

APG 4ESA1 National applications: Benchmark measurable enhancements to at least 2 national decision support systems using NASA results, including the use of optical depth derived from MODIS data into the Air Quality Index provided by EPA and the use of ocean height Derived from Topex and Jason missions into reservoir monitoring tools with USDA. (Outcome 1.2.1, 1.2.3)

APG 4ESA2 Cross Cutting Solutions: Expand DEVELOP (Digital Earth Virtual Environment and Learning Outreach Project) workforce development program to 2-4 additional states and benchmark the use of NASA research results for water and energy decision support tools. (Outcome 1.2.1, 1.2.2, 1.2.3)

APG 4ESA3 Cross Cutting Solutions: Competitively select at least 5 solutions projects for the Research, Education, Applications solutions Network (REASoN) program to serve national applications through projects that support agriculture, public health and water quality decision support tools. (Outcome 1.2.1, 1.2.2, 1.2.3)

APG 4ESA4 Cross Cut Solutions: Verify and validate at least two commercial remote sensing sources/products for Earth science research including DigitalGlobe Quicksat and OrbImage Overview-3 high resolutions optical imagery. (Outcome 1.2.1)

Objective 1.3 Understand the origins and societal impacts of variability in the Sun-Earth connection.

Outcome 1.3.1 *Develop the capability to predict solar activity and the evolution of solar disturbances as they propagate in the heliosphere and affect the Earth.*

APG 4SEC8 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.

Outcome 1.3.2 *Specify and enable prediction of changes to the Earth's radiation environment, ionosphere, and upper atmosphere.*

APG 4SEC9 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.

Outcome 1.3.3 *Understand the role of solar variability in driving space climate and global change in the Earth's atmosphere.*

APG 4SEC10 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.

Objective 1.4 Catalog and understand potential impact hazards to Earth from space.

Outcome 1.4.1 *By 2008, inventory at least 90 percent of asteroids and comets larger than 1 km in diameter that could come near Earth.*

APG 4SSE10 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.

Outcome 1.4.2 *Determine the physical characteristics of comets and asteroids relevant to any threat they may pose to Earth.*

APG 4SSE11 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.

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

Outcome 2.1.1 *By 2005, research, develop, and transfer technologies that will enable the reduction of the aviation fatal accident rate by 50% from the FY 1991-1996 average.*

APG 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.

APG 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 develop prototype disks and engine containment materials with inherent failure resistant characteristics that will be ready for full scale testing in FY 2005.

APG 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.

Outcome 2.1.2 *By 2009, research, develop & transfer technologies that will reduce the vulnerability exposure of the aircraft, and reduce the vulnerabilities of other components in the air transportation system.*

APG 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.

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

Outcome 2.2.1 *By 2007, develop, demonstrate and transfer technologies that enable a reduction by half, in community noise due to aircraft, based on the 1997 state of the art.*

APG 4AT8 Validate initial concepts for engine and airframe source noise reduction by 5dB (re: to CY 2001 SOA).

Outcome 2.2.2 *By 2007, develop, demonstrate and transfer technologies for reducing NOx emission by 70% from the 1996 ICAO standard, to reduce smog and lower atmospheric ozone.*

APG 4AT19 Complete detailed design of a low-emission combustor leading to a 2005 test of a full-annular combustor demonstrating a 70% reduction of nitrogen oxides.

Outcome 2.2.3 *By 2007, develop, demonstrate and transfer technologies for reducing the green-house gas, CO_2, emissions by 25% based on the state of the art for airframe and engine component technologies in 2000.*

APG 4AT9 Experimentally demonstrate a 2-stage highly loaded compressor for increasing pressure rise per stage.

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

Outcome 2.3.1 *By 2004, develop, demonstrate and transfer technologies that enable a 35% increase in aviation system throughput in the terminal area and a 20% increase in aviation system throughput en route based on 1997 NAS capacities.*

APG 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.

Outcome 2.3.2 *By 2005, develop, demonstrate and transfer key enabling capabilities for a small aircraft transportation system.*

APG 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.

Outcome 2.3.3 *By 2009, develop, demonstrate, and transfer technologies that enable a further 5% increase in throughput in the terminal area and a further 10% increase in en route throughput based on 1997 NAS capacity.*

APG 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 concepts and technologies for the future air transportation system.

APG 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.

Objective 3.1 Enhance the Nation's security through partnerships with DOD, DHS and other U.S. or international government agencies.

Outcome 3.1.3 *By 2012, in partnership with the Department of Homeland Security, the Department of Defense, and the Department of State, deliver 15 observations and 5 model predictions for climate change, weather prediction and natural hazards to national and global organizations and decision-makers to evaluate 5 scenarios and optimize the use of Earth resources (food, water, energy, etc.) for homeland security, environmental security and economic security.*

APG 4ESA5 Benchmark improvements to at least two of the target national applications - air quality and agricultural competitiveness.

Outcome 3.1.4 *Demonstrate effective international collaboration on the International Space Station.*

APG 4ISS1 In concert with the ISS International Partners, extend a continuous two-person (or greater) crew presence on the ISS through the end of FY04.

Outcome 3.1.5 *Transfer technology both to and from the Department of Defense.*

APG 4AT14 Conduct and obtain flight test data of autonomous aerial refueling technologies in support of DoD UCAV Program.

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

Outcome 3.2.1 *On an annual basis, develop 50 new technology transfer agreements with the Nation's industrial and entrepreneurial sectors.*

APG 4HRT6 Complete 50 transfers of NASA technologies, expertise or facility usage to the U.S. private sector, through hardware licenses, software usage agreements, or Space Act agreements.

Outcome 3.2.2 By 2008, realign commercial product development to focus on NASA needs, while maintaining industrial partnerships.

APG 4RPFS1 Complete realignment plans of SPD.

APG 4RPFS2 Enable industry research in space that allows them to bring one commercial product under investigation to market by FY04.

Outcome 3.2.3 By 2008, develop and test at least two design tools for advanced materials and in-space fabrication, and validate on ISS.

APG 4RPFS3 Complete preparations for launch of a new containerless processing facility for research on synthesis of advanced materials on ISS.

APG 4RPFS4 Continue synthesis of zeolite crystals on ISS.

Outcome 3.2.4 By 2008, working with all OBPR research organizations and other NASA enterprises, identify at least three additional users of Research Partnership Center spaceflight hardware.

APG 4RPFS5 Develop a database of RPC spaceflight hardware showing potential outside users.

APG 4RPFS6 Develop a system for sharing RPC spaceflight hardware with outside users.

Outcome 3.2.5 By 2008, increase by 30% (from the 2003 level) the utilization of NASA/OBPR-derived technologies by other agencies, private sector, and academia to advance basic and applied research goals of practical impact.

APG 4PSR1 Maintain an active research program in collaboration with other agencies in laser light scattering, bioreactor, and containerless technologies.

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

Outcome 3.3.1 By 2008, analyze the impact of the results of the first phase of ISS and ground-based research in Biotechnology, fundamental science, and engineering to demonstrate the introduction of at least two new design tools and/or process improvements to existing technologies and industrial practices.

APG 4PSR2 Demonstrate the productivity of the research program in Combustion, Fluids Physics, Biotechnology, and Materials science and accomplish the milestones of ISS research projects.

Outcome 3.3.2 By 2008, quantitatively assess the impact of space and ground-based research on fire safety hazard prevention and containment and on energy conversion to demonstrate measurable risk reduction and increased efficiency.

APG 4PSR3 Process and analyze existing STS-107 data on fire safety and microgravity combustion research and maintain a productive ground and flight-based research program.

Outcome 3.3.3 By 2008, develop at least three new leveraged research partnerships with industry, academia, and other government agencies that improve NASA spacecraft safety.

APG 4RPFS7 Develop at least one enabling technology to improve the safety of space transportation systems.

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.

Objective 4.1 Determine how fundamental biological processes of life respond to gravity and space environments.

Outcome 4.1.1 Use ground-based simulators and ISS to determine gravity responses for at least five model organisms by 2008.

APG 4BSR1 Solicit ground-based research on two widely studied model organisms.

APG 4BSR2 Produce a road map and strategic goals for plant research ground-based studies and flight opportunities. Solicit flight-based research on at least one model plant species.

Outcome 4.1.2 Develop predictive models of cellular, pathogenic, and ecological responses to space for at least two organisms by 2008.

APG 4BSR3 Solicit ground-based research on responses of cells and pathogens to space environments.

APG 4BSR4 Select two model species to support the development of predictive models. Communicate with the research community in workshops and at national and international scientific meetings about the approach.

Outcome 4.1.3 By 2008, structure the Fundamental Space Biology flight research program to emphasize at least five model organisms and teams of Principal Investigators.

APG 4BSR5 In coordination with International partners, solicit flight research on two model organisms and establish at least two research teams.

APG 4BSR6 Review and reprioritize Fundamental Space Biology flight experiments with a focus on model specimens.

APG 4BSR7 Reevaluate flight hardware and habitats with respect to research goals and focus resources on select units.

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

Outcome 4.2.1 By 2008, complete the first generation of ISS research in colloidal physics and soft condensed matter and demonstrate the ability to control the colloidal engineering of at least two different model structures.

APG 4PSR4 Demonstrate the productivity of the colloidal physics and soft-condensed matter program and accomplish the planned ISS research projects milestones.

Outcome 4.2.2 By 2008, complete the design and fabrication of the first ISS fundamental microgravity physics facility to allow the performance of two capstone investigations in dynamical critical phenomena.

APG 4PSR5 Demonstrate the accomplishments of the ISS fundamental physics facility development milestones and maintain a productive ground and space-based research program in condensed matter physics.

Outcome 4.2.3 By 2008, complete the design for the ISS laser-cooling laboratory and demonstrate the feasibility to deploy the most accurate atomic clock in space.

APG 4PSR6 Demonstrate the accomplishments of the ISS laser cooling and atomic physics facility milestones and maintain an innovative and productive ground and space-based research program in atomic and gravitational physics.

Outcome 4.2.4 By 2008, complete the first phase of the ISS biotechnology facility and demonstrate cellular biotechnology research throughput increase by a factor of two.

APG 4PSR7 Demonstrate the accomplishments of the ISS Biotechnology research facility development milestones and maintain a productive and innovative ground and space-based research program in cellular biotechnology and tissue engineering.

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

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

Outcome 5.1.1 Understand the initial stages of planet and satellite formation.

APG 4SSE12 Successfully demonstrate progress in understanding the initial stages of planet and satellite formation. Progress towards achieving outcomes will be validated by external review.

Outcome 5.1.2 Understand the processes that determine the characteristics of bodies in our solar system and how these processes operate and interact.

APG 4SSE13 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.

Outcome 5.1.3 Understand why the terrestrial planets are so different from one another.

APG 4SSE14 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.

Outcome 5.1.4 Learn what our solar system can tell us about extra-solar planetary systems.

APG 4SSE15 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.

Objective 5.2 Understand how life begins and evolves and determine the characteristics of the solar system that led to the origin of life.

Outcome 5.2.1 Determine the nature, history, and distribution of volatile and organic compounds in the solar system.

APG 4SSE16 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.

Outcome 5.2.2 Identify the habitable zones in the solar system.

APG 4SSE17 Successfully demonstrate progress in identifying the habitable zones in the solar system. Progress towards achieving outcomes will be validated by external review.

Outcome 5.2.3 Identify the sources of simple chemicals that contribute to pre-biotic evolution and the emergence of life.

APG 4SSE18 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.

Outcome 5.2.4 Study Earth’s geologic and biologic records to determine the historical relationship between Earth and its biosphere.

APG 4SSE19 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.

Objective 5.3 Understand the current state and evolution of the atmosphere, surface, and interior of Mars.

Outcome 5.3.1 Characterize the present climate of Mars and determine how it has evolved over time.

APG 4MEP9 Successfully demonstrate progress in characterizing the present climate of Mars and determining how it has evolved over time. Progress towards achieving outcomes will be validated by external review.

Outcome 5.3.2 Understand the history and behavior of water and other volatiles on Mars.

APG 4MEP10 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.

Outcome 5.3.3 Understand the chemistry, mineralogy, and chronology of Martian materials.

APG 4MEP11 Successfully demonstrate progress in studying the chemistry, mineralogy, and chronology of Martian materials. Progress towards achieving outcomes will be validated by external review.

Outcome 5.3.4 Determine the characteristics and dynamics of the interior of Mars.

APG 4MEP12 Successfully demonstrate progress in determining the characteristics and dynamics of the interior of Mars. Progress towards achieving outcomes will be validated by external review.

Objective 5.4 Determine if life exists or has ever existed on Mars.

Outcome 5.4.1 Understand the character and extent of prebiotic chemistry on Mars.

APG 4MEP13 Successfully demonstrate progress in investigating the character and extent of prebiotic chemistry on Mars. Progress towards achieving outcomes will be validated by external review.

Outcome 5.4.2 Search for chemical and biological signatures of past and present life on Mars.

APG 4MEP14 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.

Objective 5.5 Develop an understanding of Mars in support of future human exploration.

Outcome 5.5.1 Identify and understand the hazards that the Martian environment will present to human explorers.

APG 4MEP15 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.

Outcome 5.5.2 Inventory and characterize Martian resources of potential benefit to human exploration of Mars.

APG 4MEP16 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.

Objective 5.6 Understand the changing flow of energy and matter throughout the Sun, heliosphere, and planetary environments.

Outcome 5.6.1 Understand the structure and dynamics of the Sun and solar wind and the origins of magnetic variability.

APG 4SEC11 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.

Outcome 5.6.2 Determine the evolution of the heliosphere and its interaction with the galaxy.

APG 4SEC12 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.

Outcome 5.6.3 Understand the response of magnetospheres and atmospheres to external and internal drivers.

APG 4SEC13 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.

Objective 5.7 Understand the fundamental physical processes of space plasma systems.

Outcome 5.7.1 Discover how magnetic fields are created and evolve and how charged particles are accelerated.

APG 4SEC14 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.

Outcome 5.7.2 Understand coupling across multiple scale lengths and its generality in plasma systems.

APG 4SEC15 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.

Objective 5.8 Learn how galaxies, stars, and planetary systems form and evolve.

Outcome 5.8.1 Learn 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.

APG 4ASO9 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.

Outcome 5.8.2 *Understand how different galactic ecosystems of stars and gas formed and which ones might support the existence of planets and life.*

APG 4ASO10 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.

Outcome 5.8.3 *Learn how gas and dust become stars and planets.*

APG 4ASO11 Successfully demonstrate progress in learning how gas and dust become stars and planets. Progress towards achieving outcomes will be validated by external review.

Outcome 5.8.4 *Observe planetary systems around other stars and compare their architectures and evolution with our own.*

APG 4ASO12 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.

Objective 5.9 Understand the diversity of worlds beyond our solar system and search for those that might harbor life.

Outcome 5.9.1 *Characterize the giant planets orbiting other stars.*

APG 4ASO13 Successfully demonstrate progress in characterizing the giant planets orbiting other stars. Progress towards achieving outcomes will be validated by external review.

Outcome 5.9.2 *Find out how common Earth-like planets are and see if any might be habitable.*

APG 4ASO14 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.

Outcome 5.9.3 *Trace the chemical pathways by which simple molecules and dust evolve into the organic molecules important for life.*

APG 4ASO15 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.

Outcome 5.9.4 *Develop the tools and techniques to search for life on planets beyond our solar system.*

APG 4ASO16 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.

Objective 5.10 Discover what powered the Big Bang and the nature of the mysterious dark energy that is pulling the Universe apart.

Outcome 5.10.1 *Search for gravitational waves from the earliest moments of the Big Bang.*

APG 4SEU9 Successfully demonstrate progress in searching for gravitational waves from the earliest moments of the Big Bang. Progress towards achieving outcomes will be validated by external review.

Outcome 5.10.2 *Determine the size, shape, and matter-energy content of the Universe.*

APG 4SEU10 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.

Outcome 5.10.3 *Measure the cosmic evolution of dark energy.*

APG 4SEU11 Successfully demonstrate progress in measuring the cosmic evolution of the dark energy that controls the destiny of the Universe. Progress towards achieving outcomes will be validated by external review.

Objective 5.11 Learn what happens to space, time, and matter at the edge of a black hole.

Outcome 5.11.1 *Determine how black holes are formed, where they are, and how they evolve.*

APG 4SEU12 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.

Outcome 5.11.2 *Test Einstein's theory of gravity and map space-time near event horizons of black holes.*

APG 4SEU13 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.

Outcome 5.11.3 Observe stars and other material plunging into black holes.

APG 4SEU14 Successfully demonstrate progress in observing stars and other material plunging into black holes. Progress towards achieving outcomes will be validated by external review.

Objective 5.12 Understand the development of structure and the cycles of matter and energy in the evolving Universe.

Outcome 5.12.1 Determine how, where, and when the chemical elements were made, and trace the flows of energy and magnetic fields that exchange them between stars, dust, and gas.

APG 4SEU15 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.

Outcome 5.12.2 Explore the behavior of matter in extreme astrophysical environments, including disks, cosmic jets, and the sources of gamma-ray bursts and cosmic rays.

APG 4SEU16 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.

Outcome 5.12.3 Discover how the interplay of baryons, dark matter, and gravity shapes galaxies and systems of galaxies.

APG 4SEU17 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.

Objective 5.13 Through robotic and human lunar missions, demonstrate capabilities, including use of lunar and other space resources, for safe, affordable, effective and sustainable human-robotic solar system exploration.

Outcome 5.13.1 Develop capability to conduct robotic lunar test bed missions by 2008 and human lunar missions as early as 2015 but no later than 2020 that can demonstrate exploration systems and architectural approaches, including use of lunar resources, to enable human-robotic exploration across the solar system.

4LE1 Identify and analyze past architecture-definition and trade studies with applicability to lunar human-robotic exploration tests.

Outcome 5.13.2 Conduct robotic missions, in lunar orbit and on the lunar surface, to acquire engineering and environmental data by 2015 required to prepare for human-robotic lunar missions.

Outcome 5.13.3 By 2020, establish through lunar surface missions the building block capabilities to support safe, affordable and effective long-duration human presence beyond low Earth orbit (LEO) as a stepping-stone to sustained human-robotic exploration and discovery beyond the Moon.

Outcome 5.13.4 By 2015, demonstrate new human-robotic space operations capabilities employing advanced in-space infrastructures, including space assembly, maintenance and servicing, and logistics concepts.

Mission III: To Inspire the Next Generation of Explorers

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

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

Outcome 6.1.1 *By 2008, increase by 20%, student participation in NASA instructional and enrichment activities.*

APG 4ED1 Develop protocols to establish a baseline of NASA student participation.

APG 4ED2 Develop and implement at least one model program, based on best practices, that engages students in NASA science and technology (inclusive of the science and technical Enterprises).

Outcome 6.1.2 *By 2008, increase by 20%, the number of elementary and secondary educators effectively utilizing NASA content-based STEM materials and programs in the classroom.*

APG 4ED3 Develop protocols to establish a baseline of NASA teacher participation.

APG 4ED4 Develop and implement a model program, based on best practices, that engages teachers in NASA science and technology (inclusive of the science and technical Enterprises).

Outcome 6.1.3 *By 2008, increase by 20%, family involvement in NASA-sponsored elementary and secondary education programs.*

APG 4ED5 Establish a baseline of existing NASA sponsored family involvement activities and existing and potential partners.

APG 4ED6 Using an established best-practices model, implement one NASA-sponsored family involvement component/program at each Center.

Outcome 6.1.4 *By 2008, 90% of NASA elementary and secondary programs are aligned with state or local STEM educational objectives.*

APG 4ED7 Establish a baseline to determine the number of states in which NASA state-based programs are being implemented.

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

Outcome 6.2.1 *By 2008, attain a statistically significant increase in the number and diversity of NASA-supported students graduating in NASA-related fields.*

APG 4ED8 Establish a NASA-wide baseline of the number and diversity of NASA-supported students.

Outcome 6.2.2 *By 2008, attain a statistically significant increase in the number of faculty in higher education institutions who are first-time proposers in NASA research and development opportunities.*

APG 4ED9 Develop an inventory identifying the number of first-time proposers and the universe of faculty in higher education institutions involved with NASA research and development opportunities.

Outcome 6.2.3 *By 2008, increase by 20% the number of higher education institutions that align their NASA research and development activities with STEM teacher preparation departments to improve STEM teacher quality.*

APG 4ED10 Develop a model to demonstrate how NASA's investment in higher education institutions can influence the quality of pre-service education in STEM fields.

Outcome 6.2.4 *By 2008, increase by 10% the number and diversity of students conducting NASA-relevant research.*

APG 4ED11 Develop an infrastructure and funding plan that provides Education sponsored flight research opportunities (including STS, ISS, ELV, balloons, and sounding rockets) for graduate, undergraduate, and selected high school students.

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

Outcome 6.3.1 *By 2008, increase by 20%, underrepresented/underserved NASA-sponsored students who pursue academic degrees in NASA-related STEM disciplines.*

APG 4ED12 Develop protocols to establish a baseline of NASA underrepresented/underserved student participation.

APG 4ED13 Develop a model undergraduate program, based on best practices, bridging current programs, that engages underrepresented/underserved students.

Outcome 6.3.2 *By 2008, increase by 20%, the number and diversity of teachers and faculty from underrepresented/underserved communities and institutions who participate in NASA-related STEM programs.*

APG 4ED14 Develop protocols to establish a baseline of NASA underrepresented/underserved teacher/faculty participation in NASA STEM related learning environments.

Outcome 6.3.3 *By 2008, increase by 20% the number of underrepresented/underserved researchers and minority serving institutions that compete for NASA research and development opportunities.*

APG 4ED15 Establish a baseline of the numbers of underserved/underrepresented researchers and minority serving institutions competing for NASA research announcements.

APG 4ED16 Conduct 3 technical assistance workshops.

Outcome 6.3.4 *By 2008, increase family involvement in underrepresented/underserved NASA-sponsored student programs.*

APG 4ED17 Using an established best-practices model, pilot a NASA-sponsored family involvement component in one underrepresented/underserved NASA sponsored student program.

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

Outcome 6.4.1 *By 2008, identify and implement 4 new advanced technology applications that will positively impact learning.*

APG 4ED18 Benchmark advanced technology tools/applications under development to determine the 4-6 with the most impact potential for NASA e-learning.

Outcome 6.4.2 *By 2008, demonstrate the effectiveness of NASA digital content materials in targeted learning environments.*

APG 4ED19 Assess at least 25 of the NASA explorer schools, utilizing the School Technology and Readiness (STaR) tool.

Outcome 6.4.3 *By 2008, establish a technology infrastructure that meets citizen demand for NASA learning services.*

APG 4ED20 Perform a NASA learning services technology infrastructure needs assessment.

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

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

Outcome 7.1.1 *By 2008, establish a national program to engage the informal education community with NASA Science and Technology.*

APG 4ED23 Conduct an opinion survey to baseline public attitudes and knowledge of NASA research and exploration.

Outcome 7.1.2 *By 2008 provide instructional materials derived from NASA research and scientific activities that meet the needs of NASA's informal education partners.*

APG 4ED21 Compile an inventory of existing programs and partnerships to establish a baseline to assess and prioritize high-leverage and critical informal education programs and educational family involvement activities.

Outcome 7.1.3 *By 2008 provide professional development for NASA's informal education partners.*

APG 4ED22 Inventory and assess current NASA professional development programs for relevance to the targeted informal learning environments.

FY 2004 Performance Plan Update

Outcome 7.1.4 Engage the public in NASA missions, discoveries and technology through public programs, community outreach, mass media, and the Internet.

APG 4SSE20 Through partnerships with major science museums or planetariums, put on display or on tour major exhibitions or planetarium shows based on Theme content.

APG 4SSE21 Provide materials and technical expertise to support the development of exhibits and programs at science museums and planetariums.

APG 4SSE22 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.

APG 4ESA6 Provide in public venues at least 50 stories on the scientific discoveries, practical benefits, or new technologies sponsored by the Earth Science Enterprise.

APG 4ESS13 Post the most exciting imagery and explanations about Earth science on the Earth observations/ESE website.

APG 4SFS3 Ensure participation of all space flight programs and Centers in increasing by 10% venues that provide "hands-on" opportunities for the public to experience and become more knowledgeable of space flight benefits and contributions, particularly ISS.

APG 4RPFS8 Increase distribution of the Space Research newsletter by 5,000 over FY03 circulation in order to further educate the general public, industry, and academia on space-based research.

APG 4RPFS9 Through collaboration with PAO, establish and sustain a series of media briefings highlighting OBPR research.

APG 4RPFS10 Expand outreach activities that reach minority and under-represented sectors of the public, through increased participation in conferences and community events that reflect cultural awareness and outreach. Each fiscal year, increase the previous year baseline by supporting at least one new venue that focuses on these public sectors.

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

APG 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.

APG 4TS4 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.

APG 4HRT11 Publish and distribute program specific publications (Aerospace Innovations, NASA Tech Briefs, Spinoff) including 1 industry targeted edition, in a sector where NASA can promote its technologies available for commercialization.

APG HRT12 Provide public and industry access to the TechTracS database, which features approximately 18,000 updated and evolving new technologies, as well as technical briefs, diagrams, and illustrations.

Exploration Capabilities

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

Objective 8.1 Assure safe, affordable, and reliable crew and cargo access and return from the International Space Station.

Outcome 8.1.1 *Acquire non-Shuttle, crew and cargo access and return capability for the Station by 2010.*

Objective 8.3 Improve the accessibility of space via the Space Shuttle to better meet Space Station assembly, operations, and research requirements.

Outcome 8.3.1 *Assure public, flight crew, and workforce safety for all Space Shuttle operations and safely meet the manifest and flight rate commitment through completion of Space Station aaembly.*

APG 4SSP1 Implement necessary modifications to the Space Shuttle system for return-to-flight in FY04.

APG 4SSP2 Achieve zero Type-A (damage to property at least $1M or death) or Type-B (damage to property at least $250K or permanent disability or hospitalization of 3 or more persons) mishaps in FY2004.

APG 4SSP3 Achieve 100% on-orbit mission success for all Shuttle missions launched in FY04. 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.

Objective 8.4 Assure capabilities for world-class research on a laboratory in low Earth orbit.

Outcome 8.4.1 *Provide a safe, reliable, and well-managed on-orbit research facility.*

APG 4ISS2 Achieve zero Type-A (damage to property at least $1M or death) or Type-B (damage to property at least $250K or permanent disability or hospitalization of 3 or more persons) mishaps in FY2004.

APG 4ISS3 Based on the Space Shuttle return-to-flight plan, establish a revised baseline for ISS assembly (through International Core Complete) and research support.

APG 4ISS4 Provide at least 80% of up-mass, volume and crew-time for science as planned at the beginning of FY04.

Outcome 8.4.2 *Expand the ISS crew size to accommodate U.S. and International Partner research requirements.*

APG 4ISS5 Obtain agreement among the International Partners on the final ISS configuration.

Objective 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 safe, well-managed and 95% reliable space communications, rocket propulsion testing, and launch services to meet agency requirements.*

APG 4SFS4 Maintain NASA success rate at or above a running average of 95% for missions on the FY04 Expendable Launch Vehicle (ELV) manifest.

APG 4SFS5 Achieve at least 95% of planned data delivery for the International Space Station, each Space Shuttle mission, and low-Earth orbiting missions in FY04.

APG 4SFS6 Achieve zero Type-A (damage to property at least $1M or death) or Type-B (damage to property at least $250K or permanent disability or hospitalization of 3 or more persons) mishaps in FY2004.

APG 4SFS7 Achieve positive feedback from a minimum of 95% of all rocket propulsion test customers.

APG 4SFS8 Establish the Agency wide baseline space communications architecture, including a framework for possible deep space and near Earth laser communications services.

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

Objective 9.1 Understand human physiological reactions to reduced gravity and develop countermeasures to assure survival of humans traveling far from Earth.

Outcome 9.1.1 By 2008, develop and test candidate countermeasures using ground-based analysis and space flight.

APG 4BSR8 Use ground-based and space-based research to lessen the risks related to long duration phenomena such as bone loss, physiological adaptation to isolation and confinement, and the biological effects of radiation as described in the Bioastronautics Critical Path Roadmap.

APG 4BSR9 Publish results of Bioastronautics experiments conducted during early ISS Increments (1 through 8) and preliminary results from Increments 9 and 10.

APG 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.

APG 4SFS10 Certify the medical fitness of all crew members before launch.

Outcome 9.1.2 By 2008, reduce uncertainties in estimating radiation risks by one-half.

APG 4BSR11 Expand the space radiation research science community to involve cutting edge researchers in related disciplines by soliciting, selecting, and funding high quality research.

APG 4BSR12 Complete two experimental campaigns ("runs") using recently completed National Space Radiation Laboratory (NSRL) 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.

APG 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.

Outcome 9.1.3 Advance understanding of the role of gravity in biological processes to support biomedical research.

APG 4BSR14 Openly 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.

APG 4BSR15 Plan for increased early utilization for basic biology research in 2005 to take advantage of evolving ISS capabilities.

APG 4BSR16 Maintain a competitive, productive peer-reviewed research program to advance understanding of the role of gravity in biological processes.

Objective 9.2 Develop new human support systems and solutions to low gravity technological challenges to allow the next generation of explorers to go beyond low earth orbit.

Outcome 9.2.1 Identify & test technologies by 2010 to reduce total mass requirements by a factor of three for Life Support using current ISS mass requirement baseline.

APG 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.

APG 4HRT14 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.

Outcome 9.2.2 By 2008, develop predictive models for prototype two-phase flow and phase change heat transfer systems for low- and fractional gravity with an efficiency improvement of at least a factor of two over 2003 ISS radiative systems, and prepare ISS experiments for validation.

APG 4PSR8 Increase the current strategic ground research in microgravity heat exchange and advance the existing ISS investigations toward flight.

Outcome 9.2.3 *By 2008, develop predictive engineering model and prototype systems to demonstrate the feasibility of deploying enhanced space radiation-shielding multi-functional structures with at least a factor of two improvement in shielding efficiency and mass reduction, and prepare a space experiment for validation.*

APG 4PSR9 Extend the available database on radiation effects on materials properties using the newly commissioned NASA Space Radiation Laboratory at Brookhaven.

Objective 9.3 Demonstrate the ability to support a permanent human presence in low Earth orbit as a stepping-stone to human presence beyond.

Outcome 9.3.1 *Develop experience in working and living in space by continuously supporting a crew on-board the ISS through 2016.*

APG 4ISS6 Continuously sustain a crew to conduct research aboard the ISS.

Objective 9.4. Develop technologies to enable safe, affordable, effective and sustainable human-robotic exploration and discovery beyond low Earth orbit (LEO).

Outcome 9.4.1 *Identify, develop and validate human-robotic capabilities by 2015 required to support human-robotic lunar missions.*

4HRT1 Formulate guidelines for a top-down strategy-to-task (STT) technology R&D planning process that will facilitate the development of human-robotic exploration systems requirement.

4HRT2 Charter an Operational Advisory Group of technologists and operators to prepare for two systems-focused Quality Function Deployment (QFD) exercises that will take place in FY 2005.

4HRT3 Charter a Technology Transition Team that will review candidate human-robotic exploration systems technologies, and provide detailed updates to human-robotic technology roadmaps.

Outcome 9.4.2 *Identify and execute a research and development program to develop technologies by 2015 critical to support human-robotic lunar missions.*

4HRT4 Conduct an “Industry Day” by mid-FY 2004 to communicate the Exploration Systems Enterprise vision and processes.

Outcome 9.4.3 *By 2016, develop and demonstrate in space nuclear fission-based power and propulsion systems that can be integrated into future human and robotic exploration missions.*

4HRT5 Review nuclear propulsion and vehicle systems technology roadmap for alignment with exploration priorities, particularly human-related system and safety requirements.

Outcome 9.4.4 *Develop and deliver 1 new critical technology every 2 years in at least each of the following disciplines: in-space computing, space communications and networking, sensor technology, modular systems, and engineering risk analysis.*

Objective 9.5. Develop crew transportation systems to enable exploration beyond low Earth orbit (LEO).

Outcome 9.5.1 *By 2014, develop and flight-demonstrate a human exploration vehicle that supports safe, affordable and effective transportation and life support for human crews traveling from the Earth to destinations beyond LEO.*

4TS1 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 to the International Space Station.

4TS2 Conduct full reviews of OSP and NGLT programs, identifying acquisitions strategies, technologies, and lessons learned that are applicable to the new CEV program.

Outcome 9.5.2 *By 2010, identify and develop concepts and requirements that could support safe, affordable and effective transportation and life support for human crews traveling from the Earth to the vicinity or the surface of Mars.*

4TS3 Compile a document that catalogs major architecture and engineering trade studies of space transportation architectures for human Mars exploration.

Goal 10: Enable revolutionary capabilities through new technology.

Objective 10.1 Improve the capability to assess and manage risk in the synthesis of complex engineering systems.

Outcome 10.1.1 *By 2005 demonstrate 2 prototype systems that prove the feasibility of resilient systems to mitigate risks in key NASA mission domains. Feasibility will be demonstrated by reconfigurability of avionics, sensors, and system performance parameters.*

APG 4HRT7 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.

Objective 10.3 Leverage partnerships between NASA Enterprises, U.S. industrial firms, and the venture capital community for innovative technology development.

Outcome 10.3.1 *Promote and develop innovative technology partnerships between NASA, venture capital firms and U.S. industry for the benefit of all Enterprise mission needs, initiating three (3) partnerships per year.*

APG 4HRT8 Establish 3 partnerships with U.S. industry and the investment community using the Enterprise Engine concept.

APG 4HRT9 Develop 36 industry partnerships that will add value to NASA Enterprises.

Outcome 10.3.2 *Facilitate on an annual basis the award of venture capital funds or Phase III contracts to no less than two SBIR firms to further develop or produce their technology through industry or government agencies.*

APG 4HRT10 Achieve through NASBO, the award of Phase III contracts or venture capital funds to 2 SBIR firms to further develop or produce their technology through industry or government agencies.

Objective 10.5 Create novel aeronautics concepts and technology to support science missions and terrestrial and space applications.

Outcome 10.5.1 *Develop technologies that will enable solar powered vehicles to serve as sub-orbital satellites for science missions.*

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

Outcome 10.5.2 *By 2008, develop and demonstrate technologies required for routine Unmanned Aerial Vehicle operations in the National Airspace System above 18,000 feet for High-Altitude, Long-Endurance (HALE) UAVs.*

APG 4AT15 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.

Implementing Strategies to Conduct Well-Managed Programs

Solar System Exploration

APG 4SSE1 Complete all development projects within 110% of the cost and schedule baseline.

APG 4SSE2 Each research project will allocate 75% of its funding competitively during FY04.

APG 4SSE3 SSE will complete all of its missions within 10% of their baseline schedules.

Accomplish key development activities in support of Solar System Exploration:

APG 4SSE4 Successfully launch MESSENGER.

APG 4SSE5 Deliver the Deep Impact spacecraft for Environmental Testing.

APG 4SSE6 Successfully complete the New Horizons/Pluto Critical Design Review (CDR).

Accomplish key technology activities in support of Solar System Exploration:

APG 4SSE7 Define the Level One science goals for the Jupiter Icy Moons Orbiter (JIMO) Mission.

APG 4SSE8 Release an NRA for high capability instruments useful on the JIMO Mission and follow-on Project Prometheus payloads.

APG 4SSE9 Release an NRA for the next New Frontiers Mission.

Mars Exploration Program

APG 4MEP1 Complete all development projects within 110% of the cost and schedule baseline.

APG 4MEP2 Each research project will allocate 75% of its funding competitively during FY04.

APG 4MEP3 MEP will complete all of its missions within 10% of their baseline schedules.

Accomplish key development activities in support of Mars Exploration:

APG 4MEP4 Successfully land at least one of the two Mars Exploration Rovers.

APG 4MEP5 Successfully complete the Level One Requirements for the Mars Exploration Rover Mission.

APG 4MEP6 Successfully complete the 2005 Mars Reconnaissance Orbiter (MRO) Assembly, Test, and Launch Operations (ATLO) Readiness Review.

Accomplish key technology activities in support of Mars Exploration:

APG 4MEP7 Complete Laser Communication Demonstration Concept Review.

APG 4MEP8 Release Instrument Announcement of Opportunity (AO) for the 2009 Mars Science Laboratory (MSL).

Astronomical Search for Origins

APG 4ASO1 Complete all development projects within 110% of the cost and schedule baseline.

APG 4ASO2 Each research project will allocate 75% of its funding competitively during FY04.

APG 4ASO3 ASO will complete all of its missions within 10% of their baseline schedules.

Accomplish key development activities in support of the Astronomical Search for Origins:

APG 4ASO4 Successfully complete Hubble Space Telescope (HST) Cosmic Origins Spectrograph (COS) development.

APG 4ASO5 Successfully complete Stratospheric Observatory For Infrared Astronomy (SOFIA) Observatory Flight Test.

APG 4ASO6 Successfully complete Space Infrared Telescope Facility (SIRTF) In-Orbit Checkout (IOC) and Science Verification.

Accomplish key technology activities in support of the Astronomical Search for Origins:

APG 4ASO7 Establish and freeze James Webb Space Telescope (JWST) System-Level Requirements.

APG 4ASO8 Validate Microarcsecond Metrology (MAM-1) Testbed progress toward interferometer sensor performance for Space Interferometry Mission (SIM).

Structure and Evolution of the Universe

APG 4SEU1 Complete all development projects within 110% of the cost and schedule baseline.

APG 4SEU2 Each research project will allocate 75% of its funding competitively during FY04.

APG 4SEU3 SEU will complete all of its missions within 10% of their baseline schedules.

Accomplish key development activities to advance understanding of the Structure and Evolution of the Universe:

APG 4SEU4 Successfully complete the Gamma-ray Large Area Space Telescope (GLAST) Mission Confirmation Design Review (CDR)

APG 4SEU5 Successfully launch Swift.

APG 4SEU6 Successfully complete Pre-Ship Review of Astro-E2 instruments X-ray Spectrometer (XRS) and X-ray Telescope (XRT).

Accomplish key technology activities to advance understanding of the Structure and Evolution of the Universe:

APG 4SEU7 Begin Formulation/Phase A for the Laser Interferometer Space Antenna (LISA) Mission.

APG 4SEU8 Complete Constellation-X (Con-X) design and fabricate the 8x8 Transition Edge Sensor Array for the X-ray Microcalorimeter Spectrometer.

Sun-Earth Connection

APG 4SEC1 Complete all development projects within 110% of the cost and schedule baseline.

APG 4SEC2 Each research project will allocate 75% of its funding competitively during FY04.

APG 4SEC3 SEC will complete all of its missions within 10% of their baseline schedules.

Accomplish key development activities to advance understanding of the Sun-Earth Connection:

APG 4SEC4 Begin Solar Terrestrial Relations Observatory (STEREO) Integration & Testing (I&T).

APG 4SEC5 Begin Solar Dynamics Observatory (SDO) Implementation.

Accomplish key technology activities to advance understanding of the Sun-Earth Connection:

APG 4SEC6 Release Announcement of Opportunity (AO) for Geospace Missions.

APG 4SEC7 Make AO selections for Magnetospheric Multiscale Mission.

FY 2004 Performance Plan Update

Earth System Science

APG 4ESS1 Complete all development projects within 110% of the cost and schedule baseline.

APG 4ESS2 Each research project will allocate 80% of its funding competitively during FY04.

APG 4ESS3 Each project will complete its mission within 10% of its baseline schedules.

APG 4ESS4 Successfully develop and infuse technologies that will enable future science measurements by 1) advancing 25% of funded technology developments one Technology Readiness Level, and 2) maturing 2-3 technologies to the point where they can be demonstrated in space or in an operational environment.

APG 4ESS5 At least 90% of all on-orbit instruments will be operational during their design lifetimes.

APG 4ESS6 Disseminate data that are easy to access to science focus area customers.

Earth Science Applications

APG 4ESA7 Deliver at least 90% of operating hours for all operations and research facilities.

APG 4ESA8 At least 80%, by budget, of research projects will be peer-reviewed and competitively awarded.

Biological Sciences Research

APG 4BSR18 Complete all development projects within 110% of the cost and schedule baseline.

APG 4BSR19 At least 80%, by budget, of research projects will be peer-reviewed and competitively awarded.

Physical Sciences Research

APG 4PSR10 Complete all development projects within 110% of the cost and schedule baseline.

APG 4PSR11 At least 80%, by budget, of research projects will be peer-reviewed and competitively awarded.

Research Partnerships and Flight Support

APG 4RPFS11 Deliver at least 90% of operating hours for all operations and research facilities.

Aeronautics Technology

APG 4AT1 Complete all development projects within 110% of the cost and schedule baseline.

APG 4AT2 The Theme will allocate 75% of its procurement funding competitively during FY04.

APG 4AT3 The Theme will complete 90% of the major milestones planned for FY04.

Education

APG 4ED24 At least 80%, by budget, of research projects will be peer reviewed and competitively awarded.

Transportation Systems

APG 4TS5 The Theme will distribute at least 80% of its allocated procurement funding to competitively awarded contracts.

Human Robotic Technologies

APG 4HRT13 Distribute at least 80% of allocated procurement funding to competitively awarded contracts, including continuing and new contract activities.

FY 2004 Performance Plan Update

International Space Station

APG 4ISS7 Complete all development projects within 110% of the cost and schedule baseline.

APG 4ISS8 The ISS Program will complete all of its missions within 10% of its baseline schedules.

Space Shuttle Program

APG 4SSP5 Complete all development projects within 110% of the cost and schedule baseline.

APG 4SSP6 Space Shuttle Program will execute its program within 10% of its baseline schedules.

Space and Flight Support

APG 4SFS14 Complete all development projects within 110% of the cost and schedule baseline.

APG 4SFS15 Space and Flight Support will execute its programs within 10% of its baseline schedules.

FY 2005 Performance Plan

NASA is undergoing extensive internal programmatic reviews to determine how best to implement the new exploration vision. As a result, the specific goals and milestones for FY 2005 are expected to change.

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.

Objective 1.1 Understand how the Earth is changing, better predict change and understand the consequences for life on Earth.

Outcome 1.1.1 *Enable prediction of polar and global stratospheric ozone recovery (amount and timing) to within 25% by 2014.*

5ESS1 Integrate satellite, suborbital, ground based observations, coupled with laboratory studies and model calculations to assess potential for future ozone depletion in the Arctic. Characterize properties and distributions of clouds and aerosols as they relate to the extinction of solar radiation in the atmosphere. Specific output: first release of validated Aura data. Progress toward achieving outcomes will be validated by external review. See Atmospheric Composition Roadmap

Outcome 1.1.2 *Predict the global distribution of tropospheric ozone and the background concentration in continental near-surface air to within 25% by 2014.*

5ESS1 Integrate satellite, suborbital, ground based observations, coupled with laboratory studies and model calculations to assess potential for future ozone depletion in the arctic. Characterize properties and distributions of clouds and aerosols as they relate to the extinction of solar radiation in the atmosphere. Specific output: first release of validated Aura data. Progress toward achieving outcomes will be validated by external review. See Atmospheric Composition Roadmap.

Outcome 1.1.3 *Enable extension of air quality forecasts for ozone and aerosols from 24 to 72 hours by 2010.*

5ESS1 Integrate satellite, suborbital, ground based observations, coupled with laboratory studies and model calculations to assess potential for future ozone depletion in the arctic. Characterize properties and distributions of clouds and aerosols as they relate to the extinction of solar radiation in the atmosphere. Specific Output: first release of validated Aura data. Progress will be validated by external review. See Atmospheric Composition Roadmap.

Outcome 1.1.4 *Use satellite data to help enable decreased hurricane landfall uncertainty from +/- 400 km to +/- 100 km in the three-day forecasts by 2010.*

5ESS2 Improve predictive capabilities of regional models using satellite-derived localized temperature and moisture profiles and ensemble modeling. Progress toward achieving outcomes will be validated by external review. See Weather Roadmap.

Outcome 1.1.5 *Use satellite data to help extend more accurate regional weather forecasting from 3 days to 5 days by 2010.*

5ESS2 Improve predictive capabilities of regional models using satellite-derived localized temperature and moisture profiles and ensemble modeling. Progress toward achieving outcomes will be validated by external review. See Weather Roadmap.

Outcome 1.1.6 *Develop projections of future atmospheric concentrations of carbon dioxide and methane for 10-100 years into the future with improvements in confidence of >50% by 2014.*

5ESS3 Reduce land cover errors in ecosystem and carbon cycle models, and quantify global terrestrial and marine primary productivity and its interannual variability. Specific output: Produce a multi-year global inventory of fire occurrence and extent. Progress toward achieving outcomes will be validated by external review. See Carbon Cycles and Ecosystems Roadmap.

Outcome 1.1.7 *By 2014, develop in partnership with other agencies, credible ecological forecasts that project the sensitivities of terrestrial and aquatic ecosystems to global environmental changes for resource management and policy-related decision-making.*

5ESS4 Reduce land cover errors in ecosystem and carbon cycle models, and quantify global terrestrial and marine primary productivity and its interannual variability. Specific Output: Release first synthesis of results from research on the effects of deforestation and agricultural land use in Amazonia. Progress toward achieving outcomes will be validated by external review. See Carbon Cycle and Ecosystems Roadmap.

Outcome 1.1.8 *Report changes in global land cover, productivity, and carbon inventories with accuracies sufficient for use in the food industry, in evaluating resource management activities, and in verifying inventories of carbon emissions and storage.*

5ESS5 Reduce land cover errors in ecosystem and carbon cycle models, and quantify global terrestrial and marine primary productivity and its interannual variability. Specific output: Improve knowledge of processes affecting carbon flux within the coastal zone, as well as sources and sinks of aquatic carbon, to reduce uncertainty in North American carbon models. Progress toward achieving outcomes will be validated by external review. See Carbon Cycle and Ecosystems Roadmap.

Outcome 1.1.9 *Enable development of seasonal precipitation forecasts with > 75% accuracy by 2014.*

5ESS6 Enhance land surface modeling efforts, which will lead to improved estimates of soil moisture and run-off. Specific output: launch Cloudsat. Progress toward achieving outcomes will be validated by external review. See Water and Energy Cycle Roadmap.

Outcome 1.1.10 *Improve estimates of the global water and energy cycles by 2012 to enable balancing of the global and regional water and energy budgets to within 10%.*

5ESS6 Enhance land surface modeling efforts, which will lead to improved estimates of soil moisture and run-off. Specific output: launch Cloudsat. Progress toward achieving outcomes will be validated by external review. See Water and Energy Cycle Roadmap.

Outcome 1.1.11 *Reduce uncertainty in global sea level change projections by 50% by the year 2014, and include regional estimates of deviation from global mean.*

5ESS7 Assimilate satellite/in situ observations into variety of ocean, atmosphere, and ice models for purposes of state estimation; provide experimental predictions on variety of climatological timescales; determine plausibility of these predictions using validation strategies. Specific output: documented assessment of relative impact of different climate forcings on long-term climate change and climate sensitivities to those various forcings. See Climate, Variability and Change Roadmap.

Outcome 1.1.12 *Enable 10-year or longer climate forecasts by the year 2014 with a national climate modeling framework capable of supporting policy decision-making at regional levels.*

5ESS8 Assimilate satellite/in situ observations into variety of ocean, atmosphere, and ice models for purposes of state estimation; provide experimental predictions on variety of climatological timescales; determine plausibility of these predictions using validation strategies. Specific output: An assimilated product of ocean state on a quarter degree grid. See Climate, Variability and Change roadmap.

Outcome 1.1.13 *Enable 30-day volcanic eruption forecasts with > 50% confidence by 2014.*

5ESS9 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. Progress toward achieving outcomes will be validated by external review. See Earth Surface and Interior Roadmap.

Outcome 1.1.14 *Enable estimation of earthquake likelihood in North American plate boundaries with > 50% confidence by 2014.*

5ESS9 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. Progress toward achieving outcomes will be validated by external review. See Earth Surface and Interior Roadmap.

Objective 1.2 Expand and accelerate the realization of economic and societal benefits from Earth science, information, and technology.

Outcome 1.2.1 *By 2012, benchmark the assimilation of observations (geophysical parameters, climate data records) provided from 20 of the 80 remote sensing systems deployed on the flotilla of 18-22 NASA Earth observation research satellites.*

5ESA1 Crosscutting Solutions: Work within the Joint Agency Committee on Imagery Evaluation and the Commercial Remote Sensing Policy Working Group through partnerships with NIMA, USGS, NOAA, and USDA to verify/validate at least two commercial remote sensing sources/products for Earth science research, specifically with respect to land use/land cover observations for carbon cycle and water cycle research.

5ESA2 National Apps: Benchmark measurable enhancements to at least 2 national decision support systems using NASA results, specifically in the Disaster Management and Air Quality communities. These projects will benchmark the use of observations from 5 sensors from NASA research satellites.

5ESA3 Crosscutting Solutions: Expand DEVELOP (Digital Earth Virtual Environment and Learning Outreach Project) human capital development program to increase the capacity for the Earth science community at a level of 100 program graduates per year and perform significant student-led activities using NASA research results for decision support with representation in 30 states during the fiscal year.

5ESA4 Crosscutting Solutions: Benchmark solutions from at least 5 projects that were selected in FY03 REASoN program to serve national applications through projects that support decision support in areas such as agriculture, public health and water quality. These projects will benchmark use of observations from at least 5 sensors from NASA research satellites.

Outcome 1.2.2 By 2012, benchmark the assimilation of 5 specific types of predictions resulting from Earth Science Model Framework (ESMF) of 22 NASA Earth system science models.

5ESA5 The DEVELOP (Digital Earth Virtual Environment and Learning Outreach Project) program will advance the capacity of our future workforce with students from at least 20 states working to develop and deliver benchmark results of at least 4 rapid prototype projects using NASA Earth science research results in decision support tools for state, local and tribal government applications.

5ESA6 Crosscutting Solutions: Benchmark solutions associated with at least 5 decision support systems that assimilate predictions from Earth system science models (e.g. GISS, GFDL, NCEP, SpoRT, and the Earth Science laboratories).

Outcome 1.2.3 By 2012, benchmark the assimilation of observations and predictions resulting from NASA Earth Science research in 8-10 decision support systems serving national priorities and the missions of federal agencies.

5ESA7 National applications: Benchmark enhancements to at least 2 national decision support systems using NASA results, specifically in the Disaster Management, Public Health, and Air Quality communities. These projects will benchmark the use of observations from 5 sensors from NASA research satellites.

5ESA8 Crosscutting Solutions: Verify and validate solutions for at least 5 decision support systems in areas of national priority associated with the FY03 selected REASoN projects.

Objective 1.3 Understand the origins and societal impacts of variability in the Sun-Earth connection.

Outcome 1.3.1 Develop the capability to predict solar activity and the evolution of solar disturbances as they propagate in the heliosphere and affect the Earth.

5SEC2 Successfully complete Solar Dynamics Observatory (SDO) Critical Design Review (CDR).

5SEC3 Successfully complete THEMIS Critical Design Review (CDR).

5SEC6 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.

Outcome 1.3.2 Specify and enable prediction of changes to the Earth's radiation environment, ionosphere, and upper atmosphere.

5SEC4 Complete Announcement of Opportunity (AO) Selection for Geospace Missions far ultraviolet Imager

5SEC7 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.

Outcome 1.3.3 Understand the role of solar variability in driving space climate and global change in the Earth's atmosphere.

5SEC8 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.

Objective 1.4 Catalog and understand potential impact hazards to Earth from space.

Outcome 1.4.1 *By 2008, inventory at least 90 percent of asteroids and comets larger than 1 km in diameter that could come near Earth.*

5SSE5 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.

Outcome 1.4.2 *Determine the physical characteristics of comets and asteroids relevant to any threat they may pose to Earth.*

5SSE1 Successfully launch Deep Impact.

5SSE6 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.

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

Outcome 2.1.1 *By 2005, research, develop, and transfer technologies that will enable the reduction of the aviation fatal accident rate by 50% from the FY 1991-1996 average.*

5AT1 Evaluate and flight validate selected next generation cockpit weather information, communications, airborne weather reporting, turbulence prediction and warning technologies, Synthetic Vision System and Runway Incursion Prevention System display concepts. The flight demonstration will illustrate the increased safety of integrating selected concepts in support of fleet implementation decisions. (AvSSP)

5AT2 Demonstrate through applications and simulations safety-improvement systems that will illustrate the increased safety of integrating selected concepts in support of fleet implementation decisions. (AvSSP)

Outcome 2.1.2 *By 2009, research, develop & transfer technologies that will reduce the vulnerability exposure of the aircraft, and reduce the vulnerabilities of other components in the air transportation system.*

5AT3 Create and establish a prototype data collection system for confidential, non-punitive reporting on aviation security by functional personnel in the aviation system.

5AT16 Develop a preliminary joint research plan with the Transportation Security Administration (TSA). (AvSSP)

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

Outcome 2.2.1 *By 2007, develop, demonstrate and transfer technologies that enable a reduction by half, in community noise due to aircraft, based on the 1997 state of the art.*

5AT4 Using laboratory data and systems analysis, complete selection of the technologies that show the highest potential for reducing commercial air transportation noise by at least 50%.(Vehicle Systems)

Outcome 2.2.2 *By 2007, develop, demonstrate and transfer technologies for reducing NOx emission by 70% from the 1996 ICAO standard, to reduce smog and lower atmospheric ozone.*

5AT5 Demonstrate 70% reduction NOx emissions in full-annular rig tests of candidate combustor configurations for large subsonic vehicle applications (Vehicle Systems).

Outcome 2.2.3 *By 2007, develop, demonstrate and transfer technologies for reducing the green-house gas, CO2, emissions by 25% based on the state of the art for airframe and engine component technologies in 2000.*

5AT6 Based on laboratory data and systems analysis, select unconventional engine or power systems for technology development that show highest potential for reducing CO2 emissions and/or enabling advanced air vehicles for new scientific missions. (Vehicle Systems)

5AT7 Complete laboratory aerodynamic assessment of low-drag slotted wing concept. (Vehicle Systems)

5AT19 Complete supersonic inlet design requirements study that will identify technology gaps and priorities required for design of future efficient long range supersonic propulsion systems. (Vehicle Systems)

5AT27 Demonstrate through sector testing a full scale CMC turbine vane that will reduce cooling flow requirements and thus fuel burn in future turbine engine system designs. (Vehicle Systems)

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

Outcome 2.3.2 *By 2005, develop, demonstrate and transfer key enabling capabilities for a small aircraft transportation system.*

5AT10 Complete experimental validation of airborne systems with concept vehicle development

Outcome 2.3.3 *By 2009, develop, demonstrate, and transfer technologies that enable a further 5% increase in throughput in the terminal area and a further 10% increase in en route throughput based on 1997 NAS capacity.*

5AT8 Complete development of WakeVAS concept of operations and downselect WakeVAS architecture.

5AT9 Complete human-in-the-loop concept and technology evaluation of shared separation. (Airspace Systems)

5AT11 Complete analysis of capacity-increasing operational concepts and technology roadmaps with VAST models, simulations, and Common Scenario Set. (Airspace Systems)

5AT12 Develop display guidelines that exploit new understanding of perceptual systems and cognitive and physiological determinants of human performance. (Airspace Systems)

5AT13 Establish the fluid dynamics mechanism for alleviating wake through experimental and computational fluid mechanics studies. (Airspace Systems)

5AT14 Complete System-Wide Evaluation and Planning Tool initial simulation and field demonstration. (Airspace Systems)

5AT15 Complete communications, navigation, and surveillance requirements analysis. (Airspace Systems)

5AT22 Using laboratory data and systems analysis, complete selection of the technologies that show the highest potential for reducing takeoff/landing field length while maintaining cruise Mach, low speed controllability and low noise. (Vehicle Systems)

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

Objective 3.1 Enhance the Nation's security through partnerships with DoD, the Department of Homeland Security and other U.S. or international government agencies.

Outcome 3.1.3 *By 2012, in partnership with the Department of Homeland Security, the Department of Defense, and the Department of State, deliver 15 observations and 5 model predictions for climate change, weather prediction and natural hazards to national and global organizations and decision-makers to evaluate 5 scenarios and optimize the use of Earth resources (food, water, energy, etc.) for homeland security, environmental security and economic security.*

5ESA9 Benchmark the use of predictions from 2 NASA Earth system science models (including the GISS 1200 and NCEP weather prediction) for use in national priorities, such as support for the Climate Change Science Program (CCSP) and Climate Change Technology Program (CCTP) and the NOAA National Weather Service.

5ESA10 Benchmark the use of observations and predictions of Earth science research results in 2 scenarios assessment tools, such as tools used by the Environmental Protection Agency (specifically in the Community Multi-scale and Air Quality (CMAQ) Improvement Program tools) and the Department of Energy.

Outcome 3.1.4 *Demonstrate effective international collaboration on the International Space Station.*

5ISS1 In concert with the ISS International Partners, extend a continuous two-person (or greater) crew presence on the ISS through the end of FY2004.

Outcome 3.1.5 *Transfer technology both to and from the Department of Defense.*

5AT17 Complete NASA / Industry / DoD studies of heavy-lift Vertical Take Off and Landing (VTOL) configurations to provide strategic input for future decisions on commercial / military Runway Independent Vehicles. (Vehicle Systems)

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

Outcome 3.2.1 On an annual basis, develop 50 new technology transfer agreements with the Nation's industrial and entrepreneurial sectors.

5HRT18 Complete 50 technology transfer agreements with the U.S. private sector for the transfer of NASA technologies, through hardware licenses, software usage agreements, facility usage agreements or Space Act Agreements.

Outcome 3.2.2 By 2008, realign commercial product development to focus on NASA needs, while maintaining industrial partnerships.

5RPFS1 Implement SPD realignment plan by establishing three partnerships between SPD and other divisions of OBPR.

5RPFS2 Involve RPC industrial partners in at least one new project that directly benefits NASA's mission.

Outcome 3.2.3 By 2008, develop and test at least two design tools for advanced materials and in-space fabrication, and validate on ISS.

5RPFS3 Based on present manifest, begin on-orbit containerless processing of new ceramic materials using Space-DRUMS hardware installed on ISS.

Outcome 3.2.4 By 2008, working with all OBPR research organizations and other NASA enterprises, identify at least three additional users of Research Partnership Center spaceflight hardware.

5RPFS4 Promote availability of RPC-built spaceflight hardware throughout NASA utilizing the new database.

5RPFS5 Implement hardware sharing system.

5RPFS6 Identify and develop a working relationship with at least one new non-SPD user of RPC-built spaceflight hardware.

Outcome 3.2.5 By 2008, increase by 30% (from the 2003 level) the utilization of NASA/OBPR-derived technologies by other agencies, private sector, and academia to advance basic and applied research goals of practical impact.

5PSR1 Develop a multi-agency collaboration for research at the interface between the physical and life sciences, and enhance collaborative efforts with other agencies and the private sector on biotechnology, materials research, and optical diagnostics for health research.

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

Outcome 3.3.1 By 2008, analyze the impact of the results of the first phase of ISS and ground-based research in Biotechnology, fundamental science, and engineering to demonstrate the introduction of at least two new design tools and/or process improvements to existing technologies and industrial practices.

5PSR2 Continue a productive ground and flight-based research program in Combustion, Fluid Physics, Biotechnology, and Materials science, and carry out the milestones for all ISS research projects.

Outcome 3.3.2 By 2008, quantitatively assess the impact of space and ground-based research on fire safety hazard prevention and containment and on energy conversion to demonstrate measurable risk reduction and increased efficiency.

5PSR3 Publish the results of STS-107 investigations based on available data in microgravity combustion research, and maintain a productive ground and flight-based program in fundamental and strategic combustion and reactive flows research.

Outcome 3.3.3 By 2008, develop at least three new leveraged research partnerships with industry, academia, and other government agencies that improve NASA spacecraft safety.

5RPFS7 Develop a prototype system based on one new enabling technology to improve the safety of space transportation systems

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.

Objective 4.1 Determine how fundamental biological processes of life respond to gravity and space environments.

Outcome 4.1.1 *Use ground-based simulators and ISS to determine gravity responses for at least five model organisms by 2008.*

5BSR1 Solicit ground-based research on three widely studied model organisms.

5BSR2 Implement a tactical plan for plant research and solicit studies appropriate to that plan on at least two model plant species.

Outcome 4.1.2 *Develop predictive models of cellular, pathogenic, and ecological responses to space for at least two organisms by 2008.*

5BSR3 Solicit ground-based research on responses of cells and pathogens to space environments.

5BSR4 Initiate intra- and interagency programs to study microbial ecology and evolution

Outcome 4.1.3 *By 2008, structure the Fundamental Space Biology flight research program to emphasize at least five model organisms and teams of Principal Investigators.*

5BSR5 Develop selected flight research experiments on two model organisms in coordination with research teams for identified flight opportunities.

5BSR6 Align reprioritized fundamental biology flight experiments with available hardware and hardware development.

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

Outcome 4.2.1 *By 2008, complete the first generation of ISS research in colloidal physics and soft condensed matter and demonstrate the ability to control the colloidal engineering of at least two different model structures.*

5PSR4 Continue flight and ground-based research in colloidal physics and soft-condensed matter, and accomplish the project milestones for the ISS research program in fluid physics.

Outcome 4.2.2 *By 2008, complete the design and fabrication of the first ISS fundamental microgravity physics facility to allow the performance of two capstone investigations in dynamical critical phenomena.*

5PSR5 Continue the development of the ISS fundamental physics facility for low temperature and condensed matter physics, and maintain a productive ground-based research program in condensed matter physics.

Outcome 4.2.3 *By 2008, complete the design for the ISS laser-cooling laboratory and demonstrate the feasibility to deploy the most accurate atomic clock in space.*

5PSR6 Continue the development of the ISS laser cooling and atomic facility by accomplishing the project milestones, and maintain an innovative and outstanding ground research program in atomic and gravitational physics.

Outcome 4.2.4 *By 2008, complete the first phase of the ISS biotechnology facility and demonstrate cellular biotechnology research throughput increase by a factor of two.*

5PSR7 Continue the development of the ISS Biotechnology Facility and maintain a productive and innovative ground and space research program in cellular biotechnology and tissue engineering.

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

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

Outcome 5.1.1 *Understand the initial stages of planet and satellite formation.*

5SSE2 Complete integration and testing for New Horizons/Pluto.

5SSE4 Release a NASA Research Announcement (NRA) for In Space Power and Propulsion technology development activities (NOTE: this APG could potentially support multiple SSE research focus areas).

5SSE7 Successfully demonstrate progress in understanding the initial stages of planet and satellite formation. Progress towards achieving outcomes will be validated by external review.

Outcome 5.1.2 *Understand the processes that determine the characteristics of bodies in our solar system and how these processes operate and interact.*

5SSE8 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.

Outcome 5.1.3 *Understand why the terrestrial planets are so different from one another.*

5SSE9 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.

Outcome 5.1.4 *Learn what our solar system can tell us about extra-solar planetary systems.*

5SSE10 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.

Objective 5.2 Understand how life begins and evolves and determine the characteristics of the solar system that led to the origin of life.

Outcome 5.2.1 *Determine the nature, history, and distribution of volatile and organic compounds in the solar system.*

5SSE3 Select the next New Frontiers mission (NOTE: this APG could potentially support multiple SSE research focus areas).

5SSE11 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.

Outcome 5.2.2 *Identify the habitable zones in the solar system.*

5SSE12 Successfully demonstrate progress in identifying the habitable zones in the solar system. Progress towards achieving outcomes will be validated by external review.

Outcome 5.2.3 *Identify the sources of simple chemicals that contribute to pre-biotic evolution and the emergence of life.*

5SSE13 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.

Outcome 5.2.4 *Study Earth's geologic and biologic records to determine the historical relationship between Earth and its biosphere.*

5SSE14 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.

Objective 5.3 Understand the current state and evolution of the atmosphere, surface, and interior of Mars.

Outcome 5.3.1 *Characterize the present climate of Mars and determine how it has evolved over time.*

5MEP5 Successfully complete the Mission Concept Review and PMSR for the 2009 Mars Telesat Orbiter (NOTE: this APG supports all MEP research focus areas).

5MEP7 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.

Outcome 5.3.2 Understand the history and behavior of water and other volatiles on Mars.

5MEP1 Successfully complete Assembly, Test, and Launch Operations (ATLO) for the Mars Reconnaissance Orbiter mission.

5MEP2 Successfully launch the Mars Reconnaissance Orbiter.

5MEP8 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.

Outcome 5.3.3 Understand the chemistry, mineralogy, and chronology of Martian materials.

5MEP9 Successfully demonstrate progress in studying the chemistry, mineralogy, and chronology of Martian materials. Progress towards achieving outcomes will be validated by external review.

Outcome 5.3.4 Determine the characteristics and dynamics of the interior of Mars.

5MEP10 Successfully demonstrate progress in determining the characteristics and dynamics of the interior of Mars. Progress towards achieving outcomes will be validated by external review.

Objective 5.4 Determine if life exists or has ever existed on Mars.

Outcome 5.4.1 Understand the character and extent of prebiotic chemistry on Mars.

5MEP4 Successfully complete the Preliminary Mission System Review (PMSR) for the 2009 Mars Science Laboratory (MSL) Mission.

5MEP6 Successfully complete Preliminary Design Review (PDR) for Laser Communication Demonstration (NOTE: this APG supports all MEP research focus areas).

5MEP11 Successfully demonstrate progress in investigating the character and extent of prebiotic chemistry on Mars. Progress towards achieving outcomes will be validated by external review.

Outcome 5.4.2 Search for chemical and biological signatures of past and present life on Mars.

5MEP3 Complete science instrument selections for the 2009 Mars Science Laboratory (MSL).

5MEP12 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.

Objective 5.5 Develop an understanding of Mars in support of future human exploration.

Outcome 5.5.1 Identify and understand the hazards that the Martian environment will present to human explorers.

5MEP13 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.

Outcome 5.5.2 Inventory and characterize Martian resources of potential benefit to human exploration of Mars.

5MEP14 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.

Objective 5.6 Understand the changing flow of energy and matter throughout the Sun, heliosphere, and planetary environments.

Outcome 5.6.1 Understand the structure and dynamics of the Sun and solar wind and the origins of magnetic variability.

5SEC1 Complete Solar Terrestrial Relations Observatory (STEREO) instrument integration.

5SEC9 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.

Outcome 5.6.2 Determine the evolution of the heliosphere and its interaction with the galaxy.

5SEC10 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.

Outcome 5.6.3 *Understand the response of magnetospheres and atmospheres to external and internal drivers.*

5SEC11 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.

Objective 5.7 Understand the fundamental physical processes of space plasma systems.

Outcome 5.7.1 *Discover how magnetic fields are created and evolve and how charged particles are accelerated.*

5SEC12 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

Outcome 5.7.2 *Understand coupling across multiple scale lengths and its generality in plasma systems.*

5SEC13 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

Objective 5.8 Learn how galaxies, stars, and planetary systems form and evolve.

Outcome 5.8.1 *Learn 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.*

5ASO4 Demonstrate James Webb Space Telescope (JWST) primary mirror technology readiness by testing a prototype in a flight-like environment.

5ASO5 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.

Outcome 5.8.2 *Understand how different galactic ecosystems of stars and gas formed and which ones might support the existence of planets and life.*

5ASO6 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.

Outcome 5.8.3 *Learn how gas and dust become stars and planets.*

5ASO7 Successfully demonstrate progress in learning how gas and dust become stars and planets. Progress towards achieving outcomes will be validated by external review.

Outcome 5.8.4 *Observe planetary systems around other stars and compare their architectures and evolution with our own.*

5ASO3 Demonstrate system-level instrument pointing precision consistent with SIM's flight system basic performance requirements, as specified in program plan.

5ASO8 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.

Objective 5.9 Understand the diversity of worlds beyond our solar system and search for those that might harbor life.

Outcome 5.9.1 *Characterize the giant planets orbiting other stars.*

5ASO9 Successfully demonstrate progress in characterizing the giant planets orbiting other stars. Progress towards achieving outcomes will be validated by external review.

Outcome 5.9.2 *Find out how common Earth-like planets are and see if any might be habitable.*

5ASO2 Successfully complete the Kepler mission Preliminary Design Review (PDR).

5ASO10 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.

Outcome 5.9.3 *Trace the chemical pathways by which simple molecules and dust evolve into the organic molecules important for life.*

5ASO1 Deliver the SOFIA Airborne Observatory to Ames Research Center for final testing.

5ASO11 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.

Outcome 5.9.4 Develop the tools and techniques to search for life on planets beyond our solar system.

5ASO12 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.

Objective 5.10 Discover what powered the Big Bang and the nature of the mysterious dark energy that is pulling the Universe apart.

Outcome 5.10.1 Search for gravitational waves from the earliest moments of the Big Bang.

5SEU4 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.

Outcome 5.10.2 Determine the size, shape, and matter-energy content of the Universe.

5SEU5 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.

Outcome 5.10.3 Measure the cosmic evolution of dark energy.

5SEU6 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

Objective 5.11 Learn what happens to space, time, and matter at the edge of a black hole.

Outcome 5.11.1 Determine how black holes are formed, where they are, and how they evolve.

5SEU7 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.

Outcome 5.11.2 Test Einstein’s theory of gravity and map space-time near event horizons of black holes.

5SEU8 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.

Outcome 5.11.3 Observe stars and other material plunging into black holes.

5SEU9 Successfully demonstrate progress in observing stars and other material plunging into black holes. Progress towards achieving outcomes will be validated by external review.

Objective 5.12 Understand the development of structure and the cycles of matter and energy in the evolving Universe.

Outcome 5.12.1 Determine how, where, and when the chemical elements were made, and trace the flows of energy and magnetic fields that exchange them between stars, dust, and gas.

5SEU10 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.

Outcome 5.12.2 Explore the behavior of matter in extreme astrophysical environments, including disks, cosmic jets, and the sources of gamma-ray bursts and cosmic rays.

5SEU1 Complete the integration and testing of the Gamma-ray Large Area Space Telescope (GLAST) spacecraft bus.

5SEU11 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.

Outcome 5.12.3 Discover how the interplay of baryons, dark matter, and gravity shapes galaxies and systems of galaxies.

5SEU12 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.

Objective 5.13 Through robotic and human lunar missions, demonstrate capabilities, including use of lunar and other space resources, for safe, affordable, effective and sustainable human-robotic solar system exploration.

Outcome 5.13.1 *Develop capability to conduct robotic lunar test bed missions by 2008 and human lunar missions as early as 2015 but no later than 2020 that can demonstrate exploration systems and architectural approaches, including use of lunar resources, to enable human-robotic exploration across the solar system.*

5LE1 Identify and define preferred human-robotic exploration systems concepts and architectural approaches for validation through lunar missions.

5LE2 Identify candidate architectures and systems approaches that can be developed and demonstrated through lunar missions to enable a safe, affordable and effective campaign of human-robotic Mars exploration.

Outcome 5.13.2 *Conduct robotic missions, in lunar orbit and on the lunar surface, to acquire engineering and environmental data by 2015 required to prepare for human-robotic lunar missions.*

5LE3 Establish a baseline plan and Level 1 requirements to utilize the robotic lunar orbiter(s) and robotic lunar surface mission(s) to collect key engineering data and validate environmental characteristics and effects that might affect later robotics, astronauts and supporting systems.

5LE4 Identify candidate scientific research and discovery opportunities that could be pursued effectively during robotic lunar missions.

Outcome 5.13.3 *By 2020, establish through lunar surface missions the building block capabilities to support safe, affordable and effective long-duration human presence beyond low Earth orbit (LEO) as a stepping-stone to sustained human-robotic exploration and discovery beyond the Moon.*

5LE5 Establish a viable investment portfolio for development of human support systems, including human/machine extravehicular activity (EVA) systems, locally autonomous medical systems and needed improvements in human performance and productivity beyond low Earth orbit (LEO).

Outcome 5.13.4 *By 2015, demonstrate new human-robotic space operations capabilities employing advanced in-space infrastructures, including space assembly, maintenance and servicing, and logistics concepts.*

5LE6 Identify preferred approaches for development and demonstration during lunar missions to enable transformational space operations capabilities.

5LE7 Conduct reviews with international and U.S. government partners, to determine common capability requirements and opportunities for collaboration.

Mission III: To Inspire the Next Generation of Explorers

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

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

Outcome 6.1.1 *By 2008, increase by 20%, student participation in NASA instructional and enrichment activities.*

5ED1 Increase NASA student participation by 5% above baseline

Outcome 6.1.2 *By 2008, increase by 20%, the number of elementary and secondary educators effectively utilizing NASA content-based STEM materials and programs in the classroom.*

5ED2 Increase NASA teacher participation by 5% above baseline.

Outcome 6.1.3 *By 2008, increase by 20%, family involvement in NASA-sponsored elementary and secondary education programs.*

5ED3 Increase existing NASA-sponsored family involvement activities and existing and potential partners by 5% over baseline

Outcome 6.1.4 *By 2008, 90% of NASA elementary and secondary programs are aligned with state or local STEM educational objectives.*

5ED4 25% of NASA elementary and secondary programs are aligned with state or local STEM educational objectives.

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

Outcome 6.2.1 *By 2008, attain a statistically significant increase in the number and diversity of NASA-supported students graduating in NASA-related fields.*

5ED5 Establish a NASA-wide baseline of the diversity of NASA-supported students.

Outcome 6.2.2 *By 2008, attain a statistically significant increase in the number of faculty in higher education institutions who are first-time proposers in NASA research and development opportunities.*

5ED6 Use existing higher education programs to assist and encourage first time faculty proposers for NASA research and development opportunities.

Outcome 6.2.3 *By 2008, increase by 20% the number of higher education institutions that align their NASA research and development activities with STEM teacher preparation departments to improve STEM teacher quality.*

5ED7 Establish a baseline of institutions receiving NASA research and development grants and contracts that link their research and development to the institution's school of education.

Outcome 6.2.4 *By 2008, increase by 10% the number and diversity of students conducting NASA-relevant research.*

5ED8 Establish a baseline of the number and diversity of students conducting NASA-relevant research.

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

Outcome 6.3.1 *By 2008, increase by 20%, underrepresented/underserved NASA-sponsored students who pursue academic degrees in NASA-related STEM disciplines.*

5ED9 Increase NASA underrepresented/underserved student participation by 5% over baseline.

Outcome 6.3.2 *By 2008, increase by 20%, the number and diversity of teachers and faculty from underrepresented/underserved communities and institutions who participate in NASA-related STEM programs.*

5ED10 Increase NASA underrepresented/underserved teacher/faculty participation in NASA STEM-related learning environments by 5% over baseline.

Outcome 6.3.3 *By 2008, increase by 20% the number of underrepresented/underserved researchers and minority serving institutions that compete for NASA research and development opportunities.*

5ED11 Increase the numbers of underserved/underrepresented researchers and minority serving institutions competing for NASA research announcements by 5% above baseline.

Outcome 6.3.4 *By 2008, increase family involvement in underrepresented/underserved NASA-sponsored student programs.*

5ED12 Establish a baseline of family involvement in underrepresented/underserved NASA-sponsored student programs.

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

Outcome 6.4.1 *By 2008, identify and implement 4 new advanced technology applications that will positively impact learning.*

5ED13 Implement 1 new advanced technology application.

Outcome 6.4.2 *By 2008, demonstrate the effectiveness of NASA digital content materials in targeted learning environments.*

5ED14 Evaluate the 50 pilot NASA Explorer Schools, utilizing a design experiment approach.

Outcome 6.4.3 *By 2008, establish a technology infrastructure that meets citizen demand for NASA learning services.*

5ED15 Develop a plan for establishing a technology infrastructure.

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

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

Outcome 7.1.1 *By 2008, establish a national program to engage the informal education community with NASA Science and Technology.*

5ED16 Implement Phase 1 of a plan to increase appreciation of the relevance and role of NASA science and technology.

Outcome 7.1.2 *By 2008 provide instructional materials derived from NASA research and scientific activities that meet the needs of NASA's informal education partners.*

5ED17 Develop a plan to assess and prioritize high-leverage and critical informal education programs and educational involvement activities.

Outcome 7.1.3 *By 2008 provide professional development for NASA's informal education partners.*

5ED18 Develop a plan to assess current NASA professional development programs for relevance to the targeted informal learning environments.

Outcome 7.1.4 *Engage the public in NASA missions, discoveries and technology through public programs, community outreach, mass media, and the Internet.*

5AT18 Partner with museums and other cultural organizations and institutions to engage non-traditional audiences in NASA missions.

5ESA11 Provide in public venues at least 50 stories on the scientific discoveries, the practical benefits, or new technologies sponsored by the Earth Science Enterprise.

5ESS10 Post the most exciting imagery and explanations about Earth science on the Earth observations/ESE website.

5RPFS8 Through collaboration with PAO, establish and sustain a series of media briefings highlighting OBPR research.

5RPFS9 Expand outreach activities that reach minority and under-represented sectors of the public, through increased participation in conferences and community events that reflect cultural awareness and outreach. Each fiscal year, increase the previous year baseline by supporting at least one new venue that focuses on these public sectors.

Exploration Capabilities

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

Objective 8.1 Assure safe, affordable, and reliable crew and cargo access and return from the International Space Station.

Outcome 8.1.1 Acquire non-Shuttle, crew and cargo access and return capability for the Station by 2010.

5ISS7 Baseline a strategy and initiate procurement of cargo delivery service to the ISS.

Objective 8.3 Improve the accessibility of space via the Space Shuttle to better meet Space Station assembly, operations, and research requirements.

Outcome 8.3.1 Assure public, flight crew, and workforce safety for all Space Shuttle operations and safely meet the manifest and flight rate commitment through completion of Space Station assembly.

5SSP1 Achieve zero Type-A (damage to property at least $1M or death) or Type-B (damage to property at least $250K or permanent disability or hospitalization of three or more persons) mishaps in FY 2005

5SSP2 Achieve an average of eight or fewer flight anomalies per Space Shuttle mission in FY 2005

5SSP3 Achieve 100 percent on-orbit mission success for all Shuttle missions launched in FY 2005. 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.

Objective 8.4 Assure capabilities for world-class research on a laboratory in low Earth orbit.

Outcome 8.4.1 Provide a safe, reliable, and well-managed on-orbit research facility.

5ISS2 Achieve zero Type-A (damage to property at least $1M or death) or Type-B (damage to property at least $250K or permanent disability or hospitalization of 3 or more persons) mishaps in FY2004.

5ISS3 Based on the Space Shuttle return-to-flight plan, establish a revised baseline for ISS assembly (through International Core Complete) and research support.

5ISS4 Provide at least 80% of up-mass, volume and crew-time for science as planned at the beginning of FY2004. (Supports Objective 1.1, 3.5, 4.1 and 4.2)

Outcome 8.4.2 Expand the ISS crew size to accommodate U.S. and International Partner research requirements.

5ISS5 Obtain agreement among the International Partners on the final ISS configuration.

Objective 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 safe, well-managed and 95% reliable space communications, rocket propulsion testing, and launch services to meet agency requirements.

5SFS8 Establish the Agency-wide baseline space communications architecture, including a framework for possible deep space and near Earth laser communications services.

5SFS15 Maintain NASA success rate at or above a running average of 95% for missions on the FY2004 Expendable Launch Vehicle (ELV) manifest.

5SFS16 Achieve at least 95% of planned data delivery for the International Space Station, each Space Shuttle mission, and low-Earth orbiting missions in FY2004.

5SFS19 Define and provide space transportation requirements for future human and robotic exploration and development of space to all NASA and other government agency programs pursuing improvements in space transportation.

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

Objective 9.1 Understand human physiological reactions to reduced gravity and develop countermeasures to assure survival of humans traveling far from Earth.

Outcome 9.1.1 *By 2008, develop and test candidate countermeasures using ground-based analysis and space flight.*

5BSR7 Increase the use of space flight analogs on the ground to better define hypotheses for flight experiments

5BSR8 Publish final results of Bioastronautics experiments conducted during ISS increment 8 and preliminary results from Increments 9 and 10.

5BSR9 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.

5BSR10 Under the Human Research Initiative (HRI) increase the number of investigations addressing biomedical issues associated with human space exploration.

5BSR11 Conduct scientific workshops to fully engage the scientific community in defining research strategies for addressing and solving NASA's biomedical risks.

5SFS20 Certify the medical fitness of all crew members before launch.

Outcome 9.1.2 *By 2008, reduce uncertainties in estimating radiation risks by one-half.*

5BSR12 Expand the space radiation research science community to involve cutting edge researchers in related disciplines by soliciting, selecting, and funding high quality research.

5BSR13 Use 1000 hours/yr of beam time at the National Space Radiation Laboratory (NSRL) 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.

5BSR14 Integrate research data collected over the past two years at NSRL, with existing database to develop more accurate predictions resulting in improved biological strategies for radiation risk reduction.

Outcome 9.1.3 *Advance understanding of the role of gravity in biological processes to support biomedical research.*

5BSR15 Maintain a completed, productive, peer-reviewed ground-based research program in appropriate fundamental biology disciplines to lay the groundwork for advanced understanding of the role of gravity in biological processes associated with the human health risk of space flight.

5BSR16 Initiate a nanosatellite program for in-situ analytical technology for producing the fundamental biological understanding necessary for countermeasure development.

Objective 9.2 Develop new human support systems and solutions to low gravity technological challenges to allow the next generation of explorers to go beyond low earth orbit.

Outcome 9.2.1 *Identify & test technologies by 2010 to reduce total mass requirements by a factor of three for Life Support using current ISS mass requirement baseline.*

5BSR17 Demonstrate, through vigorous research and technology development, a 55% reduction in the projected mass of a life support flight system compared to the system base-lined for ISS.

Outcome 9.2.2 *By 2008, develop predictive models for prototype two-phase flow and phase change heat transfer systems for low- and fractional gravity with an efficiency improvement of at least a factor of two over 2003 ISS radiative systems, and prepare ISS experiments for validation.*

5PSR8 Continue Strategic ground-based research in microgravity heat-exchange multi-phase systems and advance existing flight projects toward flight.

Outcome 9.2.3 *By 2008, develop predictive engineering model and prototype systems to demonstrate the feasibility of deploying enhanced space radiation-shielding multi-functional structures with at least a factor of two improvement in shielding efficiency and mass reduction, and prepare a space experiment for validation.*

5PSR9 Continue accumulating data on radiation effects on materials properties and initiate the assessment of the performance of multifunctional materials.

FY 2005 Performance Plan

Objective 9.3. Demonstrate the ability to support a human presence in low Earth orbit as a stepping-stone to human presence beyond.

Outcome 9.3.1 *Develop experience in working and living in space by continuously supporting a crew on-board the ISS through 2016.*

5ISS6 Continuously sustain a crew to conduct research aboard the ISS

Objective 9.4. Develop technologies to enable safe, affordable, effective and sustainable human-robotic exploration and discovery beyond low Earth orbit (LEO).

Outcome 9.4.1 *Identify, develop and validate human-robotic capabilities by 2015 required to support human-robotic lunar missions.*

5HRT1 Establish an integrated, top-down strategy-to-task technology R&D planning process to facilitate the development of human-robotic exploration systems requirements

5HRT2 Execute two systems-focused Quality Function Deployment exercises through an Operational Advisory Group (including both technologists and operators) to better define systems attributes necessary to accomplish human-robotic exploration operational objectives.

5HRT3 Execute selected R&D-focused Quality Function Deployment exercises through an external/internal Technology Transition Team to review candidate human-robotic exploration systems technologies, and provide detailed updates to human-robotic technology road maps.

5HRT4 Test and validate preferred engineering modeling and simulation computational approaches through which viable candidate architectures, systems designs and technologies may be identified and characterized. Select one or more approaches for ongoing use in systems/technology road mapping and planning.

Outcome 9.4.2 *Identify and execute a research and development program to develop technologies by 2015 critical to support human-robotic lunar missions.*

5HRT5 Identify and analyze viable candidates and identify the preferred approach to sustained, integrated human-robotic solar system exploration involving lunar/planetary surfaces and small bodies, and supporting operations. Validate a focused technology R&D portfolio that addresses the needs of these approaches and identifies existing gaps in technological capabilities.

5HRT6 Establish and obtain approval for detailed R&D requirements, roadmaps and program planning in key focused technology development areas, including self-sufficient space systems; space utilities and power; habitation and bioastronautics; space assembly, maintenance and servicing; space transportation; robotic networks; and information technology and communications.

Outcome 9.4.3 *By 2016, develop and demonstrate in space nuclear fission-based power and propulsion systems that can be integrated into future human and robotic exploration missions.*

5HRT7 Develop Level 1/ Level 2 requirements for nuclear power and propulsion systems in support of selected human and robotic exploration architectures and mission concepts.

5HRT8 Complete a validated road map for nuclear power and propulsion R&D, and related vehicle systems technology maturation.

5HRT9 Formulate a demonstration mission plan for Jupiter Icy Moons Orbiter that will test and validate nuclear power and propulsion systems for future human-robotic exploration missions.

Outcome 9.4.4 *Develop and deliver 1 new critical technology every 2 years in at least each of the following disciplines: in-space computing, space communications and networking, sensor technology, modular systems, and engineering risk analysis.*

5HRT15 Complete an Advanced Space Technology Program technology roadmap that interfaces appropriately with the technology planning of NASA's enterprises.

5HRT16 Deliver at least one new critical technology in each key area (including: in-space computing, space communications and networking, sensor technology, modular systems, and engineering risk analysis) to NASA's enterprises, for possible test and demonstration.

5HRT17 Prepare and announce the Centennial Challenge Cycle 2 major award purses, including competition rules, regulations, and judgment criteria.

Objective 9.5. Develop crew transportation systems to enable exploration beyond low Earth orbit (LEO).

Outcome 9.5.1 *By 2014, develop and flight-demonstrate a human exploration vehicle that supports safe, affordable and effective transportation and life support for human crews traveling from the Earth to destinations beyond LEO.*

5TS1 Conduct a detailed review of previous vehicle programs to capture lessons-learned and appropriate technology maturation; incorporate results into the human exploration vehicle requirements definition process.

5TS2 Develop and obtain approval for human exploration vehicle Level 1 and Level 2 Requirements and the resulting Program Plan.

5TS3 Complete preliminary conceptual design(s) for the human exploration vehicle, in conjunction with definition of an integrated exploration systems architecture.

5TS4 Develop launch vehicle Level 1 Requirements for human-robotic exploration within an integrated architecture, and define corresponding programs to assure the timely availability of needed capabilities, including automated rendezvous, proximity operations and docking, modular structure assembly, in space refueling, and launch vehicle modifications and developments.

Outcome 9.5.2 *By 2010, identify and develop concepts and requirements that could support safe, affordable and effective transportation and life support for human crews traveling from the Earth to the vicinity or the surface of Mars.*

5TS5 Conduct a preliminary conceptual design study for a human-robotic Mars exploration vehicle, in conjunction with definition of an integrated exploration systems architecture.

Goal 10: Enable revolutionary capabilities through new technology.

Objective 10.1 Improve the capability to assess and manage risk in the synthesis of complex engineering systems.

Outcome 10.1.1 *By 2005 demonstrate 2 prototype systems that prove the feasibility of resilient systems to mitigate risks in key NASA mission domains. Feasibility will be demonstrated by reconfigurability of avionics, sensors, and system performance parameters.*

5HRT10 Develop prototype design and organizational risk analysis tools to do risk identifications, assessments, mitigation strategies, and key trade-off capabilities not only between risks, but between risks and other mission design criteria.

5HRT11 Develop a robust software tool for accident investigation that can help identify the causes of spacecraft, airplane, and/or other mission hardware accidents.

Objective 10.3 Leverage partnerships between NASA Enterprises, U.S. industrial firms, and the venture capital community for innovative technology development.

Outcome 10.3.1 *Promote and develop innovative technology partnerships between NASA, venture capital firms and U.S. industry for the benefit of all Enterprise mission needs, initiating three partnerships per year.*

5HRT12 Establish three partnerships with U.S. industry and the investment community using the Enterprise Engine concept.

5HRT13 Develop 12 industry partnerships, including the three established using the Enterprise Engine, that will add value to NASA Enterprises.

Outcome 10.3.2 *Facilitate on an annual basis the award of venture capital funds or Phase III contracts to no less than two SBIR firms to further develop or produce their technology through industry or government agencies.*

5HRT14 Achieve through NASBO, the award of Phase III contracts or venture capital funds to no less than two SBIR firms to further develop or produce their technology through industry or government agencies.

Objective 10.5 Create novel aeronautics concepts and technology to support science missions and terrestrial and space applications.

Outcome 10.5.1 *Develop technologies that will enable solar powered vehicles to serve as “sub-orbital satellites” for science missions.*

5AT20 Complete flight demonstration of a second generation damage adaptive flight control system. (Vehicle Systems)

5AT21 Define requirements for a robust, fault-tolerant avionics architecture that supports fully autonomous vehicle concepts. (Vehicle Systems)

5AT24 Complete laboratory aerodynamic assessment of low-drag slotted wing concept. (Vehicle Systems)

5AT25 Based on laboratory data and systems analysis, select unconventional engine or power systems for technology development that show highest potential for reducing CO2 emissions and/or enabling advanced air vehicles for new scientific missions. (Vehicle Systems)

5AT26 Complete initial flight series for validation of improved HALE ROA aero-structural modeling tools used to reduce risk and increase mission success. (Vehicle Systems)

Outcome 10.5.2 *By 2008, develop and demonstrate technologies required for routine Unmanned Aerial Vehicle operations in the National Airspace System above 18,000 feet for High-Altitude, Long-Endurance UAVs.*

5AT23 Demonstrate integrated technologies and policies for UAV flight operations above FL400.(Vehicle Systems)

Implementing Strategies to Conduct Well-Managed Programs

Solar System Exploration

5SSE15 Complete all development projects within 110% of the cost and schedule baseline.

5SSE16 Deliver at least 90% of scheduled operating hours for all operations and research facilities.

5SSE17 At least 80%, by budget, of research projects will be peer-reviewed and competitively awarded.

Mars Exploration Program

5MEP15 Complete all development projects within 110% of the cost and schedule baseline.

5MEP16 Deliver at least 90% of scheduled operating hours for all operations and research facilities.

5MEP17 At least 80%, by budget, of research projects will be peer-reviewed and competitively awarded.

Lunar Exploration Program

5LE8 The Theme will distribute at least 80% of its allocated procurement funding to competitively awarded contracts.

Astronomical Search for Origins

5ASO13 Complete all development projects within 110% of the cost and schedule baseline.

5ASO14 Deliver at least 90% of scheduled operating hours for all operations and research facilities.

5ASO15 At least 80%, by budget, of research projects will be peer-reviewed and competitively awarded.

Structure and Evolution of the Universe

5SEU13 Complete all development projects within 110% of the cost and schedule baseline.

5SEU14 Deliver at least 90% of scheduled operating hours for all operations and research facilities.

5SEU15 At least 80%, by budget, of research projects will be peer-reviewed and competitively awarded.

Sun-Earth Connection

5SEC14 Complete all development projects within 110% of the cost and schedule baseline.

5SEC15 Deliver at least 90% of scheduled operating hours for all operations and research facilities.

5SEC16 At least 80%, by budget, of research projects will be peer-reviewed and competitively awarded.

Earth System Science

5ESS11 Complete all development projects within 110% of the cost and schedule baseline.

5ESS12 Deliver at least 90% of scheduled operating hours for all operations and research facilities.

5ESS13 At least 80%, by budget, of research projects will be peer-reviewed and competitively awarded.

Earth Science Applications

5ESA12 Deliver at least 90% of scheduled operating hours for all operations and research facilities.

5ESA13 At least 80%, by budget, of research projects will be peer-reviewed and competitively awarded.

FY 2005 Performance Plan

Biological Sciences Research

5BSR18 Complete all development projects within 110% of the cost and schedule baseline.

5BSR19 Deliver at least 90% of scheduled operating hours for all operations and research facilities.

5BSR20 At least 80%, by budget, of research projects will be peer-reviewed and competitively awarded.

Physical Sciences Research

5PSR10 Complete all development projects within 110% of the cost and schedule baseline.

5PSR11 Deliver at least 90% of scheduled operating hours for all operations and research facilities.

5PSR12 At least 80%, by budget, of research projects will be peer-reviewed and competitively awarded.

Research Partnerships and Flight Support

5RPFS10 Deliver at least 90% of scheduled operating hours for all operations and research facilities.

Aeronautics Technology

5AT28 This Theme will complete 90% of the major milestones planned for FY 2005.

Education

5ED19 At least 80%, by budget, of research projects will be peer-reviewed and competitively awarded.

Human Robotic Technologies

5HRT15 Distribute at least 80% of allocated procurement funding to competitively awarded contracts, including continuing and new contract activities.

Transportation Systems

5TS6 Distribute at least 80% of allocated procurement funding to competitively awarded contracts, including continuing and new contract activities.

International Space Station

5ISS8 Complete all development projects within 110% of the cost and schedule baseline.

5ISS9 Deliver at least 90% of scheduled operating hours for all operations and research facilities.

Space Shuttle Program

5SSP4 Complete all development projects within 110% of the cost and schedule baseline.

5SSP5 Deliver at least 90% of scheduled operating hours for all operations and research facilities.

Space and Flight Support

5SFS21 Complete all development projects within 110% of the cost and schedule baseline.

5SFS22 Deliver at least 90% of scheduled operating hours for all operations and research facilities.

National Aeronautics and Space Administration Proposed Appropriations Language

EXPLORATION CAPABILITIES

(INCLUDING TRANSFER OF FUNDS)

For necessary expenses, not otherwise provided for, in the conduct and support of exploration 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 therefore, as authorized by 5 U.S.C. 5901-5902; travel expenses; purchase and hire of passenger motor vehicles; not to exceed $35,000 for official reception and representation expenses; and purchase, lease, charter, maintenance and operation of mission and administrative aircraft, $8,456,400,000, to remain available until September 30, 2006, 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 ``Exploration, science and aeronautics'' in accordance with section 312(b) of the National Aeronautics and Space Act of 1958, as amended by Public Law 106-377.

EXPLORATION, SCIENCE AND AERONAUTICS

(INCLUDING TRANSFER OF FUNDS)

For necessary expenses, not otherwise provided for, in the conduct and support of exploration, science and aeronautics 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 restoration, 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 therefore, as authorized by 5 U.S.C. 5901-5902; travel expenses; purchase and hire of passenger motor vehicles; not to exceed $35,000 for official reception and representation expenses; and purchase, lease, charter, maintenance and operation of mission and administrative aircraft, $7,760,000,000, to remain available until September 30, 2006, 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 ``Exploration capabilities'' 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, $27,600,000.

ADMINISTRATIVE PROVISIONS

Notwithstanding the limitation on the availability of funds appropriated for ``exploration, science and aeronautics'', or ``exploration capabilities'' by this appropriations Act, when any activity has been initiated by the incurrence of obligations for construction of facilities or environmental compliance and restoration activities 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.

Proposed Appropriations Language

Notwithstanding the limitation on the availability of funds appropriated for ``Exploration, science and aeronautics'', or ``Exploration capabilities'' by this appropriations Act, the amounts appropriated for construction of facilities shall remain available until September 30, 2007.

From amounts made available in this Act for these activities, the Administration may transfer amounts between Exploration, science and aeronautics'' account and exploration systems of the ``Exploration 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.

The unexpired balances of prior appropriations to NASA for activities for which funds are provided under this Act may be transferred to the new account established for the appropriation that provides such activity under this Act. Balances so transferred may be merged with funds in the newly established account and thereafter may be accounted for as one fund under the same terms and conditions.

GENERAL PROVISIONS

SEC. 417. Section 312 of the National Aeronautics and Space Administration Act of 1958, as amended, is further amended--

(1) by striking the second Sec. ``312'' and inserting ``313'';

(2) by inserting the title, ``Full Cost Appropriations Account Structure'', before Sec. 313;

(3) in subsection (a)--

(A) by striking ``Human space flight'' and inserting ``Exploration Capabilities'';

(B) by striking ``Science, aeronautics and technology'' and inserting ``Exploration, science and aeronautics''; and

(C) by striking ``2002'' and inserting ``2004''; and

(4) by striking subsection (c), and inserting the following new subsection:

``(c) The unexpired balances of prior appropriations to the Administration for activities authorized under this Act may be transferred to the new account established for such activity in subsection (a). Balances so transferred may be merged with funds in the newly established account and thereafter may be accounted for as one fund under the same terms and conditions''.

SEC. 427. Of the amounts available to the National Aeronautics and Space Administration, such sums as maybe necessary for the benefit of the families of the astronauts who died on board the Space Shuttle Columbia on February 1, 2003, are available under the terms of section 203(c)(13) of the National Aeronautics and Space Act of 1958, as amended, independent of the limitations established therein.

Supporting Data: Reconciliation of Appropriations to Budget Requests

(In Millions of Real Year Dollars)	TOTAL	Human Space Flight	Science, Aeronautics and Technology	Inspector General
FISCAL YEAR 2003 REQUEST	**15,000.0**	**6,130.9**	**8,844.5**	**24.6**
FY 2003 OMNIBUS APPROPRIATIONS ACT (P.L. 108-7) AS PASSED BY CONGRESS, DIRECTION INCLUDED IN CONFERENCE REPORT (H.R. 108-10)	**414.2**	50.0	363.2	1.0
TRANSFERS PER NATIONAL AERONAUTICS AND SPACE ACT AS AMENDED BY P.L. 106-377	**0.0**	-66.9	66.9	—
EMERGENCY SUPPLEMENTAL APPROPRIATIONS ACT, 2003 (P.L. 108-83)	**50.0**	50.0	0.0	—
FY 2003 RESCISSION (P.L. 108-7)	**-75.3**	-15.2	-59.9	-.2
TOTAL FY 2003 BUDGET PLAN	**15,388.8**	**6,148.8**	**9,214.6**	**25.4**

(In Millions of Real Year Dollars)	TOTAL	Science, Aeronautics and Exploration	Space Flight Capabilities	Inspector General
FISCAL YEAR 2004 REQUEST	**15,469.3**	**7,660.9**	**7,782.1**	**26.3**
TOTAL FY 2004 CONFERENCE REPORT ON H.R. 2673, CONSOLIDATED APPROPRIATIONS ACT, 2004	**15,378.0**	**7,830.2**	**7,520.7**	**27.1**

Supporting Data: FY 2003 Appropriation by Budget Line Item

FY 2003 APPROPRIATION STRUCTURE	Request	9/04/2003 Operating Plan
HUMAN SPACE FLIGHT	**6,130.9**	**6,148.8**
INTERNATIONAL SPACE STATION	1,492.1	1,462.4
SPACE SHUTTLE	3,208.0	3,301.4
PAYLOAD & ELV SUPPORT	87.5	84.4
HEDS INVESTMENTS AND SUPPORT	1,178.2	1,136.5
SPACE COMMUNICATION & DATA SYSTEMS	117.5	115.3
SAFETY, MISSION ASSURANCE & ENGINEERING	47.6	48.8
SCIENCE, AERONAUTICS & TECHNOLOGY	**8,844.5**	**9,214.6**
SPACE SCIENCE	3,414.3	3,530.6
BIOLOGICAL & PHYSICAL RESEARCH	842.3	882.6
EARTH SCIENCE	1,628.4	1,716.8
AEROSPACE TECHNOLOGY	2,815.8	2,886.0
ACADEMIC PROGRAMS	143.7	198.6
INSPECTOR GENERAL	**24.6**	**25.4**
TOTAL AGENCY	**15,000.0**	**15,388.8**

Note: Shuttle funding includes $50M Supplemental

REIMBURSABLE ESTIMATES BY APPROPRIATION

Budget Authority ($ in millions)	FY 2003	FY 2004	FY 2005
Human Space Flight	251.0		
Science, Aeronautics and Technology	526.0		
Science, Aeronautics and Exploration		677.0	
Space Flight Capabilities		357.0	
Exploration, Science and Aeronautics			664
Exploration Capabilities			351
Total	**777.0**	**1,034**	**1,015**

DISTRIBUTION OF FUNDS BY INSTALLATION

(In millions of dollars)		FY 2004	FY 2005
Ames Research Center	Direct Personnel	103	116
	Direct Travel	4	4
	Center G& A	129	124
	Service Pools	172	74
	Program CoF	0	0
	Total	**408**	**318**
	FTEs	1,444	1,409
Glenn Research Center	Direct Personnel	159	154
	Direct Travel	3	3
	Center G& A	99	106
	Service Pools	84	89
	Program CoF	7	0
	Total	**352**	**352**
	FTEs	1,934	1,934
Langley Research Center	Direct Personnel	141	133
	Direct Travel	3	3
	Center G& A	142	120
	Service Pools	126	112
	Program CoF	0	0
	Total	**412**	**368**
	FTEs	2,365	2,365
Dryden Flight Research Center	Direct Personnel	35	38
	Direct Travel	1	1
	Center G& A	40	53
	Service Pools	37	23
	Program CoF	0	0
	Total	**113**	**115**
	FTEs	566	567
Goddard Space Flight Center	Direct Personnel	218	229
	Direct Travel	6	5
	Center G& A	170	183
	Service Pools	146	131
	Program CoF	0	0
	Total	**540**	**548**
	FTEs	3,329	3,334

Marshall Flight Center	Direct Personnel	205	181
	Direct Travel	5	4
	Center G& A	145	143
	Service Pools	119	89
	Program CoF	8	18
	Total	**482**	**435**
	FTEs	2,684	2,597
Stennis Space Center	Direct Personnel	16	17
	Direct Travel	<1	<1
	Center G& A	39	44
	Service Pools	17	21
	Program CoF	2	3
	Total	**74**	**85**
	FTE's	300	295
Johnson Space Center	Direct Personnel	258	284
	Direct Travel	7	8
	Center G& A	158	185
	Service Pools	121	124
	Program CoF	4	1
	Total	**548**	**602**
	FTEs	2,895	2,850
Kennedy Space Center	Direct Personnel	114	129
	Direct Travel	3	3
	Center G&A	168	243
	Service Pools	112	77
	Program CoF	43	33
	Total	**440**	**485**
	FTEs	1,798	1,748
Jet Propulsion Laboratory	N/A since FFRDC		

FY 2004 and FY 2005 FTEs are under review as NASA begins implementing the President's new vision for space exploration.

Civil Service Distribution of Full time Equivalents

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. The FY 2004 and FY 2005 FTE values provides for a human capital initiative targeting fresh-out and at risk technical talents that are needed. These numbers are presently under review.

NASA's primary goals for its civil service workforce are to:

- Acquire and maintain a civil service workforce reflecting the cultural diversity of the Nation; and
- Provide a workforce sized and skilled as need to accomplishing NASA's research, development, and operational missions with innovation, excellence, and efficiency.

Civil Service Distribution Detail

Full Time Equivalents (FTEs)	FY 2003	FY 2004	FY 2005
Johnson Space Center	2,970	2,895	2,850
Kennedy Space Center	1,835	1,798	1,748
Marshall Space Flight Center	2,690	2,684	2,597
Stennis Space Center	296	300	295
Ames Research Center	1,445	1,444	1,409
Dryden Flight Research Center	578	566	567
Langley Research Center	2,352	2,365	2,365
Glenn Research Center	1,898	1,934	1,934
Goddard Space Flight Center	3,301	3,329	3,334
Headquarters	1,153	1,378	1,392
Human Capital Initiative	—	150	250
Total	**18,518**	**18,843**	**18,741**

FY 2004 and FY 2005 FTEs are under review as NASA begins implementing the President's new vision for space exploration.

Supporting Data: Consulting Services

SUMMARY OF CONSULTING SERVICES

NASA uses paid experts and consultants to provide NASA with advice and expert input in addition to or beyond that available from its in-house civil service workforce. NASA established management controls assure that there is ample justification presented and the action is approved at top management levels before entering into a consulting services arrangement with an individual.

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 analysis of technical and functional problems in order to give top management the widest possible range of views before making major decisions.

Expert/Consultants (Total NASA)	FY 2003	FY 2004	FY 2005
Number of Paid Experts and Consultants	41	50	50
Annual FTE Usage	4	4	4
Salaries	$441,000	$449,820	$458,816
Total Salary and Benefits Costs	$474,737	$484,231	$493,916
Travel Costs	$540,513	$556,728	$573,430
Total Costs	**$1,015,250**	**$1,040,959**	**$1,067,346**

SUMMARY OF RESOURCES INCLUDED IN BUDGET REQUEST

In Millions of Dollars	FY 2003	FY 2004	FY 2005
Exploration, Science and Aeronautics Programs*	27.0	7.0	--
Exploration Capabilities Programs*	58.9	57.3	55.2
Non-Programmatic Programs (included within G&A)	165.1	184.0	152.5
Total Construction of Facilities	**251.0**	**248.3**	**207.7**

* FY 2003 and FY 2004 data shown mapped to new FY 2005 appropriation accounts.

The Construction of Facilities (CoF) program ensures that the facilities critical to achieving NASA's space and aeronautics programs are available, safe, secure, environmentally sound, operate efficiently and effectively, 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, although some adjustments may be required to reflect the new vision for space exploration announced in January 2004. NASA is also conducting a Real Property Mission Analysis (RPMA), which should be complete in FY 2005. The RPMA is an independent, top-down, mission-driven process to identify the physical plant necessary to support NASA's Mission and programs, identify shortages and excesses, and make recommendations regarding the disposition of excesses to ensure that NASA owns and maintains only essential real property.

Funding for construction projects required for specific programs is included in the appropriate budget line item within each Enterprise. Non-Programmatic CoF projects are required for components of NASA's basic infrastructure and institutional facilities. Beginning in FY 2004, funding for Non-Programmatic CoF identified to specific Centers has been included in that Center's General and Administrative (G&A) rate, and agency-wide initiatives are included as part of Corporate G&A. Descriptions and cost estimates of both non-programmatic and programmatic (or "program direct") projects are provided to show a complete picture of NASA's budget requirement for facilities revitalization and construction.

The institutional facility projects requested for FY 2005 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. Projects between $0.5 million and $5.0 million are included as Minor Revitalization and Construction projects, and projects with an estimated cost of at least $5.0 million are budgeted as discrete projects. (Projects less than $0.5 million are accomplished by routine day-to-day facility maintenance and repair activities provided for in direct program and Center operating budgets.) Should residual resources become available from any Minor Revitalization or Discrete projects, they will be used for urgently needed facility revitalization requirements and Congress will be notified before work is initiated for any such discrete projects. Funds requested for Facility Planning and Design (FP&D) cover: advance planning and design requirements for 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.

SUMMARY OF FY 2005 PROGRAM DIRECT PROJECTS BY PROGRAM

In Millions of Dollars	FY 2003	FY 2004	FY 2005
EXPLORATION, SCIENCE & AERONAUTICS COF PROGRAMS	**27.0**	**7.0**	**0.0**
SPACE SCIENCE	8.6	0.0	0.0
Construct 34-Meter Beam Waveguide Antenna, Madrid, Spain (JPL)	2.0	—	—
Facility Planning and Design	6.6	—	—
BIOLOGICAL AND PHYSICAL RESEARCH	2.8	0.0	0.0
Construct Booster Applications Facility, Brookhaven National Laboratory	2.8	—	—
AERONAUTICS*	15.6	7.0	0.0
Modify Cell W-2 for Dual-Spool Turbine Research, ERB (GRC)	4.9	7.0	—
Upgrade E-Complex Test Capabilities	4.0	—	—
Upgrade to Propulsion Test Complex	4.0	—	—
Development of Stennis Visitor's Center	2.7	—	—
EXPLORATION CAPABILITIES COF PROGRAMS	**58.9**	**57.3**	**55.2**
SPACE SHUTTLE	56.5	53.9	54.0
Repairs to Vehicle Assembly Building (VAB) (KSC)	—	—	23.7
Repairs to Launch Complex LC-39A (KSC)	—	22.4	—
Replace Roof, Vehicle Assembly Building (KSC)	—	16.0	—
Replace 15kV Feeders, Shuttle Landing Facility Area (KSC)	1.7	—	—
Replace 15kV Feeders, East Area VAB (KSC)	2.2	—	—
Replace Hi-Pressure Nitrogen & Helium Pipelines, LC39 Area (KSC)	4.8	—	—
Restore Low Voltage Power System, LC-39A (KSC)	2.0	—	—
Restore Low Voltage Power System, LC-39B (KSC)	1.7	—	—
Restore Low Voltage Power System, MLP, Phase 1 (KSC)	2.5	—	—
Integrate Chilled Water System (110/114/130/131) (MAF)	1.7	—	—
Rehabilitate and Modify Crane Control System 110/114 (MAF)	1.6	—	—
Repair Downspouts, ET Manufacturing Building (MAF)	2.7	—	—
Replace Cell "E" Air Handling Units, Building 110 (MAF)	1.7	—	—
Replace Chilled Water Laterals 103 (MAF)	2.2	—	—
Replace Chilled Water, Steam, and Condensate Systems 110/114 (MAF)	1.9	—	—
Replace Paint Spray Facility, Building 103 (MAF)	1.6	—	—
Repair and Modernize Space Shuttle Main Engine A-2 Test Stand (SSC)	1.9	—	—
Minor Revitalization of Facilities at Various Locations (less than $5M per project)	21.4	13.8	26.0
Facility Planning and Design	4.9	1.7	4.3
SPACE AND FLIGHT SUPPORT	2.4	3.4	1.2
Minor Revitalization of Facilities at Various Locations (less than $5M per project)	2.4	3.0	0.9
Facility Planning and Design	—	0.4	0.3

** FY03 includes the non-aeronautics portion of Aerospace Technology*

SUMMARY OF FY 2005 NON-PROGRAMMATIC COF PROJECTS

In Millions of Dollars	FY 2003	FY 2004	FY 2005
NON-PROGRAMMATIC PROJECTS	**165.1**	**184.0**	**152.5**
Seismic Upgrade of Building B180 (JPL)	—	—	5.0
Construct Replacement for Fire Station No. 2 at Shuttle Landing Facility (KSC)	—	—	6.5
Repair/Replace 350psig Steam Distribution System, Utility Tunnel No. 4 (LaRC)	—	—	9.6
Construct First Response Facility (SSC)	—	—	6.0
Rehabilitate and Upgrade Electrical and Mechanical Systems (24) (JSC)	—	5.0	—
Addition and Rehabilitation of 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)	1.6	—	—
Upgrade 150 PSIG Combustion Air System, ERB, (GRC)	3.5	—	—
Realign Soil Conservation Service Road, Greenbelt (GSFC)	7.8	—	—
Connect Madrid Deep Space Communications Complex to Commercial Power (JPL)	2.2	—	—
Relocate and Revitalize High Efficiency Antenna, DSS-65, Madrid, Spain (JPL)	2.0	—	—
Construct Astronaut Crew Quarters (JSC)	3.0	—	—
Construct Operations Support Building II, LC-39 Area (KSC)	1.0	—	—
Replace Air Handling Units, Headquarters Building (KSC)	2.0	—	—
Repairs to Air Conditioning Systems, Various Facilities (LaRC)	3.7	—	—
Upgrade Hangar Fire Suppression System, B1244 (LaRC)	2.8	—	—
Replace Roof, External Tank Manufacturing Building (MAF)	11.0	—	—
Replace Site-Wide High Voltage Oil Switches (MAF)	2.8	—	—
Construct Child Development Center (MSFC)	2.1	—	—
Repairs to Airfield (WFF)	2.0	—	—
Minor Revitalization and Construction of Facilities at Various Locations (less than $5M per project)	90.8	127.1	98.1
Facility Planning and Design	17.7	17.0	17.3
Demolition of Facilities	—	10.0	10.0

**Beginning in FY 2004, funding for Non-Programmatic 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.*

Exploration Capabilities Programs Discrete Projects

Space Shuttle Program

Project Title: Repairs to Vehicle Assembly Building

Location: Kennedy Space Center (KSC), Brevard County, Merritt Island, FL

Enterprise: Space Flight

FY05 Estimate: $23.7M

This project will repair and refurbish several of the Vehicle Assembly Building (VAB) systems and mechanisms. Door siding, structures, and mechanisms will be repaired and replaced. Corrosion control systems will be repaired and improved. Secondary power systems will be revitalized. Platform systems in high-bay 3 will be repaired and improved. VAB systems are significantly deteriorated as a result of 35 years of operational use and the corrosive environment at the Kennedy Space Center. Siding has corroded to the point where fasteners holding the siding to the structure have failed. There is extensive corrosion damage to door structures and skin. VAB mechanical and electrical systems have become unreliable. In some cases, system components are obsolete and replacement parts are no longer available. Failure to complete VAB repairs could lead to loss of flight hardware in VAB, and increased risk of injury to personnel.

In Millions of Dollars	FY 2003	FY 2004	FY 2005
Discrete Projects	56.6	29.9	27.1
Minor Revitalization and Construction	90.8	127.1	98.1
Facility Planning and Design	17.7	17.0	17.3
Demolition	--	10.0	10.0
Total Institutional Construction of Facilities	165.1	184.0	152.5

Non-Programmatic Discrete Projects

Project Title: Seismic Upgrade of Building B180

Location: Jet Propulsion Laboratory (JPL), La Canada-Flintridge, Los Angeles County, CA

Enterprise: Space Science

FY05 Estimate: $5.0M

This project provides braced steel frame trusses to strengthen the lateral force resisting capacity of the building. The structural retrofit will satisfy Federal Emergency Management Agency structural performance guidelines for both life safety and immediate occupancy of the facility and ensure safe stairway exiting. JPL Administration Building 180 is deficient in its ability to resist a major seismic event. Due to the inherent design of the structure, extent of asbestos fireproofing, and necessity for continued full occupancy, the cost to perform a seismic retrofit on the interior of the building would be too disruptive and cost prohibitive.

Project Title: Construct Replacement for Fire Station No. 2 at Shuttle Landing Facility

Location: Kennedy Space Center (KSC), Brevard County, Merritt Island, FL

Enterprise: Space Flight

FY05 Estimate: $6.5M

This project provides for the construction of a new fire station in the vicinity of the Shuttle Landing Facility (SLF) to replace Fire Station No. 2 in the LC-39 Area. The approximately 35,000 square foot facility will include drive through vehicle bays, living quarters for fire combat personnel, and an administrative area. The living area includes a bathroom and showers, kitchen facilities, dayroom/dining area, and a protective ensemble laundry. The administrative area includes offices, training and conference room, an emergency medical exam room, and storage area. The project includes demolition of the existing fire station and the SLF fire department vehicle storage building. The existing Fire Station No. 2 is inside the explosion Quantity Distance zone for the Vehicle Assembly Building, does not meet the minimum requirements for fire stations, is over 35 years old and its condition contributes to fire fighter illnesses. Implementation of this project will improve the quality of life for the firefighters, provide a healthier work and living environment, consolidate the functions of Fire Station No. 2 and the SLF fire department vehicle storage building, and improve response capabilities in the Launch Complex 39 Area.

Project Title: Repair/Replace 350 psig Steam Distribution System, Utility Tunnel No. 4

Location: Langley Research Center (LaRC), Hampton, VA

Enterprise: Aeronautics

FY 05 Estimate: $9.6M

This project repairs or replaces steam distribution components and tunnel structure as required. This includes piping, piping supports, expansion joints, valves, safety devices, and controls to bring the system into compliance with current codes and standards. Utility Tunnel No. 4 and the steam distribution piping are 37 years old. There have been three concrete ceiling collapses and several cracked wall areas in the last 15 years, creating increasing danger to maintenance personnel. A safety analysis has been performed and two of the four undesirable events identified are potentially Risk Assessment Code (RAC) 1, threat to life safety. The Center has mitigated the RAC 1 conditions by shutting the system down prior to performing any work on it. Some of the steam system anchors, supports and expansion joints show signs of damage. An assessment by the LaRC Systems Engineering Competency Office has determined that Utility Tunnel No. 4 and the steam system need immediate attention. This steam distribution system provides essential support for Langley Research Center facilities and programs. The failure of the system would inhibit the execution of Center missions and personnel.

Project Title: Construct First Response Facility

Location: Stennis Space Center (SSC), Bay St. Louis, MS

Enterprise: Space Flight

FY05 Estimate: $6.0M

This project provides for the construction of a 3,800-square meter building. The facility will be a single story steel frame structure with all required building systems such as: heating, ventilating, and air-conditioning (HVAC); electrical power; water; sewer; sprinkler; and fire alarm. The project will include site development and parking areas. This project also includes sub-grading, grading, and pavement of connecting driveways from Trent Lott Parkway and Saturn Drive to the facility that will be located at the NE intersection of Trent Lott and Saturn Drive. This facility will house the Stennis Space Center Fire Station, Security Office, Energy Management and Control Systems (EMCS) office, Emergency Operations Center (EOC), and medical Clinic.

MINOR REVITALIZATION & CONSTRUCTION OF FACILITIES LESS THAN $5.0M/PROJECT

	Institutional Support	Exploration Capabilities
FY 2005 Estimate (Millions of Dollars)	98.1	26.9
Ames Research Center	10.2	
Dryden Flight Research Center	3.0	
Glenn Research Center	12.8	
Goddard Space Flight Center	14.5	
Jet Propulsion Laboratory	6.3	
Johnson Space Center	19.4	0.8
Kennedy Space Center	14.4	7.1
Langley Research Center	8.9	
Marshall Space Flight Center	2.8	16.2
Stennis Space Center	5.8	2.8

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 2005 Non-Programmatic projects total $98.1 million for components of the basic infrastructure and institutional facilities, and $26.9 million for specific Exploration Capabilities projects. These resources provide for revitalization and construction of facilities at NASA field installations and government-owned industrial plants supporting NASA activities. Revitalization and modernization projects provide for the repair, modernization, and/or upgrade of facilities and collateral equipment. Repair 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. Modernization and upgrade projects include both restoration of current functional capability and enhancement of the condition of a facility so that it can more effectively accomplish its designated purpose or increase its functional capability or so that it can meet new building, fire, and accessibility codes.

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.

NON-PROGRAMMATIC MINOR REVITALIZATION PROGRAMS: $98.1 MILLION

A. Ames Research Center (ARC), $10.2 million for the following:

1. Legionella Mitigation, Buildings 210, 216, 216A, 227
2. Legionella Mitigation, Buildings 226, 227D, 229, 237
3. Rehabilitate and Modify Fire Exits and Safety Egress, Buildings 215, 223, 233, 243, 244
4. Rehabilitate and Modify Fire Suppression and Alarms, Buildings 229, 237
5. Rehabilitate and Modify Fire Exits and Safety Egress, Buildings 200, 202/202A, 211, 213, 230, 234, 236, 241
6. Rehabilitate and Modify Fire Suppression and Alarm System, Building N245
7. Repair Second Floor Mechanical Replacement and Install Elevator, Building N233
8. Seismic Upgrades, Buildings 201, 223
9. Rehabilitate and Modify Fire Suppression and Alarm Systems, Building N202/202A, 216, 230, 234, 236, 238, 242

B. Dryden Flight Research Center (DFRC), $3.0 million for the following:

1. Repair Primary Electrical Distribution Systems, Phase 3
2. Construct Composite Facility in B-4823
3. Repair Paving, Phase 2

C. Glenn Research Center (GRC), $12.8 million for the following:

1. Upgrade Electronic Propulsion Research Building (EPRB) No. 16, Phase 2
2. Replace K1 and K2 Switchgear and Re-insulate Cables, Phase 2
3. Repair Natural Gas System, Phase 4
4. Rehabilitate Safety and Mechanical Systems, Central Air Equipment Building No. 64, Phase 1
5. Rehabilitation of Mechanical and Electrical Systems, Building No. 51
6. Repair Parking Lots and Roads, Various Locations
7. Rehabilitation of Electric Propulsion Laboratory (EPL) Controls, Building 301, Phase 2
8. Repair High Voltage System, Plum Brook Station, Phase 1
9. Upgrade Variable Frequency System, Engine Research Building (ERB) No. 23, Phase 2

D. Goddard Space Flight Center (GSFC), $14.5 million for the following:

1. Restoration of Building 23, Phase 5
2. Revitalization of Water System, Wallops Flight Facility (WFF)
3. Repair Site Steam Distribution System, Phase 5
4. Information Technology Facilities Environmental Control Upgrades, Phase 1
5. Upgrade Fire Alarm System, Various Buildings
6. Repair of High Voltage Electrical Systems, Island, Phase 2, WFF
7. Modify Buildings For Accessibility at Greenbelt and Wallops
8. Revitalization of Sewer System, WFF
9. Repair of Airfield, Phase 2, WFF
10. Restoration of Building 5, Phase 2
11. Repair of Paved Surfaces, Main Base, WFF

E. Jet Propulsion Laboratory (JPL), $6.3 million for the following:

1. Replace Liquid Nitrogen Storage Tanks, Phase 1
2. Upgrade 2.4 kV Electrical Distribution System to 16.5 kV, Phase 5
3. Replace Roofs of Buildings 148, 149, 157, 158, 230, and 303
4. Upgrade Utilities to Building 186
5. Repave Table Mountain Roads

F. Johnson Space Center (JSC), $19.4 million for the following:

1. Replacement and Upgrade of Electrical and Mechanical Systems (24), Phase 2
2. Rehabilitation of Underground Sanitary Sewer System
3. Replacement of Uninterruptible Power Source (UPS), Building 48
4. Rebuild High Voltage Arrangement, Building 48
5. Replace Cooling Towers and Upgrade Chillers, Building 48
6. Refurbish Mechanical Systems for Indoor Air Quality, Building 4N, Phase 2
7. Refurbish Utility Tunnel Steam and Condensate Distribution System
8. Rehabilitate Sanitary Sewer System, White Sands Test Facility (WSTF)
9. Replace Roof, Building 15
10. Upgrades for Americans with Disabilities Act (ADA) Compliance, Phase 1
11. Replace Roofs, Building 2

G. Kennedy Space Center (KSC), $14.4 million for the following:

1. Repairs to Primary Electrical Power Systems, Phase 2
2. Replace Air Handling Units (AHUs), KSC Headquarters M6-399, Phase 3
3. Revitalize Cable and Duct Distribution, Industrial Area, Phase 2
4. Upgrade Water and Waste Systems, Kennedy Athletic Recreational and Social (KARS) Park 1
5. Install Ultraviolet Infrared Fire Detection Systems, Various Locations
6. Upgrade Bathroom Plumbing and Fixtures, Headquarters Building, Phase 2
7. Refurbish Indian River Bridge
8. Repair Roads and Pavements, Various Locations
9. Modify Sub-Stations for Vacuum Switch Gear, SS-900, 902 and 1001
10. Replace Industrial Area Support Building M-493

H. Langley Research Center (LaRC), $8.9 million for the following:

1. Rehabilitation of N2 and W Substations
2. Replace Tunnel Dryer and Cooling Coil, National Transonic Facility (NTF), B 1236
3. Replace Roofs, Various Facilities
4. Upgrade Energy Management. Control System, Various Locations
5. Revitalization of Building 1268 Complex

I. Marshall Space Flight Center (MSFC), $2.8 million for the following:

1. Replace and Repair Roofs at Various Buildings, Phase 2
2. Replace and Upgrade Control Systems for Bridge Cranes Site-wide, Phase 3

J. Stennis Space Center, $5.8 million for the following:

1. Repairs to Roofs in Test Complex
2. Replace Electrical Switchgear in the Test Complex
3. Restoration of Fire Alarms Systems, Phase 4
4. Rehabilitate 120/208 V Power Distribution, Site-wide
5. Restore LN2 and GHe Systems at High Pressure Gas Facility
6. Replace Cryogenic and High Pressure Components in the Test Complex

EXPLORATION CAPABILITIES MINOR REVITALIZATION PROGRAMS: $26.9 MILLION

A. Johnson Space Center (JSC), $0.8 million for the following:

1. Modify Chemical Steam Generator To Increase Reliability, WSTF (Shuttle)

B. KENNEDY SPACE CENTER (KSC), $7.1 MILLION FOR THE FOLLOWING:

1. Rehabilitate Pad Grounding System, SLC-2, Vandenberg Launch Site (Space and Flight Support)
2. Restore Pad B Low Voltage Power, Phase 4 (Shuttle)
3. Revitalize Secondary Power Systems, Orbiter Processing Facilities (OPF) 1 and 2 (Shuttle)
4. Upgrade Launch Control Center-3 (Shuttle)
5. Upgrade OPF-1 and 2 Firex Water Systems (Shuttle)
6. Upgrade Switch Gear, VAB Utility Annex (Shuttle)

C. Marshall Space Flight Center (MSFC), $16.2 million for the following:

1. Install Closed Loop Chilled Water System, Building 103, Phase 1 (MAF) (Shuttle)
2. Rehabilitate Controls, Cranes and Trolleys, Building 103, Phase 1, MAF (Shuttle)
3. Rehabilitate Waste Water Process Tanks, Phase 1, MAF (Shuttle)
4. Rehabilitate West Master Substation, Phase 2, MAF (Shuttle)
5. Replace Air Handling Units (AHUs) 14, 17, 20, 25 and 26, Building 114, MAF (Shuttle)
6. Replace AHUs/Desiccant Units Thermal Protection System Area, Building 103, MAF (Shuttle)
7. Replace Fire Alarm Systems, Phase 1, MAF (Shuttle)
8. Replace Roof, Building 303, MAF (Shuttle)
9. Rehabilitate and Modernize Building 4649 for Hazardous Operations (Shuttle)

D. Stennis Space Center (SSC), $2.8 million for the following:

1. Refurbish High Pressure Industrial Water Pumps, Phase 3 (Shuttle)
2. Repair & Modernize SSME A-2 Test Stand, Phase 6 (Shuttle)

FACILITY PLANNING AND DESIGN (FP&D)

Cognizant Office: Office of Management Systems

FY05 Estimate: $17.3M

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 non-programmatic construction projects. Project planning and design activities for construction projects required to conduct specific Exploration Capabilities or Exploration, Science, and Aeronautics 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

FY05 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 two 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 more 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.

Supporting Data: Integrated Financial Management Program

PURPOSE

2003 Strategic Plan Objectives	Performance Measures
Achieve Management and Institutional Excellence comparable to NASA's Technical Excellence	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 re-engineer 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 projects were implemented in FY03 or are currently being managed by IFMP. The Core Financial Project, NASA's first fully integrated financial management system, was implemented in FY03 at all ten Centers. This gives the Agency timelier, more consistent and reliable information for management decisions. It also improves our ability to manage in full cost. Core Financial (CF) and its use of SAP software, is helping NASA achieve efficiencies and operate more effectively, thereby improving its information exchange with customers and stakeholders. The Resume Management Project, implemented in FY02, introduced a new process and system that has changed how Human Resources offices fulfill their recruiting and staffing responsibilities. The Position Description Management Project, completed in September, 2002, enables users to rapidly prepare and classify Position Descriptions (PDs). The Travel Management Project, completed in FY03 implemented a standardized, integrated travel management system that provides electronic routing, e-mail, and timely travel information. The Budget Formulation Project gives the Agency an integrated, full cost budgeting system and is currently on schedule for implementation in FY04. Future projects include Human Resources (HR), Integrated Asset Management (IAM), and Contracts Administration (CA). The budget runout has been modified to focus on the development/implementation costs of the program. Deployment of all modules is planned to be completed in FY 2006. As a result, the program funding total was decreased in the FY04 budget from the prior baseline of $644.8M, which included some operations costs beyond deployment, to $497.5M through FY06. The difference in funding will be transferred to a systems operating account. Although funded in corporate G&A, beginning in FY04, NASA is managing IFMP as a full cost program, which adds $63.6M to the FY04 PB baseline. For the FY05 submission, the Agency further reduced the IFMP baseline by $1.35M for the FY03/FY04 Rescissions and by $2M in FY05. With respect to the recent GAO reports related to NASA's Integrated Financial Management Program, the Agency fully acknowledges and accepts the GAO recommendations and will develop the necessary corrective actions.

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 (acting) and point of contact is Bobby German. This program is in full compliance with NPG7120.

TECHNICAL COMMITMENT

The baseline for this technical commitment was made in February 2002. The baseline was updated in the FY04 President's Budget and updated in May 2003 in the IFMP Program Commitment Agreement (PCA). NASA reduced the program baseline by $3.35M from the FY04 President's Budget.

Technical Specifications	FY 2005 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; 2. Provide on-line access to program and project data to the Agency, Enterprises and Centers; 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. *Percent of users having on-line, real time access to financial data necessary to function.
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; 2. Improve financial data consistency.	*Number of Days between periodic closings and availability of financial data to internal customers. *Percent of users having on-line, real time access to financial data necessary to function.
3. Achieve efficiencies and operate effectively.	1. Streamline and standardize financial business processes across NASA to operate more effectively; 2. Provide tools to utilize admin and tech work force more effectively; 3. Provide an automated audit trail for financial data.	*Number of applications or systems required to conduct process; for Core Financial the number of legacy systems shutdown with processes transitioned to SAP R/3.
4. Exchange information with customers and stakeholders.	1. Provide consistent, timely, and reliable financial data to NASA's external customers; 2. Improve exchange of financial data among internal customers.	*Number of applications or systems required to conduct process; for Core Financial the number of legacy systems shutdown with processes transitioned to SAP R/3.
5. Attract and retain a world-class workforce.	1. Provide tools to users that enable them to do their jobs more effectively; 2. Provide increased opportunities for sharing of data, practices and teaming across Centers.	*Percent of users having on-line, real time access to financial data necessary to function.
*IFMP benefits a broad range of NASA processes and programs and is principally aligned with the Implementing Strategy-1: achieve management and institutional excellence comparable to NASA's technical excellence, as defined in the NASA 2003 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 2005 President's Budget	Change from Baseline
CF Roll out to all ten Centers	June 2003	Nine months early
Position Description Rollout to ten Centers	September 2002	Completed
Travel Manager roll out to all ten Centers	February 2003	Completed
Implement Budget Formulation	February 2004	New
Begin formulation of: HR, IAM, and Contract Administration	January 2003	IAM in Formulation Phase, HR and CA delayed due to FY03 Rescission

Supporting Data: Integrated Financial Management Program

ACQUISITION STRATEGY AND PERFORMING ORGANIZATIONS

Current Acquisition	Actual*	Selection Method	Actual*	Performer	Actual*
Cooperative Agreements	0%	Full and Open Competition	97%	Industry	100%
Cost Reimbursable	0%	Sole Source	3%	Government	0%
Fixed Price	0%		100%	NASA Intramural	0%
Grants	0%	Science Peer Review	n/a %	University	%
Other	100%			Non Profit	%
	100%				100%
*As % of FY03 direct procurement (excl full cost)					

Future Acquisition - Major	Selection	Goals
Implementer	February 2004	GSA Schedule
Program Management Support	March 2004	GSA Schedule

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 2004 President's Budget: Currently in source evaluation for implementation contract that will support all future modules.

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 FY04 President's Budget***: *External*: NASA and several other Federal agencies recently began collaborating to develop a Federalized version of the Human Resources module.

INDEPENDENT REVIEWS

Review Types	Performer	Last Review Date	Next Review Date	Purpose
Core Financial Systems Compliance Review	IBM	Oct-02	N/A	Validate internal security and controls and satisfy Federal Financial Requirements/JFMIP.
Independent Annual Review	IPAO	19-Nov-02	March-04	To validate performance of program and project commitments.
Commercial Contractor Review	CSC, SAP, Accenture, and Gartner	12-Dec-02	N/A	Recommend Program Improvements based on Lessons Learned & Industry Best Practices.
GAO	GAO	December-03	TBD	Review NASA's IFMP enterpirse architecture, financial reporting, and program cost and schedule controls.
2003 Financial Audit	PWC	In Progress	November-04	Audit NASA's 2003 Financial Statements, IT configuration and controls, and Federal Financial Management Improvement Act system compliance.

Supporting Data: Integrated Financial Management Program

BUDGET/LIFE CYCLE COST

Budget Authority ($ millions)	Prior	FY03	FY04	FY05	FY06	FY07	FY08	FY09	Total	Comments
FY 2005 President's Budget	147.7	88.9	116.9	115.8	84.7	0.0	0.0	0.0	554.1	
System Infrastructure	23.1	23.1	13.6	10.3	9.7				79.8	
System Integration	35.0	19.9	25.0	21.3	12.5				113.7	
Core Financial	76.2	34.2	4.7	0.0	0.0				115.1	
Resume Management	3.0	0.5	0.0	0.0	0.0				3.5	
Position Description	1.3	0.6	0.0	0.0	0.0				1.9	
Travel Management	5.0	1.4	0.7	0.0	0.0				7.0	
Budget Formulation	4.3	8.3	4.5	0.0	0.0				17.1	
Integ Asset Mgt Formulation Phase		1.0							1.0	
Preliminary Estimate - Future Modules			59.6	54.0	37.7				151.3	
Full Cost			8.7	30.2	24.7				63.6	
Changes since FY 04 PBS	0.0	-4.6	8.2	28.2	24.7	0.0	0.0	0.0	56.6	Reason for Change:
System Infrastructure	0.0	-2.3	0.7	0.0	0.0				-1.6	FY03 Rescission; allocate Reserve for SAP EOY Stabilization; & FY03/04 Rephasing.
System Integration	+0.0	+0.9	+0.6	+0.0	+0.0				1.5	SAP End of Year (EOY) Stabilization and FY03/04 Rephasing.
Core Financial	+0.0	+0.0	+0.0	+0.0	+0.0				0.0	
Resume Management	+0.0	+0.0	+0.0	+0.0	+0.0				0.0	
Position Description	+0.0	+0.0	+0.0	+0.0	+0.0				0.0	
Travel Management	+0.0	+0.0	+0.0	+0.0	+0.0				0.0	
Budget Formulation	+0.0	+0.0	+1.0	+0.0	+0.0				1.0	Project Schedule Risk Mitigation.
Integ Asset Mgt Formulation Phase	0.0	1.0	0.0	0.0	0.0				1.0	Initiation of IAM Formulation Phase from Follow-on Projects.
Preliminary Estimate - Future Modules	0.0	-4.2	-2.7	-2.0	0.0				-8.9	IAM Formulation Ph, FY03/04 Rephasing, Agency FY05 Reduction, and FY04 Rescission.
Full Cost	0.0	0.0	8.7	30.2	24.7				63.6	First year reflecting Full Cost in IBPD.
FY 2004 President's Budget	147.7	93.5	108.7	87.6	60.0	0.0	0.0	0.0	497.5	Direct procurement only.
Infrastructure	23.1	25.3	12.9	10.3	9.7				81.4	
Integration Project	34.9	19.0	24.4	21.3	12.5				112.2	
Core Financial	76.1	34.2	4.7						115.1	
Resume Management	3.0	0.5							3.5	
Position Description	1.3	0.6							1.9	
Travel Management	5.0	1.4	0.7						7.0	
Budget Formulation	4.3	8.3	3.5						16.1	
Follow-on projects (IAM, HR, CA)		4.2	62.3	56.0	37.8				160.3	
Full Cost										
Initial Baseline	137.0	79.2	78.1	78.2	78.2	0.0	0.0	194.6	645.3	
Infrastructure	36.5	15.9	12.7	13.2	13.5			20.0	111.8	
Integration Project	31.4	14.2	20.3	16.9	14.2			51.4	148.4	
Core Financial	54.5	25.1	4.9	3.1	3.2			38.0	128.8	
Planning Wedge/Follow-on	14.6	24.0	40.2	45.0	47.3			85.2	256.3	

Indicates changes since the previous year's President's Budget Submit

NATIONAL INSTITUTE OF AEROSPACE

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 includes the American Institute of Aeronautics and Astronautics Foundation, the Georgia Institute of Technology, the North Carolina Agricultural and Technical State University, the North Carolina State University, the University of Maryland, University of Virginia, the Virginia Polytechnic Institute and State University, and the Hampton University as full members, and the Old Dominion University and the College of William and Mary as affiliate members. The NIA has been operational since January 3, 2003.

The Institute is 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 also has a science and engineering graduate education capability provided by the university partners.

One of the unique aspects of the Institute is 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 $5 million 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 program. The Distinguished Professor program is a resident scholars program that will attract 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 2003 Actuals	FY 2004 Estimates	FY 2005 Budget
NASA Funding	9.7	12.0	12.7
University Cost-Sharing	1.4	1.7	1.7
Total Core Program Funding	11.1	13.7	14.4

Inspector General

INTRODUCTION

The NASA Office of Inspector General (OIG) budget request for Fiscal Year 2005 is $27.6 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 OIG, Office of Audits (OA) conducts independent, objective audits and reviews of NASA and NASA contractor programs and projects, to improve NASA operations. The OA also 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 Division 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.

Our FY 2005 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, transportation 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 (PCS) costs.
- 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.
- 3.0 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 Authority ($ in millions)	**FY 2003**	**FY 2004**	**FY 2005**
Personnel and Related Costs	22.1	25.0	25.6
Travel	1.1	1.3	1.2
Operations & Equipment	1.8	0.8	0.8
Total	25.0	27.1	27.6

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 2005

- First full year of service for the Space Mission Communications and Data Service contractors; and
- Support the Shuttle Return to Flight manifest.

Theme: Space and Flight Support

Overview

Space and Flight Support, managed by the Space Flight Enterprise (SFE), is comprised of several distinct Agency-level services. These services include Space Communications, Launch Services, Rocket Propulsion Testing, Crew Health and Safety, and Environmental (Plum Brook nuclear facility dismantling and Environmental Compliance and Restoration). The services are critical for conducting space exploration, aeronautical research, and biological and physical research. These services are provided to a wide range of customers, including NASA scientists and engineers, other federal agencies, universities, foreign governments and industry interests.

Missions	Goals supported by this Theme	Objectives supporting those Goals
To 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.	SFS provides services in support of NASA's Exploration and Science Goals.
To 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.	
To Inspire the Next Generation of Explorers	7. Engage the public in shaping and sharing the experience of exploration and discovery.	7.1 Improve public understanding and appreciation of science and technology, including NASA aerospace technology, research, and exploration missions.
Exploration Capabilities	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.
	9. Extend the duration and boundaries of human space flight to create new opportunities for exploration and discovery.	9.1 Understand human physiological reactions to reduced gravity and develop countermeasures to assure survival of humans traveling far from Earth.

Relevance

Space and Flight Support includes the enabling capabilities required to conduct space exploration and expand scientific knowledge of the Earth and our universe. 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, the Space and Flight Support Theme includes funding for environmental remediation intended to address the agency's environmental legacy liabilities and demonstrate NASA's commitment to providing a safe and clean natural environment for future generations of Americans.

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, and the assurance that rocket systems have been adequately tested. A space program properly supported by this theme will produce 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. These activities benefit both the general public and the education community.

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 Space Flight Enterprise at NASA Headquarters. The Agency Program Management Council has governing responsibility. Enterprise official is William F. Readdy, Associate Administrator for Space Flight at HQ. The Headquarters Program Directors are: Space Communications - Robert Spearing; Launch Services - Karen Poniatowski; Rocket Propulsion Testing - Keith Brock; Crew Health and Safety - Dr. Jeffrey Davis; and Plum Brook decommission and the Environmental Compliance and Restoration programs - Olga Dominguez.

Theme: Space and Flight Support

IMPLEMENTATION SCHEDULE

Theme Element	Schedule by Fiscal Year 95 96 97 98 99 00 01 02 03 04 05 06 07 08 09 10	Purpose
Launch Services		Responsible for enabling access to space for all NASA missions and other select government missions as required.
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
Crew Health and Safety		Protects our astronauts from the hazards of space travel and identifies methods that allow astronauts to improve their performance.
Plum Brook Reactor Facility Decommissioning		Supports the decontaminating, 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.
Space Communications		Provides space communications services to STS, ISS, Low Earth Orbiting (LEO) satellites and launch vehicles, and telecommunications services among facilities such as NASA flight support networks, mission control centers and science facilities, and administrative communications.

Tech & Adv Concept   Development   Operations   Research

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 low Earth orbiting missions. Launch Services met all customer requirements and deadlines that resulted in the successful launch of eight 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 and Restoration: http://www.hq.nasa.gov/office/codej/codeje/je_site/about_us/about_us.html ; Launch Services http://www.ksc.nasa.gov/elvnew/elv.htm http://sspp.gsfc.nasa.gov/ ; Rocket Propulsion Test Program https://rockettest.ssc.nasa.gov/ ; Space Communications http://www.spacecommunications.nasa.gov/

PERFORMANCE MEASURES

Outcomes/Annual Performance Goals (APGs)	
Outcome 8.5.1	*Provide safe, well-managed and 95% reliable space communications, rocket propulsion testing, and launch services to meet agency requirements.*
5SFS8	Establish the Agencywide baseline space communications architecture, including a framework for possible deep space and near Earth laser communications services.
5SFS15	Maintain NASA success rate at or above a running average of 95% for missions on the FY2004 Expendable Launch Vehicle (ELV) manifest.
5SFS16	Achieve at least 95% of planned data delivery for the International Space Station, each Space Shuttle mission, and low-Earth orbiting missions in FY2004.
5SFS19	Define and provide space transportation requirements for future human and robotic exploration and development of space to all NASA and other government agency programs pursuing improvements in space transportation.
Outcome 9.1.1	*By 2008, develop and test candidate countermeasures using ground-based analysis and space flight.*
5SFS20	Certify the medical fitness of all crew members before launch.
Uniform Measures	
5SFS21	Complete all development projects within 110% of the cost and schedule baseline.
5SFS22	Deliver at least 90% of scheduled operating hours for all operations and research facilities.

Theme: Space and Flight Support

INDEPENDENT REVIEWS

Review Types	Performer	Last Review Date	Next Review Date	Purpose
See Individual Programs				

BUDGET

Budget Authority ($ millions)	FY03	FY04	Change	FY05	Comments
Space and Flight Support	**444.5**	**431.8**	**+60.3**	**492.1**	
Development	92.3	84.2	-7.7	76.5	
Plum Brook Reactor Facility Decommissioning	52.0	43.4	-12.9	30.5	
Environmental Compliance and Restoration	40.3	40.8	+5.2	46.0	
Operations	352.2	341.6	+74.0	415.6	
Technology		6.0	-6.0		

Indicates changes since the previous year's President's Budget Submit

Indicates budget numbers in full cost.

Theme: Space and Flight Support

Development: Plum Brook Reactor Facility Decommissioning

PURPOSE

Objectives	Performance Measures
	5SFS21

1) Decontaminate NASA's Plum Brook Reactor Facility (PBRF) to levels to allow for unrestricted release required under 10 Code of Federal Regulations 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.

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, Ohio. The PBRF includes a 60-megawatt (thermal) materials testing and research reactor, a 100-kilowatt mock-up reactor, 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 operated 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, which 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 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 the Environmental Management Division, Mr. Richard Wickman.

TECHNICAL COMMITMENT

Decontaminate the site to meet NRC's unrestricted release levels for License Termination per 10 CFR 20.1402

Technical Specifications	FY 2005 President’s Budget	Change from Baseline
Complete reactor building decontamination	Sept 05	--
Complete Hot Lab decontamination	Sept 05	--
Complete decontamination on remaining structures	Sept 05	--
Continue license termination activities	May 05 through June 06	--

Schedule	FY 2005 President’s Budget	Baseline	Change from Baseline
Begin demolition/disposal efforts	Jan-04	Aug-04	+ 7 months
Commence reactor building demolition/disposal	Aug-04	Jul-05	+ 11 months
NRC Validation - termination of licenses	Jul-06	Jun-07	+ 11 months
Site-wide demolition/disposal completed	June 07	Mar-06	+15 months

ACQUISITION STRATEGY AND PERFORMING ORGANIZATIONS

NASA signed a Space Act Agreement with the U.S. Army Corps of Engineers. The Corps is using a cost reimbursable type contract primarily because of the flexibility and continuous "cradle to grave" involvement. Moreover, the Corps 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 FY04 President's Budget: None.

Current Acquisition	Actual*	Selection Method	Actual*	Performer	Actual*
Cooperative Agreement	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 FY 2003 direct procurement	100%	*As of FY 2003 direct procurement		*As of FY 2003 direct procurement	100%

Theme: Space and Flight Support

Development: Plum Brook Reactor Facility Decommissioning

Future Acquisition - Major	Selection	Goals
None		

AGREEMENTS

INTERNAL AGREEMENTS: None EXTERNAL AGREEMENTS: 1) Nuclear Regulatory Commission license TR-3 for 60 megawatt research test reactor "possess but not operate"; 2) Nuclear Regulatory Commission 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 FY04 President's Budget: None.

INDEPENDENT REVIEWS

Review Types	Performer	Last Review Date	Next Review Date	Purpose
NASA Non-Advocate Review	IPAO	10/01		No further non-advocate reviews planned

BUDGET/LIFE CYCLE COST

Budget Authority ($ millions)	Prior	FY03	FY04	FY05	FY06	FY07	FY08	FY09	BTC	Total	Comments
FY2005 PRESBUD	16.0	64.0	43.4	30.5	9.2	0.6				99.7	
Development	16.0	64.0	43.4	30.5	9.2	0.6				99.7	
Changes since 2004 PRESBUD			-0.3								
Development			-0.3								
FY2004 PRESBUD			43.7	30.5	9.2	0.6				84.0	
Development			43.7	30.5	9.2	0.6				84.0	

Indicates changes since the previous year's President's Budget Submit

Indicates budget numbers in full cost.

Theme: Space and Flight Support
Development: Environmental Compliance and Restoration

PURPOSE

Objectives	Performance Measures
	5SFS21

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 is a phased approach that prioritizes 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 2005. Deferral of these necessary compliance and remediation measures would preclude NASA from complying with environmental requirements and regulatory agreements, and could jeopardize NASA operations. NASA is requesting an increase of 22 percent for environmental compliance and restoration to assure continued compliance in an environment of increasing requirements. 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 Committee and the Executive Committee 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 the Environmental Management Division, Mr. Richard Wickman.

TECHNICAL COMMITMENT

A comprehensive environmental program as directed under Executive Order 13148 and a host of Federal, state, and local environmental regulations.

Technical Specifications	FY 2005 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 and regulations.	--	--

Schedule	FY 2005 President's Budget	Baseline	Change from Baseline
No set schedule/milestones exist for this ongoing program - instead, worst-first prioritization methods employed.	Oct 04 thru Sept 05	Oct 04 thru Sept 05	--

Theme: Space and Flight Support
Development: Environmental Compliance and Restoration

ACQUISITION STRATEGY AND 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 FY04 President's Budget: None.

Current Acquisition	Actual*	Selection Method	Actual*	Performer	Actual*
Cooperative Agreement	0%	Full & Open Competition	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 FY 2003 direct procurement	100%	*As of FY 2003 direct procurement		*As of FY 2003 direct procurement	100%

Future Acquisition - 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 FY04 President's Budget: None.

INDEPENDENT REVIEWS

Review Types	Performer	Last Review Date	Next Review Date	Purpose
Institutional Committee Reviews	IC	5/03	5/04	Agency review of FY05 budget requirements for budget build.

BUDGET/LIFE CYCLE COST

Budget Authority ($ millions)	Prior	FY03	FY04	FY05	FY06	FY07	FY08	FY09	BTC	Total	Comments
FY2005 PRESBUD		40.3	40.8	46.0	51.0	51.0	51.0	51.0		331.0	
Development		40.3	40.8	46.0	51.0	51.0	51.0	51.0		331.0	
Changes since 2004 PRESBUD		-0.7	-0.2	+5.0	+10.0	+10.0	+10.0	+51.0		+85.1	Increased Environmental requirements
Development		-0.7	-0.2	+5.0	+10.0	+10.0	+10.0	+51.0		+85.1	
FY2004 PRESBUD		41.0	41.0	41.0	41.0	41.0	41.0			246.0	
Development		41.0	41.0	41.0	41.0	41.0	41.0			246.0	

Indicates changes since the previous year's President's Budget Submit
Indicates budget numbers in full cost.

Theme: Space and Flight Support
Operations

PURPOSE

Objectives	Performance Measures
8.5, 9.1	5SFS8,15-16,20,22

SPACE COMMUNICATION PROGRAM: Provide high quality, reliable and cost-effective space communications services to the Shuttle, ISS, other low Earth orbit satellites, and launch vehicles. In addition, perform conceptual studies on the continuing use of data relay satellite system(s) to meet NASA and National mission requirements. LAUNCH SERVICES: Principal objective is to provide safe, reliable, cost-effective, on schedule processing, advanced analysis and integration and launch services for NASA and NASA-sponsored payloads seeking launch on Space Shuttle and/or expendable Launch Vehicles. PROPULSION TEST PROGRAM: Provide rocket propulsion test facilities in support of NASA programs, commercial partners, and the Department of Defense. Space and Flight Support budget also provides for astronaut crew health and safety issues.

OVERVIEW

Space and Flight Support, managed by the Space Flight Enterprise, is comprised of four separate Agency-level services: SPACE COMMUNICATION PROGRAM: Comprised of two major elements: (1) The Tracking and Data Relay Satellite system, which supports the Space Shuttle program, the International Space Station, other low-Earth orbiting satellites, expendable launch vehicles, and research aircraft; and (2) the NASA Integrated Services Network, which provides telecommunications services among facilities such as NASA flight support networks, mission control centers and science facilities and administrative communications among NASA Centers. LAUNCH SERVICES PROGRAM: Develops and administers policies and procedures for assuring access (e.g. pricing, acquisition planning) and scheduling of payload launches on the Shuttle and commercial expendable launch vehicles. Manifesting and scheduling of payload launches are accomplished on a routine basis through the auspices of the Flight Planning Board, which the Space Flight Enterprise chairs and is comprised of members from each of the NASA Enterprises. PROPULSION TEST PROGRAM: Develop low-cost, safe, and reliable space transportation propulsion systems and testing of operational rockets. Program includes staff support at test facilities at SSC, MSFC, GRC and JSC-White Sands Test facility. CREW HEALTH AND SAFETY: Protects astronauts from the hazards of space travel and identifies methods that allow astronauts to improve their performance. For more information, go to: Launch Services http://www.ksc.nasa.gov/elvnew/elv.htm; http://sspp.gsfc.nasa.gov/ ; Rocket Propulsion Test https://rockettest.ssc.nasa.gov/ ; Space Communications http://spacecommunications.nasa.gov/

PROGRAM MANAGEMENT

Enterprise official is Mr. William F. Readdy, Associate Administrator for Space Flight at HQ. The Space Flight Enterprise Program Management Council 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. LAUNCH SERVICES: The Program Office Director is Karen S. Poniatowski, Assistant Associate Administrator for Launch Services at HQ. ROCKET PROPULSION TEST: The Program Office Director is Keith Brock of Stennis Space Center. CREW HEALTH AND SAFETY: The Program Office Director is Jeffrey Davis, Assistant Associate Administrator for Crew Health and Safety, Office of Space Flight at HQ.

TECHNICAL COMMITMENT

Technical Specifications	FY 2005 President's Budget	Change from Baseline
Space Communication	Manage/operate nine satellites (six in operation, three inactive). Manage NASA Integrated Services Network.	--
Launch Services	Manage processing and launch facilities at KSC, Cape Canaveral Air Force Station, and Vandenberg Air Force Base in support of current launch manifests.	--
Rocket Propulsion Testing	Manage 24 test cells and the supporting facilities.	--
Crew Health and Safety	Manage health care for entire Astronaut Corps, both in space and during ground-based training.	--

Theme: Space and Flight Support
Operations

Schedule	FY 2005 President's Budget	Change from Baseline
Launch Service	Provide expertise, facilities, and capabilities for integrating payloads with Expendable Launch Vehicles and the Shuttle manifest.	--
Space Communication	Provide 24/7 operational readiness of network. Provide system operational readiness.	--
Rocket Propulsion Testing	Maintain facilities and support for propulsion testing.	--
Crew Health and Safety	Certify the medical health of astronauts before flight and provide them with care throughout their careers.	--

ACQUISITION STRATEGY AND PERFORMING ORGANIZATIONS

The Prime Contractor for space communications/data services is Lockheed Martin under the Consolidated Space Operations Contract, which ends Dec. 31, 2003. Follow-on contracts were awarded January 1, 2004 to continue providing space communication services without interruption. Boeing Satellite Systems, the TDRS Replenishment prime contractor, developed and launched three new satellites. NASA accepted the last satellite in July 2003. The Expendable Launch Vehicle Integrated Support contractor is the Analex Corporation. This contract covers three years of operations, renewable in FY 2005. Contract Awarded May 2002. The Checkout and Payload Processing Services contractor is the Boeing Space Operations Company. This contract covers four years of operations, renewable in FY 2006. The primary Rocket Test contractors at each test site are SSC: Lockheed Martin and Mississippi Space Services; MSFC: LB&B; JSC/WSTF: Honeywell; GRC/PB: Plum Brook Operations.

Current Acquisition	Actual*	Selection Method	Actual*	Performer	Actual*
Cooperative Agreement	0%	Full & Open Competition	100%	Industry	100%
Cost Reimbursable	77%	Sole Source	0%	Government	0%
Fixed Price	23%			NASA Intramural	0%
Grants	0%		100%	University	0%
Other	0%	Sci Peer Review	0%	Non Profit	0%
*As of FY 2003 direct procurement	100%	*As of FY 2003 direct procurement		*As of FY 2003 direct procurement	100%

Future Acquisition	Selection	Goals
1. Space Communications Operations	Selected	100% Full & Open Competition, 15% Small business

AGREEMENTS

Internal: Rocket Propulsion Test Management Board (Intra-Center). External: Three NASA and DOD Memoranda of Agreement for increased efficiencies between agencies.

RISK MITIGATION

Top Risks	G	Overall	Y	Cost	G	Schedule	G	Technical	Probability	Impact	Mitigation Plan
G	Launch Failure (Overall)								Moderate	High	In place
Y	Potential decline in reimbursables for Space Communications								Moderate	High	In development

INDEPENDENT REVIEWS

Review Types	Performer	Last Review Date	Next Review Date	Purpose
(RPT) Program Review	PIMC	12/03	3/04	Rocket Propulsion Testing quarterly review

BUDGET

Budget Authority ($ millions)	FY 2003	FY 2004	FY 2005	Comments
FY2005 PRESBUD	352.2	341.6	415.6	
Space Communications	115.3	124.1	195.4	Space Communications still includes studies for the TDRS Continuation Program, which is being covered with off-set funds.
Payloads	48.7			
ELV	35.8			
Rocket Test	27.0	61.9	66.7	
Miscellaneous	125.4	14.4	7.6	
Launch Services		141.2	145.9	
Changes since 2004 PRESBUD	+113.5	-8.0		
Space Communications	+0.4	-6.8		
Payloads	-0.4	-75.3		Combined Payloads and ELV into Launch Services
ELV	-0.8	-65.8		
Rocket Test	+3.9	-0.4		
Miscellaneous	+110.3	-1.0		
Launch Services		+141.2		
FY2004 PRESBUD	238.7	349.6		
Space Communications	114.9	130.9		
Payloads	49.1	75.3		
ELV	36.6	65.8		
Rocket Test	23.1	62.3		
Miscellaneous	15.0	15.4		

Indicates changes since the previous year's President's Budget Submit
Indicates budget numbers in full cost.

The Space Shuttle program plays a vital role in NASA's goal to explore space and extend a human presence across our solar system by providing critical support for the assembly and operation of the International Space Station.

Space Shuttle

MAJOR EVENTS IN FY 2005

- Continuance of Space Station assembly missions;
- Completion of the Space Shuttle Main Engine Advanced Health Management System; and
- Preparation for the planned phase out of the Space Shuttle at the end of the decade following completion of its role in Space Station assembly.

Theme: Space Shuttle

OVERVIEW

The Space Shuttle program (SSP) plays a vital role in enabling NASA's vision and mission. This includes advancing human exploration and providing safe access to space in support of human operations in low Earth orbit. The Shuttle's primary role is to complete the assembly of the International Space Station (ISS). The Shuttle's phase out is planned for the end of the decade, following completion of it role in ISS assembly. The FY 2005 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); and include high priority projects for mission assurance.

Missions	Goals supported by this Theme	Objectives supporting those Goals
Exploration Capabilities	8. Ensure the provision of space access, and improve it by increasing safety, reliability, and affordability.	8.3 Improve the accessibility of space via the Space Shuttle to better meet Space Station assembly, operations and research requirements.

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." The Space Shuttle is essential to the assembly of the ISS, its primary mission before its planned phase out at the end of the decade.

Education and Public Benefits
The SSP provides Long-term benefits to the public through support to the ISS and enables researchers to undertake experiments in the unique environment of space. The SSP is contributing to NASA's goal to get students excited about science and mathematics and help advance the Nation's education goals by supporting the Educator Astronaut Program.

IMPLEMENTATION

This Theme is composed of many integrated parts that 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 Space Flight Enterprise at NASA Headquarters. The Agency Program Management Council has SSP governing responsibility. Enterprise official is William F. Readdy, Associate Administrator for Space Flight at NASA Headquarters. Theme Director is General Michael C. Kostelnik, Deputy Associate Administrator for ISS and SSP.

IMPLEMENTATION SCHEDULE

Theme Element	Schedule by Fiscal Year 95 96 97 98 99 00 01 02 03 04 05 06 07 08 09 10	Purpose
SSME Advanced Health Management System (AHMS)		Provides 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		Ensures the proper technical integration of all Shuttle elements and payloads. Includes high-priority mission assurance projects for safety, supportability, and infrastructure to combat obsolescence of vehicle, ground systems, and facilities.
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		Produces and maintains the various flight hardware and software elements.

Tech & Adv Concept Development Operations Research

No exceptions to NPG 7120.5B have been taken.

STATUS

Although the STS-107 Space Shuttle mission ended tragically, all 80 of the experiments onboard studying Earth and space science, advanced technology development, and astronaut health and safety were conducted successfully. More than 50 percent of this research was recovered. The Shuttle program has established an Implementation Plan for Return to Flight and Beyond to address all the actions necessary to comply with the formal recommendations of the Columbia Accident Investigation Board (CAIB) and to assure a safe return to flight as soon as practicable. Before the Columbia accident, the Space Shuttle program successfully completed two other missions in FY 2003. The STS-112 mission delivered the first starboard truss segment to the ISS. In addition to performing a crew exchange, the STS-113 mission delivered the first truss segment on the left side of the ISS. Three spacewalks were performed on each of these missions. The Program Assessment Rating Tool (PART) evaluation concluded "Results Not Demonstrated" due to the loss of the Space Shuttle Columbia, and also due to the lack of good short and long-term measures. To improve the next PART evaluation, additional measures will be added. Go to http://spaceflight.nasa.gov/ for more detailed status information.

Performance Measures

Outcomes/Annual Performance Goals (APGs)	
Outcome 8.3.1	*Assure public, flight crew, and workforce safety for all Space Shuttle operations and safely meet the manifest and flight rate commitment through completion of Space Station assembly.*
5SSP1	Achieve zero Type-A (damage to property at least $1M or death) or Type-B (damage to property at least $250K or permanent disability or hospitalization of three or more persons) mishaps in FY 2005
5SSP2	Achieve an average of eight or fewer flight anomalies per Space Shuttle mission in FY 2005
5SSP3	Achieve 100 percent on-orbit mission success for all Shuttle missions launched in FY 2005. 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 Measures	
5SSP4	Complete all development projects within 110% of the cost and schedule baseline.
5SSP5	Deliver at least 90% of scheduled operating hours for all operations and research facilities.

Independent Reviews

Review Types	Performer	Last Review Date	Next Review Date	Purpose
Observation	Office of Inspector General	12/03		Assess independence of CAIB.
Mishap Investigation	CAIB	8/03		Determine cause of Columbia accident and provide recommendations.
Audit	OIG	8/03		Survey RTF activities, identify weaknesses and ensure they are addressed.
Return to Flight Review	Return to Flight Task Group (Stafford - Covey)	On going	On going	Assess NASA's actions to implement recommendations of the CAIB.

Budget

Budget Authority ($ millions)	FY 2003	FY 2004	Change	FY 2005	Comments
Space Shuttle	**3,301.4**	**3,945.0**	**+374.2**	**4,319.2**	
Development	96.8	96.3	-9.1	87.2	
Checkout and Launch Control System (CLCS)	13.1				
Advanced Health Management System (AHMS)	4.9	6.3	-3.0	3.3	
Cockpit Avionics Upgrade (CAU)	78.8	90.0	-6.1	83.9	
Operations	3,204.6	3,848.7	+383.3	4,232.0	Increase for Return to Flight
Program Integration	503.4	609.8	+183.2	793.0	
Ground Operations	568.9	894.2	+161.3	1,055.5	
Flight Operations	267.9	373.2	+32.2	405.4	
Flight Hardware	1,705.2	1,971.5	+6.6	1,978.1	
Service Life Extension Program (SLEP)	159.3				

Indicates changes since the previous year's President's Budget Submit

Indicates budget numbers in full cost.

Theme: Space Shuttle

Development: Advanced Health Management System (AHMS)

PURPOSE

Objectives	Performance Measures
8.3	5SSP1,4

AHMS project supports this objective by enabling safe Space Shuttle Main Engine shutdown during potentially catastrophic high pressure turbopump failures which decreases ascent risk by approximately ten percent.

OVERVIEW

The 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 project with program level 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. The prime Contractor is Boeing-Rocketdyne. The Space Flight Enterprise Program Management Council has SSP governing responsibility. The Enterprise official is William F. Readdy, Associate Administrator for Space Flight at HQ. The Point of Contact is General Michael C. Kostelnik, Deputy Associate Administrator for ISS and SSP at HQ. The Project Manager is Jeffrey Spencer at Marshall. Full compliance with NPG 7120.5B will be achieved in FY 2004.

TECHNICAL COMMITMENT

The baseline for this technical commitment was made in June 1997. This project was rebaselined in August 2003 to account for impacts resulting from external factors (Columbia accident).

Technical Specifications	FY 2005 President's Budget	Change from Baseline
Digital Computer Unit Memory	128K	+64
Baseline Controller Weight Delta	+3 lb	0
Time to initiate engine shutdown after vibration redline exceedance	125 ms	0

Schedule	FY 2005 President's Budget	Baseline	Change from Baseline
Phase I Critical Design Review	May-01	May-01	Complete
Phase I Design Certification Review	Jun-04	Jun-04	0
Phase I Ready for First Flight	Oct-04	Oct-04	0

ACQUISITION STRATEGY AND PERFORMING ORGANIZATIONS

Boeing-Rocketdyne has a cost plus award fee/incentive fee contract to develop this project. Changes since FY 2004 President's Budget: None.

Current Acquisition	Actual*	Selection Method	Actual*	Performer	Actual*
Cooperative Agreement	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	%	Non Profit	0%
* as of FY03 direct procurement	100%	* as of FY03 direct procurement		* as of FY03 direct procurement	100%

Theme: Space Shuttle
Development: Advanced Health Management System (AHMS)

Future Acquisition - 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 FY 2004 President's Budget: None.

RISK MITIGATION

Risk Date: 12/1/2003

Top Risks	G Overall G Cost Y Schedule G Technical	Probability	Impact	Mitigation Plan
Y	Flight issue may divert contractor resources from AHMS tasks	Low	Moderately High	In Place
R	Initial digital computer unit & signal processor software delivery may not be suitable for hot-fire test	Moderately High	Moderately High	In Place
Y	Software requirements volatility	Medium	Medium	In Place

INDEPENDENT REVIEWS

Review Types	Performer	Last Review Date	Next Review Date	Purpose
Independent Assessment	IPAO	1/01	1/01	Assess probability of meeting schedule and cost. Assess risks and mitigation.

BUDGET/LIFE CYCLE COST

Budget Authority ($ millions)	Prior	FY03	FY04	FY05	FY06	FY07	FY08	FY09	BTC	Total	Comments
FY2005 PRESBUD	33.6	4.9	6.3	3.3	2.2	1.2				51.5	
Development	33.6	4.9	6.3	3.3	2.2	1.2				51.5	
Changes since 2004 PRESBUD	-3.0	-3.1		+0.3	+0.2	-0.1				-5.7	
Development	-3.0	-3.1		+0.3	+0.2	-0.1				-5.7	
FY2004 PRESBUD	36.6	8.0	6.3	3.0	2.0	1.3				57.2	
Development	36.6	8.0	6.3	3.0	2.0	1.3				57.2	
Initial Baseline	37.5	8.0	3.0	3.0	2.0	1.0				54.5	
AHMS	37.5	8.0	3.0	3.0	2.0	1.0				54.5	Baseline established 7/00 at ATP

Indicates changes since the previous year's President's Budget Submit
Indicates budget numbers in full cost.

Theme: Space Shuttle
Development: Cockpit Avionics Upgrade (CAU)

PURPOSE

Objectives	Performance Measures
8.3	5SSP1,4

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 percent increase in trajectory monitoring, a 50 percent increase in critical system monitoring, and 20 percent 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 with higher performance Command and Display Processors. 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 project with program level responsibility delegated to the Johnson Space Center. The Prime contractor is United Space Alliance. The Space Flight Enterprise Program Management Council has SSP governing responsibility. The Enterprise official is William F. Readdy, Associate Administrator for Space Flight at NASA Headquarters . The Point of Contact is General Michael C. Kostelnik, Deputy Associate Administrator for ISS and SSP at NASA Headquarters. The Project Manager is Daryl Peltier at JSC. Full compliance with NPG 7120.5B will be achieved in FY 2004.

TECHNICAL COMMITMENT

The baseline for this technical commitment was made in September 2000.

Technical Specifications	FY 2005 President's Budget	Change from Baseline
On-board trajectory monitoring	100% increase	--
On board critical systems monitoring	*50% increase	--
On-board overall systems monitoring	*20% increase	--
Increase is relative to current on-board Shuttle cockpit avionics capability as measured using industry standard Situation Awareness Global Assessment Technique (SAGAT).		

Schedule	FY 2005 President's Budget	Baseline	Change from Baseline
Preliminary Design Review	Apr-02	Apr-02	complete
Critical Design Review	Sep-03	Jul-03	complete
Ready for First Flight	CY 2006	CY 2006	

ACQUISITION STRATEGY AND PERFORMING ORGANIZATIONS

United Space Alliance has a cost plus award fee/incentive fee contract to develop this project. Changes since FY 2004 President's Budget: None.

Current Acquisition	Actual*	Selection Method	Actual*	Performer	Actual*
Cooperative Agreement	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	%	Non Profit	0%
* as of FY03 direct procurement	100%	* as of FY03 direct procurement		* as of FY03 direct procurement	100%

Theme: Space Shuttle
Development: Cockpit Avionics Upgrade (CAU)

Future Acquisition - Major	Selection	Goals
None		

AGREEMENTS

Internal: Memorandum of Understanding between JSC and NASA Ames Research Center (ARC) regarding common interests in Shuttle improvements and new aerospace technologies (human factors and information technology expertise). External: None Changes since FY 2004 President's Budget: None.

RISK MITIGATION

Risk Date: 11/30/2003

Top Risks	Y Overall	G Cost	Y Schedule	G Technical	Probability	Impact	Mitigation Plan
R	Unable to complete Flight SW development prior to First Article Configuration Inspection				High	Medium	In Place
R	Lack of error-free C++ products could impact schedule				High	Medium	In Place
Y	Integration of software test facility and CAU System				Medium	Moderately High	In Place

INDEPENDENT REVIEWS

Review Types	Performer	Last Review Date	Next Review Date	Purpose
NAR	IPAO	10/02	N/A	Assess probability of meeting schedule, cost and risks, and measures to mitigate.

BUDGET/LIFE CYCLE COST

Budget Authority ($ millions)	Prior	FY03	FY04	FY05	FY06	FY07	FY08	FY09	BTC	Total	Comments
FY2005 PRESBUD	181.2	78.8	90.0	83.9	16.5					450.4	
Development	181.2	78.8	90.0	83.9	16.5					450.4	
Changes since 2004 PRESBUD	+9.3	-9.7	-4.3	+4.7	+2.3					+2.3	
Development	+9.3	-9.7	-4.3	+4.7	+2.3					+2.3	
FY2004 PRESBUD	171.9	88.5	94.3	79.2	14.2					448.1	
Development	171.9	88.5	94.3	79.2	14.2					448.1	
Initial Baseline	171.9	88.5	90.5	76.9	14.2					442.0	
CAU	171.9	88.5	90.5	76.9	14.2					442.0	

Indicates changes since the previous year's President's Budget Submit
Indicates budget numbers in full cost.

Theme: Space Shuttle
Operations: Program Integration

PURPOSE

Objectives	Performance Measures
8.3	5SSP3,5

SSP Program Integration assures the successful technical integration of all Shuttle elements and payloads into each mission to efficiently and effectively meet the 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 the 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, and 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 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. High-priority mission assurance projects for safety, supportability, and infrastructure to combat obsolescence of vehicle, ground systems, and facilities that were formerly part of the Space Shuttle Service Life Extension Program are included in this budget.

PROGRAM MANAGEMENT

The Shuttle Program Integration responsibility is delegated to Johnson Space Center. The Space Flight Enterprise Program Management Council has SSP governing responsibility. The Enterprise official is William F. Readdy, Associate Administrator for Space Flight at NASA Headquarters. The Point of Contact is General Michael C. Kostelnik, Deputy Associate Administrator for ISS and SSP at NASA Headquarters. The Program Manager is William Parsons at JSC. Full compliance with NPG 7120.5B will be achieved in FY 2004.

TECHNICAL COMMITMENT

Flights are baselined approximately 12 to 13 months prior to targeted launch date. As of December 22, 2003, mission content and dates are still under review.

Technical Specifications	FY 2005 President's Budget	Change from Baseline
STS-114	LF1 - Integrate, Deliver, and Return Multi-Purpose Logistics Module	--
STS-121	ULF1.1 - Integrate, Deliver, and Return MPLM, Rotate Crew	--
STS-115	Integrate and Deliver P3/P4 Truss	--
STS-116	Integrate and Deliver P5 Truss, Rotate Crew	--
STS-117	Integrate and Deliver S3/S4 Truss	--
STS-118	Integrate and Deliver S5 Truss	--

Schedule	FY 2005 President's Budget	Change from Baseline
STS-114/Atlantis	TBD Space Shuttle RTF	--
STS-121/Discovery	TBD Space Shuttle RTF	--
STS-115/Atlantis	TBD Space Shuttle RTF	--
STS-116/Discovery	TBD Space Shuttle RTF	--
STS-117/Atlantis	TBD Space Shuttle RTF	--
STS-118/Discovery	TBD Space Shuttle RTF	--

ACQUISITION STRATEGY AND 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. Changes since FY 2004 President's Budget: None.

Theme: Space Shuttle
Operations: Program Integration

Current Acquisition	Actual*	Selection Method	Actual*	Performer	Actual*
Cooperative Agreement	0%	Full & Open Competition	12%	Industry	99%
Cost Reimbursable	96%	Sole Source	88%	Government	1%
Fixed Price	3%			NASA Intramural	0%
Grants	0%		100%	University	0%
Other	1%	Sci Peer Review	%	Non Profit	0%
* as of FY03 direct procurement	100%	* as of FY03 direct procurement		* as of FY03 direct procurement	100%

Future Acquisition	Selection	Goals
SFOC	Full & Open	President's Management 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

Risk Mitigation

Risk Date: 11/30/2003

Top Risks	Y Overall G Cost Y Schedule R Technical	Probability	Impact	Mitigation Plan
R	Significant Return to Flight milestones left to accomplish	Medium	High	In Place
Y	Manifest risk due to RTF date uncertainty	Moderately High	Medium	In Place

Independent Reviews

Review Types	Performer	Last Review Date	Next Review Date	Purpose
Mishap Investigation	CAIB	8/03		Determine cause of Columbia accident and provide recommendations.

Budget

Budget Authority ($ millions)	FY 2003	FY 2004	FY 2005	Comments
FY2005 PRESBUD	503.4	609.8	793.0	
Program Integration	503.4	609.8	793.0	
Changes since 2004 PRESBUD	+100.7	+277.7		
Program Integration	+100.7	+277.7		
FY2004 PRESBUD	402.7	332.1		
Program Integration	402.7	332.1		

Indicates changes since the previous year's President's Budget Submit
Indicates budget numbers in full cost.

Theme: Space Shuttle
Operations: Ground Operations

PURPOSE

Objectives	Performance Measures
8.3	5SSP1,5

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, two launch pads, the Vehicle Assembly Building, the Launch Control Center and three Mobile Launcher Platforms.

OVERVIEW

Ground operations support capability includes launch countdown and landing for five Shuttle missions in FY 2005. Ground support for Shuttle landing includes both the Kennedy and Edwards Air Force Base runways and multiple contingency landing sites in the United States and other countries. Ground Operations also includes the maintenance and operations of ground infrastructure to support launch and landing. The 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 Kennedy Space Center. The Space Flight Enterprise Program Management Council has SSP governing responsibility. The Enterprise official is William F. Readdy, Associate Administrator for Space Flight at NASA Headquarters. The Point of Contact is General Michael C. Kostelnik, Deputy Associate Administrator for ISS and SSP at NASA Headquarters. The Program Manager is William Parsons at JSC. Full compliance with NPG 7120.5B will be achieved in FY 2004.

TECHNICAL COMMITMENT

Flights are baselined approximately 12 to 13 months prior to targeted launch date. As of December 22, 2003, mission content and dates are still under review.

Technical Specifications	FY 2005 President's Budget	Change from Baseline
STS-114	LF1 - Integrate, Deliver, and Return Multi-Purpose Logistics Module (MPLM)	New
STS-121	ULF1.1 - Integrate, Deliver, and Return MPLM, Rotate Crew	New
STS-115	Integrate and Deliver P3/P4 Truss	--
STS-116	Integrate and Deliver P5 Truss, Rotate Crew	--
STS-117	Integrate and Deliver S3/S4 Truss	--
STS-118	Integrate and Deliver S5 Truss	--

Schedule	FY 2005 President's Budget	Change from Baseline
STS-114/Atlantis	TBD Space Shuttle RTF	--
STS-121/Discovery	TBD Space Shuttle RTF	--
STS-115/Atlantis	TBD Space Shuttle RTF	--
STS-116/Discovery	TBD Space Shuttle RTF	--
STS-117/Atlantis	TBD Space Shuttle RTF	--
STS-118/Discovery	TBD Space Shuttle RTF	--

ACQUISITION STRATEGY AND PERFORMING ORGANIZATIONS

The prime contractor for ground operations 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. Changes since FY 2004 President's Budget: None.

Theme: Space Shuttle
Operations: Ground Operations

Current Acquisition	Actual*	Selection Method	Actual*	Performer	Actual*
Cooperative Agreement	0%	Full & Open Competition	12%	Industry	99%
Cost Reimbursable	96%	Sole Source	88%	Government	1%
Fixed Price	3%			NASA Intramural	0%
Grants	0%		100%	University	0%
Other	1%	Sci Peer Review	%	Non Profit	0%
* as of FY03 direct procurement	100%	* as of FY03 direct procurement		* as of FY03 direct procurement	100%

Future Acquisition	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 FY 2004 President's Budget: None.

Risk Mitigation

Risk Date: 11/30/2003

Top Risks	Y	Overall	G	Cost	Y	Schedule	R	Technical	Probability	Impact	Mitigation Plan

Independent Reviews

Review Types	Performer	Last Review Date	Next Review Date	Purpose
Mishap Investigation	CAIB	8/03		Determine cause of Columbia accident and provide recommendations.

Budget

Budget Authority ($ millions)	FY 2003	FY 2004	FY 2005	Comments
FY2005 PRESBUD	568.9	894.2	1,055.5	
Ground Operations	568.9	894.2	1,055.5	
Changes since 2004 PRESBUD	+41.0	-5.3		
Ground Operations	+41.0	-5.3		
FY2004 PRESBUD	527.9	899.5		
Ground Operations	527.9	899.5		

Indicates changes since the previous year's President's Budget Submit
Indicates budget numbers in full cost.

Theme: Space Shuttle
Operations: Flight Operations

PURPOSE

Objectives	Performance Measures
8.3	5SSP1-3,5

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 customer requirements in exploring the fundamental principles of physics, chemistry, and biology through research in the unique environment of space.

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, Integrated Training Facility, Integrated Planning System and the Software Production Facility. The major operations facilities at Johnson Space Center include flight design systems and the fleet of training aircraft.

For more status information go to http://spaceflight.nasa.gov/.

PROGRAM MANAGEMENT

The Shuttle Flight Operations responsibility is delegated to Johnson Space Center. The Space Flight Enterprise Program Management Council has SSP governing responsibility. The Enterprise official is William F. Readdy, Associate Administrator for Space Flight at NASA Headquarters. The Point of Contact is General Michael C. Kostelnik, Deputy Associate Administrator for ISS and SSP at NASA Headquarters. The Program Manager is William Parsons at JSC. Full compliance with NPG 7120.5B will be achieved in FY 2004.

TECHNICAL COMMITMENT

Flights are baselined approximately 12 to 13 months prior to targeted launch date. As of December 22, 2003, mission content and dates are still under review.

Technical Specifications	FY 2005 President's Budget	Change from Baseline
STS-114	LF1 - Integrate, Deliver, and Return Multi-Purpose Logistics Module (MPLM)	--
STS-121	ULF1.1 - Integrate, Deliver, and Return MPLM, Rotate Crew	--
STS-115	Integrate and Deliver P3/P4 Truss	--
STS-116	Integrate and Deliver P5 Truss, Rotate Crew	--
STS-117	Integrate and Deliver S3/S4 Truss	--
STS-118	Integrate and Deliver S5 Truss	--

Schedule	FY 2005 President's Budget	Change from Baseline
STS-114/Atlantis	TBD Space Shuttle RTF	--
STS-121/Discovery	TBD Space Shuttle RTF	--
STS-115/Atlantis	TBD Space Shuttle RTF	--
STS-116/Discovery	TBD Space Shuttle RTF	--
STS-117/Atlantis	TBD Space Shuttle RTF	--
STS-118/Discovery	TBD Space Shuttle RTF	--

ACQUISITION STRATEGY AND PERFORMING ORGANIZATIONS

The prime contractor for flight operations is United Space Alliance under the Space Flight Operations Contract (SFOC). This contract covers two years of operations through September 30, 2004. The SFOC contract was awarded in 1996 as a sole source contract. Changes since FY 2004 President's Budget: None.

Theme: Space Shuttle
Operations: Flight Operations

Current Acquisition	Actual*	Selection Method	Actual*	Performer	Actual*
Cooperative Agreement	0%	Full & Open Competition	12%	Industry	99%
Cost Reimbursable	96%	Sole Source	88%	Government	1%
Fixed Price	3%			NASA Intramural	0%
Grants	0%		100%	University	0%
Other	1%	Sci Peer Review	0%	Non Profit	0%
* as of FY03 direct procurement	100%	* as of FY03 direct procurement		* as of FY03 direct procurement	100%

Future Acquisition	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 FY 2004 President's Budget: None.

Risk Mitigation

Risk Date: 11/30/2003

Top Risks	Y Overall	G Cost	Y Schedule	R Technical	Probability	Impact	Mitigation Plan
Y	Significant Return to Flight milestones left to accomplish				Moderately High	Medium	In Place
R	Manifest risk due to RTF date uncertainty				Medium	High	In Place

Independent Reviews

Review Types	Performer	Last Review Date	Next Review Date	Purpose
Mishap Investigation	CAIB	8/03		Determine cause of Columbia accident and provide recommendations.

Budget

Budget Authority ($ millions)	FY 2003	FY 2004	FY 2005	Comments
FY2005 PRESBUD	267.9	373.2	405.4	
Flight Operations	267.9	373.2	405.4	
Changes since 2004 PRESBUD	+3.3	-2.2		
Flight Operations	+3.3	-2.2		
FY2004 PRESBUD	264.6	375.4		
Flight Operations	264.6	375.4		

Indicates changes since the previous year’s President’s Budget Submit
Indicates budget numbers in full cost.

Theme: Space Shuttle
Operations: Flight Hardware

PURPOSE

Objectives	Performance Measures
8.3	5SSP1-3,5

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 customer 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, which 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 Johnson Space Center for Orbiter and Extra-vehicular Activity (EVA), MSFC for ET, RSRM, SRB, and SSME, and SSC for SSME test support. The Space Flight Enterprise Program Management has SSP governing responsibility. Enterprise official is William F. Readdy, Associate Administrator for Space Flight at Headquarters. Point of Contact is General Michael C. Kostelnik, Deputy Associate Administrator for ISS and SSP at Headquarters. The Program Manager is William Parsons at JSC. Full compliance with NPG 7120.5B will be achieved in FY 2004.

TECHNICAL COMMITMENT

Flights are baselined approximately 12 to 13 months prior to targeted launch date. As of December 22, 2003 mission content and dates are still under review.

Technical Specifications	FY 2005 President's Budget	Change from Baseline
STS-114	LF1 -Integrate, Deliver, and Return MPLM	New
STS-121	ULF1.1 -Integrate, Deliver, and Return MPLM, Rotate Crew	New
STS-115	Integrate and Deliver P3/P4 Truss	--
STS-116	Integrate and Deliver P5 Truss, Rotate Crew	--
STS-117	Integrate and Deliver S3/S4 Truss	--
STS-118	Integrate and Deliver S5 Truss	--

Schedule	FY 2005 President's Budget	Change from Baseline
STS-114/Atlantis	TBD Space Shuttle RTF	--
STS-121/Discovery	TBD Space Shuttle RTF	--
STS-115/Atlantis	TBD Space Shuttle RTF	--
STS-116/Discovery	TBD Space Shuttle RTF	--
STS-117/Atlantis	TBD Space Shuttle RTF	--
STS-118/Discovery	TBD Space Shuttle RTF	--

ACQUISITION STRATEGY AND 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 and Power Systems. This contract expires December 31, 2006. The Prime Contractor for the Vehicle and Solid Rocket Booster is United Space Alliance (USA). This contract ends September 30, 2004. The Prime Contractor for the Reusable Solid Rocket Motor is ATK Thiokol Propulsion. This contract covers two years of operations, renewable in FY 2004. 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 FY 2004 President's Budget: None.

Theme: Space Shuttle
Operations: Flight Hardware

Current Acquisition	Actual*	Selection Method	Actual*	Performer	Actual*
Cooperative Agreement	0%	Full & Open Competition	12%	Industry	99%
Cost Reimbursable	96%	Sole Source	88%	Government	1%
Fixed Price	3%			NASA Intramural	0%
Grants	0%		100%	University	0%
Other	1%	Sci Peer Review	%	Non Profit	0%
* as of FY03 direct procurement	100%	* as of FY03 direct procurement		* as of FY03 direct procurement	100%

Future Acquisition	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 FY 2004 President's Budget: None.

Risk Mitigation

Risk Date: 11/30/2003

Top Risks	Y Overall G Cost Y Schedule R Technical	Probability	Impact	Mitigation Plan
G	OV-103 OMM Rudder Speed Brake Actuators	Low	Medium	In Place
Y	Booster Separation Motor Availability	Medium	Moderately High	In Place
G	External Tank Attachment Ring safety requirements	Low	Medium	In Place
Y	Orbiter Boom Sensor System capability	Medium	Medium	In Place

Independent Reviews

Review Types	Performer	Last Review Date	Next Review Date	Purpose
Mishap Investigation	CAIB	8/03	N/A	Determine cause of Columbia accident and provide recommendations.

Budget

Budget Authority ($ millions)	FY 2003	FY 2004	FY 2005	Comments
FY2005 PRESBUD	1,705.2	1,971.5	1,978.1	
Flight Hardware	1,705.2	1,971.5	1,978.1	
Changes since 2004 PRESBUD	+23.5	-11.6		
Flight Hardware	+23.5	-11.6		
FY2004 PRESBUD	1,681.7	1,983.1		
Flight Hardware	1,681.7	1,983.1		

Indicates changes since the previous year's President's Budget Submit
Indicates budget numbers in full cost.

The International Space Station (ISS) is a complex of research laboratories in low Earth orbit for conducting unique scientific and technological investigations in microgravity environment.

International Space Station

MAJOR EVENTS IN FY 2005

- Increase crew size to 3 persons delivered by Shuttle after the Shuttle returns to flight; and
- Resume ISS Assembly with Shuttle after it returns to flight.

Theme: International Space Station

OVERVIEW

The International Space Station (ISS) is a complex of research laboratories in low Earth orbit in which American and International astronauts are conducting unique scientific and technological investigations in a microgravity environment. The primary objective of the ISS is to support scientific research and other activities requiring the unique attributes of humans in space. In concert with the new exploration vision, NASA will refocus U.S. Space Station research on activities, such as the development of countermeasures against space radiation and the long-term effects of reduced gravity, that prepare human explorers to travel beyond low Earth orbit.

Although the Columbia accident has delayed assembly, two crew members are on board and are conducting reduced on-orbit research operations supported by resupply and crew rotation using Russian Progress and Soyuz vehicles. The program continues to complete flight hardware development in order to minimize the financial impact of the assembly delay. Increased science capability must wait until on orbit assembly resumes after the Shuttle returns to flight.

Following large Space Station cost overruns in previous years, the Administration linked the development or deployment of any ISS components beyond the "U.S. Core Complete" configuration and delivery of international partner elements to the program's ability to demonstrate improvement in cost estimation and resolution of technical issues. Since then, NASA has implemented numerous positive changes that have resulted in improved program management and control over the program's cost. The Space Station program is now free to move forward to complete construction of the International Space Station, including those U.S. components that support the goals of U.S. space exploration, by the end of the decade.

The FY05 Budget provides funding for continued development of the vehicle, operations to support continued assembly, logistics re-supply, crew exchange, research operations and other utilization within the constraints of uncertainty about when the Shuttle will return to flight. Impacts from the Shuttle hiatus, programmatic changes, and institutional requirements have resulted in reductions to the ISS Program's estimated budget reserve. Once the Shuttle returns to flight and the schedule for future assembly of the Space Station is understood, the program will undergo a re-baselining activity.

NASA plans to dedicate the Shuttle to ISS assembly and phase out the Shuttle when its role in ISS assembly is complete, planned by the end of this decade. NASA plans to acquire cargo and crew transportation services to supplement and eventually replace the Space Shuttle. The ISS program has a new project, ISS Cargo and Crew Services, which will responsible for the purchase of launch, delivery, and earth return services for ISS cargo including the replacement of failed orbital replacement units, the replenishment of research materials and products, and the purchase of human-rated launch, delivery, and return capability for expedition crew rotation.

Missions	Goals supported by this Theme	Objectives supporting those Goals
To 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 through partnerships with DOD, DHS and other U.S. or international government agencies.
Exploration Capabilities	8. Ensure the provision of space access, and improve it by increasing safety, reliability, and affordability.	8.1 Assure safe, affordable, and reliable crew and cargo access and return from the International Space Station.
		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.	9.3 Demonstrate the ability to support a human presence in low Earth orbit as a stepping-stone to human presence beyond.

RELEVANCE

The ISS will serve as a platform for research on activities that prepare human explorers to travel beyond low Earth orbit, such as the development of countermeasures against space radiation and the long-term effects of reduced gravity. In addition, 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 Earth's surface and atmosphere, the Sun, and other astronomical objects. 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 Japanese Aerospace Exploration Agency (JAXA). Additionally, there are several bilateral agreements between NASA and other nations such as Italy and Brazil, resulting in a total of 16 participating nations. International participation in the program has significantly enhanced the capabilities of the ISS. During the current Shuttle hiatus, Russian participation has been critical to the continued operation of the Space Station.

Theme: International Space Station

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 enables the conduct of research to enable human and robotic exploration and development of space, as well as basic and applied research in biological and physical sciences and applied research and development. No other facility can provide provides prolonged human research interaction in zero-gravity and routine sample return to Earth.

IMPLEMENTATION

This Theme is composed of two Development and three Operational areas. Individual information templates are included for each. Enterprise Official is William F. Readdy, Associate Administrator for Space Flight. The theme Director is General Michael C. Kostelnik, the Deputy Associate Administrator for ISS and Space Shuttle. The program management and reporting flows from the Program Manager, William Gerstenmaier, located at the Johnson Space Center, to the Deputy Associate Administrator for ISS and the Space Shuttle Program. The Deputy Associate Administrator for ISS and the Space Shuttle Program reports directly to the Associate Administrator for Space Flight who reports directly to the NASA Administrator. The Agency Program Management Council has oversight responsibility.

Go to Project Homepage for more information: http://spaceflight.nasa.gov/station/index.html

The Space Station programs expects to complete the "U.S. core" of the Space Station approximately 17 months after the Shuttle returns to flight and to complete the entire Space Station (including international contributions) approximately five years after the Shuttle returns to flight. To achieve NASA's plan to phase out the Space Shuttle by the end of the decade, NASA may modify the assembly sequence of the Space Station. The following chart reflects the ISS implementation schedule based on the Shuttle returning to flight in September 2004.

IMPLEMENTATION SCHEDULE

Theme Element	Schedule	Purpose
ULF1 - Logistics Module	Sep-04	Research and Resupply; Maintenance
12A - P3/P4 Truss Segment	Feb-05	Truss Assembly
12A.1 - P5 Truss Segment	Apr-05	Truss Assembly & Logistical Support
13A - S3/S4 Truss Segment	Jun-05	Truss Assembly
13A.1 - S5 Truss	Sep-05	Truss Assembly & Logistical Support
15A - S6 Truss Segment	10/5/2004	Truss Assembly
10A - Node 2	Feb-06	US Core Complete
ULF2 - Logistics Module	Mar-06	Research and Re-supply; Maintenance
1E - ESA Columbus Laboratory	Jun-06	Partner Element Delivery & Activation
1J/A - Japanese Experiment Logistics Module	Jan-07	Partner Element Delivery & Activation
2J/A - JEM Exposed Facility	10/1/2007	Partner Element Delivery & Activation
1J - Japanese Experiment Module (JEM)	4/1/2007	Partner Module Delivery & Activation
14A - Cupola	6/1/2008	Element & Equipment Delivery - Int'l Partner Complete
9A.1 - Russian Science Power Platform (SPP)	Aug-09	Partner Element Delivery & Activation
ULF7 - Centrifuge Accommodation Module	Nov-09	Utilization and Module Delivery

Tailoring: Full compliance with NPG 7120.5B was achieved in FY 2003.

STATUS

By end of FY2003, a total of 37 U.S. and Russian flights, as well as seven crew increments, were accomplished, with an eighth crew increment underway. The current crew will operate the Station until the end of April 2004.

Theme: International Space Station

ISS operations were significantly impacted by the loss of the Space Shuttle Columbia on February 1, 2003. The next ISS crew exchange used a Soyuz spacecraft, 6S, to replace the three-member Expedition 6 with the two-man Expedition 7 crew. The Expedition 8 crew is continuing to conduct a limited research program.

ISS achievements during FY2003 included**:**

- The addition of two Space Station truss segments (S1 and P1) with ancillary equipment in October and in November 2002;
- The accumulation of a total of 51 extravehicular activities, with 318.5 hours accumulated time, by U.S. and Russian crewmembers in support of ISS assembly;
- The launch of two Russian Soyuz spacecraft (Soyuz 5 and 6)-- the first a "taxi" flight carrying Belgian guest cosmonaut Frank De Winne, the second with the ISS Expedition 7 crew; and
- The launch of three Progress logistics flights (10P, 11P, 12P), taking consumables, spare parts and propellant to the Station.

The Program Assessment and Rating Tool (PART) evaluation concluded that Space Station program had not demonstrated results, due mainly to the loss of the Space Shuttle Columbia, which affected the program's ability to meet several of its annual performance goals or to make large strides toward achieving long-term goals. To improve the next PART evaluation, the program must resume assembly operations and develop additional annual and long-term efficiency measures.

PERFORMANCE MEASURES

Outcomes/Annual Performance Goals (APGs)	
Outcome 3.1.4	*Demonstrate effective international collaboration on the International Space Station.*
5ISS1	In concert with the ISS International Partners, extend a continuous two-person (or greater) crew presence on the ISS through the end of FY2004.
Outcome 8.1.1	*Acquire non-Shuttle, crew and cargo access and return capability for the Station by 2010.*
5ISS7	Baseline a strategy and initiate procurement of cargo delivery service to the ISS.
Outcome 8.4.1	*Provide a safe, reliable, and well-managed on-orbit research facility.*
5ISS2	Achieve zero Type-A (damage to property at least $1M or death) or Type-B (damage to property at least $250K or permanent disability or hospitalization of 3 or more persons) mishaps in FY2004.
5ISS3	Based on the Space Shuttle return-to-flight plan, establish a revised baseline for ISS assembly (through International Core Complete) and research support.
5ISS4	Provide at least 80% of up-mass, volume and crew-time for science as planned at the beginning of FY2004. (Supports Objective 1.1, 3.5, 4.1 and 4.2)
Outcome 8.4.2	*Expand the ISS crew size to accommodate U.S. and International Partner research requirements.*
5ISS5	Obtain agreement among the International Partners on the final ISS configuration.
Outcome 9.3.1	*Develop experience in working and living in space by continuously supporting a crew on-board the ISS through 2016.*
5ISS6	Continuously sustain a crew to conduct research aboard the ISS
Uniform Measures	
5ISS8	Complete all development projects within 110% of the cost and schedule baseline.
5ISS9	Deliver at least 90% of scheduled operating hours for all operations and research facilities.

INDEPENDENT REVIEWS

Review Types	Performer	Last Review Date	Next Review Date	Purpose
Crew Enhancement Option Assessment	TBD	N/A	6/04	Assessment of cost, schedule, and technical risks for crew enhancement option.

Theme: International Space Station

BUDGET

Budget Authority ($ millions)	FY 2003	FY 2004	Change	FY 2005	Comments
International Space Station	**1,462.4**	**1,498.1**	**+364.6**	**1,862.7**	
Development	231.9	146.8	-47.8	99.0	
ISS Core Development	200.1	101.3	-31.9	69.4	
ISS Capability Upgrades	31.8	45.5	-15.9	29.6	
Operations	1,230.5	1,351.3	+412.4	1,763.7	
Spacecraft Operations	658.6	710.2	+101.8	812.0	
Launch and Mission Operations	289.6	439.9	+18.4	458.3	
Operations Program Integration	282.3	201.2	+152.2	353.4	
ISS Cargo/Crew Services			+140.0	140.0	New Activity

Indicates changes since the previous year's President's Budget Submit

Indicates budget numbers in full cost.

Theme: International Space Station
Development: ISS Core Development

PURPOSE

Objectives	Performance Measures
8.4	5ISS3,8

Vehicle development of the ISS is responsible for providing 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, an unpressurized logistics carrier, and a cupola. Various systems have been developed by the United States, 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/centrifuge provided by the Japanese. During FY04, it is expected that the Space Shuttle will return to flight and the assembly of the ISS will resume. In the meantime, the ISS will continue on-orbit research operations with two crew, and with resupply and crew rotation provided by Russian Progress and Soyuz vehicles. Expedition 8 will be completed and expeditions nine and ten will be accomplished during FY04. Node 2 and the last truss segment (S6) will be completing their final integrated testing and be ready for final pre-launch test and checkout in preparation for Space Shuttle integration.

PROGRAM MANAGEMENT

The program management and reporting flows from the Program Manager, William Gerstenmaier, located at the Johnson Space Center (JSC), to the Deputy Associate Administrator (DAA) for ISS and SSP. The DAA for ISS & SSP reports directly to the Associate Administrator for Space Flight who reports directly to the NASA Administrator. The Agency Program Management Council (PMC) has oversight responsibility. Full compliance with NPG 7120.5B was achieved in FY 2003.

TECHNICAL COMMITMENT

Program Commitment Agreement signed August 19, 2003. The baseline was defined by a May 2002 Cost Analysis Requirements Document.

Technical Specifications	FY 2005 President's Budget	Change from Baseline
Crew Size	Three international crew members	--
Power	80 Kilowatts	--
Accommodations	27 U.S. User Racks	--
External Payload Sites	24 External payload sites on truss. Ten 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	Ten years after deployment of the U.S. Laboratory (FY 2016)	--

Schedule	FY 2005 President's Budget	Change from Baseline
Dates subject to change depending on Shuttle return to flight and possible modifications to the ISS assembly sequence.		
9A - S1 Truss	Launched October 2002	+2 months
11A - P1 Truss	Launched November 2002	+2 Months
12A - P3/P4 Truss	Feb 2005	0 months
12A.1 - P5 Truss	Apr 2005	0 months
13A - S3/S4 Truss	Jun 2005	+21 months
13A.1 - S5 Truss	Sep 2005	+24 months
15A - S6 Truss	Oct 2005	+22 months
10A - Node 2 - U.S. CORE COMPLETE	Feb 2006	+24 months

ACQUISITION STRATEGY AND 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 which covers development and operations has been extended through September 2006. In FY2003, direct procurements from Boeing represented about 37% of budget authority in development and operations.

Current Acquisition	Actual*	Selection Method	Actual*	Performer	Actual*
Cooperative Agreement	0%	Full & Open Competition	18%	Industry	99%
Cost Reimbursable	87%	Sole Source	82%	Government	0%
Fixed Price	4%		100%	NASA Intramural	0%
Grants	0%			University	0%
Other	9%	Sci Peer Review	0%	Non Profit	1%
*As of FY 2003 direct procurement	100%	*As of FY 2003 direct procurement		*As of FY 2003 direct procurement	100%

Future Acquisition - Major	Selection	Goals
None		

AGREEMENTS

External: 1.) Intergovernmental Agreement (IGA) Active (1/29/98) 2.) NASA/RSA Memorandum of Understanding (MOU) Active (1/29/98) 3.) NASA/ESA MOU Active (1/29/98) 4.) NASA/Government of Japan (GOJ) MOU Active (2/24/98) 5.) NASA/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).

RISK MITIGATION

Risk Date: 10/17/2003

Top Risks	G	Overall	G	Cost	R	Schedule	G	Technical	Probability	Impact	Mitigation Plan
R	Assembly sequence uncertainty until Shuttle returns to flight								High	High	In place

INDEPENDENT REVIEWS

Review Types	Performer	Last Review Date	Next Review Date	Purpose
None scheduled in FY 2005.				

BUDGET/LIFE CYCLE COST

Budget Authority ($ millions)	Prior	FY03	FY04	FY05	FY06	FY07	FY08	FY09	BTC	Total	Comments
FY2005 PRESBUD	12,315.3	200.1	101.3	69.4	65.5	55.8	22.4	15.7		12,845.5	
Development	12,315.3	200.1	101.3	69.4	65.5	55.8	22.4	15.7		12,845.5	
Changes since 2004 PRESBUD	-0.2	-78.3	-6.3	+18.4	+31.9	-1.5	-18.7	+15.7		-39.2	
Development	-0.2	-78.3	-6.3	+18.4	+31.9	-1.5	-18.7	+15.7		-39.2	
FY2004 PRESBUD	12,315.5	278.4	107.6	51.0	33.6	57.3	41.1			12,884.6	
Development	12,315.5	278.4	107.6	51.0	33.6	57.3	41.1			12,884.6	
Initial Baseline	9,088.1									9,088.1	
Flight Hardware	7,139.0									7,139.0	FY95 budget est
TMAS	513.6									513.6	FY95 budget est
Ops Cap Dev	882.0									882.0	FY95 budget est
Other (Trans Supt, Prog Spt, FTD)	553.5									553.5	FY95 budget est

Indicates changes since the previous year's President's Budget Submit

Indicates budget numbers in full cost.

Theme: International Space Station
Development: ISS Capability Upgrades

PURPOSE

Objectives	Performance Measures
8.4	5ISS2,5,8

ISS Capability Upgrades enable potential enhancements to accommodate research requirements. Expansion of crew size above the U.S. Core baseline is in formulation. Development of a regenerative environmental control and life support system (ECLSS), Node 3, and habitability modifications are expected to continue into FY 2005, based on the selection of a specific enhancement option in FY 2004.

OVERVIEW

ECLSS and Node 3, managed by the Marshall Space Flight Center and reporting to the ISS Program, and Node 3, built by the Italian company, Alenia, are critical pacing items requiring funding to enable option paths to expand the ISS crew to greater than three after U.S. Core complete. They also provide critical life support dissimilar redundancy to the Russian life support system, Elektron Oxygen Generator. The FY 2005 budget includes funding to continue this effort. Funding beyond FY 2005 will be addressed once a final ISS configuration is determined.

PROGRAM MANAGEMENT

The program management and reporting flows from the Program Manager, Bill Gerstenmaier, located at the Johnson Space Center (JSC), to the Deputy Associate Administrator (DAA) for ISS and SSP. The DAA for ISS and SSP reports directly to the Associate Administrator for 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 was achieved in FY 2003.

TECHNICAL COMMITMENT

Program Commitment Agreement signed August 19, 2003; Baseline was defined by May 2002 Cost Analysis Requirements Document (CARD).

Technical Specifications	FY 2005 President's Budget	Change from Baseline
Node-3 Atmosphere	14.7 psi	--
Node-3 Length	249 inches (20.75 ft)	--
Node-3 Diameter	175 Inches (14.6 ft)	--
Node-3 Volume	3470 cu ft.	--
Node-3 Ports	Six (5 ACBM, 1 PCBM)	--
Advanced ECLSS Dissimilar design	ECLSS redundancy(from Russian System); O2 Generation System - Up to 41K lbs of recycled Water; Water Recovery System - up to 7,500 lbs of O2	--
Advanced ECLSS Support Increased:	Crew size to 7	--

Schedule	FY 2005 President's Budget	Baseline	Change from Baseline
Advanced ECLSS Oxygen Generator Assembly	Systems Tests Complete 11/12/04	09/09/2004	+2 Months
Advanced ECLSS Urine Processing Assembly	Rack Level Test Complete January 2005.	08/10/2004	+5 Months
Advanced ECLSS Water Processing Assembly	Rack 1 Systems Tests Complete 06/28/2004	03/25/2004	+3 Months
Advanced ECLSS Water Recovery System	Systems Tests Complete 03/29/2005	01/05/2004	+10 Months
Node-3	Joint NASA/ASI Development Plan Baseline February 2004	--	--
Node-3	Delivery to Kennedy Space Center 01/2008	--	--
Node-3	TBD Shuttle Return to Flight	--	--

ACQUISITION STRATEGY AND PERFORMING ORGANIZATIONS

The Node 3/ECLSS project is being developed by a combination of international partners, NASA, and contractors. Alenia is building the Node 3 under contract with Italian Space Agency. Boeing under contract with NASA is providing critical software and hardware to Alenia. Advanced ECLSS is being developed by Marshall Space Flight Center. Major ECLSS orbital replacement unit development and rack level integration for two of three racks is being provided by Hamilton Sundstrand. Marshall Space Flight Center will provide total ECLSS integration.

Theme: International Space Station
Development: ISS Capability Upgrades

Current Acquisition	Actual*	Selection Method	Actual*	Performer	Actual*
Cooperative Agreement	0%	Full & Open Competition	25%	Industry	69%
Cost Reimbursable	96%	Sole Source	75%	Government	31%
Fixed Price	1%		100%	NASA Intramural	0%
Grants	0%			University	0%
Other	3%	Sci Peer Review	%	Non Profit	0%
*As of FY 2003 direct procurement	100%	*As of FY 2003 direct procurement		*As of FY 2003 direct procurement	100%

Future Acquisition - Major	Selection	Goals
None		

Agreements

External: NASA/Italian Space Agency MOU on the Design, Development, and Delivery of Two Integrated Nodes (10/97).

Risk Mitigation

Risk Date: 10/17/2003

Top Risks	Y	Overall	Y	Cost	Y	Schedule	Y	Technical	Probability	Impact	Mitigation Plan
Y	Orbital replacement unit life cycle test failures								Medium	Medium	In Place

Independent Reviews

Review Types	Performer	Last Review Date	Next Review Date	Purpose
ECLSS, Node 3, Habitation Mods Independent Cost Estimate	JSC Systems Management Office	9/02	6/04	Assessment of cost, schedule and technical risks.

Budget/Life Cycle Cost

Budget Authority ($millions)	Prior	FY03	FY04	FY05	FY06	FY07	FY08	FY09	BTC	Total	Comments
FY2005 PRESBUD	633.9	31.8	45.5	29.6	16.0	9.8	3.9	0.8		771.3	
ECLSS	183.4	22.6	19.3	11.2	9.3	3.7				249.5	
Node 3	8.3	9.2	26.2	18.4	6.7	6.1	3.9	0.8		79.6	
CRV	171.8									171.8	
RPA	270.4									270.4	
Changes since 2004 PRESBUD	-13.0		-0.3	+2.5	-4.4	-0.1	+3.9	+0.8		-10.6	
ECLSS	-0.6	+0.6	-0.1	+5.5	+5.4	+2.8				+13.6	
Node 3		-0.6	-0.2	-3.0	-9.7	-2.9	+3.9	+0.8		-11.8	
CRV	-12.4									-12.4	
FY2004 PRESBUD	646.9	31.8	45.8	27.1	20.4	9.9				781.9	
ECLSS	184.0	22.0	19.4	5.7	3.9	0.9				235.9	
Node 3	8.3	9.8	26.4	21.4	16.4	9.0				91.3	
CRV	184.2									184.2	
RPA	270.4									270.4	
Initial Baseline	1,487.3	202.3	195.0	15.4	10.5	7.7				1,918.2	
ECLSS (Nov-02)	183.4	22.5	12.3	1.0						219.2	02 PMR est., dev. only
Node 3 (Nov-02)	8.3	9.8	16.7	14.4	10.5	7.7				67.4	02 PMR est., dev. only
CRV (Jan-98)	461.0	165.0	166.0							792.0	FY99 budget est
RPA (Jan-99)	834.6	5.0								839.6	FY00 budget est

Indicates changes since the previous year's President's Budget Submit
Indicates budget numbers in full cost.

Theme: International Space Station
Operations: Spacecraft Operations

PURPOSE

Objectives	Performance Measures
3.1, 8.4, 9.3	5ISS1-2,6,9

The primary objective of the Spacecraft Operations Program is to safely and reliably assemble, activate, integrate, and operate the ISS on-orbit, and to perform these activities in an affordable manner. This requires a significant level of planning, coordination, and execution. 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 in the budget table.

OVERVIEW

The first ISS crew was launched in October 2000 and a series of international crews now permanently inhabit the Station. 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 EVA systems, is consolidated and performed at the Johnson Space Center, with support from the Marshall Space Flight Center for pressurized modules and environmental control subsystems. 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, 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 (DAA) for ISS and SSP. The DAA for ISS & SSP reports directly to the Associate Administrator for Space Flight who reports directly to the NASA Administrator. The Agency Program Management Council (PMC) has ISS oversight responsibility. Full compliance with NPG 7120.5B was achieved in FY 2003.

TECHNICAL COMMITMENT

Program Commitment Agreement signed August 19, 2003. Baseline was defined by May 2002 Cost Analysis Requirements Document (CARD).

Technical Specifications	FY 2005 President's Budget	Change from Baseline
Operational Life	Nominal operations and utilization lifetime to 2015, and a one - year decommissioning period.	--
Shuttle Logistical Flights	Five per year.	--
Power to User Payloads	26 kW minimum continuous power and 30 kW annual average after U.S. Core Complete.	--
Microgravity Crew Time	At least 180 days annually (four periods greater than 30 days).	--
Spacecraft	Each flight increment nominally planned for 180 days on-orbit. Maintain and sustain U.S. flight and ground hardware and software to ensure integrity of the ISS design and the completion of research.	--

Schedule	FY 2005 President's Budget	Change from Baseline
9A - S1 Truss	Launched October 2002	+2 Months
11A - P1 Truss	Launched November 2002	+2 months
12A - P3/P4 Truss Segments	Feb 2005	--
12A.1 - P5 Truss	Apr 2005	--
13A - S3/S4 Truss Segments	Jun 2005	+21 months
13A.1 - S5 Truss	Sep 2005	+24 months
15A - S6 Truss Segment	Oct 2005	+22 months
10A - S6 Truss - U.S. Core Complete	Feb 2006	+24 months

Theme: International Space Station
Operations: Spacecraft Operations

ACQUISITION STRATEGY AND 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 which covers development and operations has been extended through September 2006. In FY 2003, direct procurements from Boeing represented about 37% of budget authority in development and operations. Changes since FY04 Pres. Budget: None

Current Acquisition	Actual*	Selection Method	Actual*	Performer	Actual*
Cooperative Agreement	0%	Full & Open Competition	14%	Industry	99%
Cost Reimbursable	93%	Sole Source	86%	Government	0%
Fixed Price	5%			NASA Intramural	0%
Grants	0%		100%	University	0%
Other	2%	Sci Peer Review	%	Non Profit	1%
*As of FY 2003 direct procurement	100%	*As of FY 2003 direct procurement		*As of FY 2003 direct procurement	100%

Future Acquisition - Major	Selection	Goals
1. Contract restructuring	Start Oct '03	25% Full & Open Competition; 100% 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/ESA MOU Active (1/29/98) 4.) NASA/GOJ MOU Active (2/24/98) 5.) NASA/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).

RISK MITIGATION

Risk Date: 10/17/2003

Top Risks	G	Overall	G	Cost	Y	Schedule	G	Technical	Probability	Impact	Mitigation Plan
R	Internal Active Thermal Control System coolant impact to system integrity								Medium	Medium	In Place
R	Control Moment Gyroscope issues								Medium	Medium	In Place

INDEPENDENT REVIEWS

Review Types	Performer	Last Review Date	Next Review Date	Purpose
None scheduled for FY 2005.				

Theme: International Space Station
Operations: Spacecraft Operations

BUDGET

Budget Authority ($ millions)	FY03	FY04	FY05	Comments
FY2005 PRESBUD	658.6	710.2	812.0	
ISS Spacecraft Management ..	91.9	133.2	245.0	
ISS Elements ..	76.9	26.6	32.9	
Flight Systems ..	110.1	143.5	93.4	
Avionics Systems ..	53.0	56.2	51.2	
Crew Systems ..	12.9	14.1	10.6	
Extra-Vehicular Activity Systems.	72.2	46.1	124.2	
Flight Software ..	33.1	148.4	126.9	
Logistics & Maintenance	208.6	142.1	124.1	
Crew Transfer Vehicle			3.7	
Changes since 2004 PRESBUD	-51.8	-126.4		
ISS Spacecraft Management	-55.5	-101.6		
ISS Elements	+15.2	-1.4		
Flight Systems	-1.1	-5.6		
Avionics Systems	+2.0	-2.3		
Crew Systems	+0.9	-0.5		
Extra-Vehicular Activity Systems	+34.3	-2.8		
Flight Software	-97.7	-6.0		
Logistics & Maintenance	+50.1	-6.2		
FY2004 PRESBUD	710.4	836.6		
ISS Spacecraft Management	147.4	234.8		
ISS Elements	61.7	28.0		
Flight Systems	111.2	149.1		
Avionics Systems.	51.0	58.5		
Crew Systems	11.9	14.6		
Extra-Vehicular Activity Systems	37.9	48.9		
Flight Software	130.8	154.4		
Logistics & Maintenance	158.4	148.3		

Indicates changes since the previous year's President's Budget Submit
Indicates budget numbers in full cost.

Theme: International Space Station
Operations: Launch and Mission Operations

PURPOSE

Objectives	Performance Measures
8.4	5ISS2,4,9

Launch and Mission Operations provides training, mission control operations, operations engineering support, operations planning and cargo integration, medical support, and launch site processing for the International Space Station.

OVERVIEW

The first crew was launched to the ISS in October 2000 and international crews have continued, to inhabit the ISS ever since. 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 performs extensive planning for operations for 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 Mission Control Center-Houston at Johnson Space Center is the prime site for the planning and execution of integrated system operations of the Space Station. Communication links from Houston and from Mission Control Center-Moscow 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 and Space Station Training Facility on systems, operations, and 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 (DAA) for ISS and SSP. The DAA for ISS & SSP reports directly to the Associate Administrator for Space Flight who reports directly to the NASA Administrator. The Agency Program Management Council (PMC) has ISS oversight responsibility. Full compliance with NPG 7120.5B was achieved in FY 2003.

TECHNICAL COMMITMENT

Program Commitment Agreement signed August 19, 2003. Baseline was defined by May 2002 Cost Analysis Requirements Document (CARD).

Technical Specifications	FY 2005 President's Budget	Change from Baseline
Operational Life	Nominal operations and utilization lifetime to 2015, and a one - year decommissioning period.	--
Shuttle Logistical Flights	Five per year.	--
Power to User Payloads	26 kW minimum continuous power and 30 kW annual average after U.S. Core Complete.	--
Microgravity	At least 180 days annually (four 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 and Operations	Operational and mission planning, coordination, training, and real-time support to ensure flight readiness and mission success.	--

Schedule	FY 2005 President's Budget	Change from Baseline
9A - S1 Truss	Launched October 2002	+2 Months
11A - P1 Truss	Launched November 2002	+2 months
12A - P3/P4 Truss Segments	Feb 2005	0 months
12A.1 - P5 Truss	Apr 2005	0 months
13A - S3/S4 Truss Segments	Jun 2005	+21 months
13A.1 - S5 Truss	Sep 2005	+24 months
15A - S6 Truss	Oct 2005	+22 months
10A - Node 2 - U.S. Core Complete	Feb 2006	+24 months

Theme: International Space Station
Operations: Launch and Mission Operations

Acquisition Strategy and 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 which covers development and operations has been extended through September 2006. In FY 2003, direct procurements from Boeing represented about 37% of budget authority in development and operations. Changes since FY04 President's Budget: None

Current Acquisition	Actual*	Selection Method	Actual*	Performer	Actual*
Cooperative Agreement	0%	Full & Open Competition	50%	Industry	100%
Cost Reimbursable	97%	Sole Source	50%	Government	0%
Fixed Price	2%			NASA Intramural	0%
Grants	0%		100%	University	0%
Other	1%	Sci Peer Review	0%	Non Profit	0%
*As of FY 2003 direct procurement	100%	*As of FY 2003 direct procurement		*As of FY 2003 direct procurement	100%

Future Acquisition - Major	Selection	Goals
1. Contract restructuring	Start Oct '03	TBD Full and Open Competition; 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/ESA MOU Active (1/29/98) 4.) NASA/GOJ MOU Active (2/24/98) 5.) NASA/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).

Risk Mitigation

Top Risks	G	Overall	G	Cost	Y	Schedule	G	Technical	Probability	Impact	Mitigation Plan
R	ISS supporting Ground Operations until Shuttle returns to flight								High	Medium	In Place

Budget/Life Cycle Cost

Budget Authority ($ millions)	FY 2003	FY 2004	FY 2005	Comments
FY2005 PRESBUD	289.6	439.9	458.3	
Mission Integration	52.9	103.1	108.7	
Medical Support	13.9	18.5	22.5	
Mission	163.4	201.6	198.8	
Launch Site Processing	59.4	116.7	128.3	
Changes since 2004 PRESBUD	+86.8	-52.6		
Mission Integration	+11.4	-36.5		
Medical Support	-0.4	-1.0		
Mission	+74.6	-9.3		
Launch Site Processing	+1.1	-5.8		
FY2004 PRESBUD	202.8	492.5		
Mission Integration	41.5	139.6		
Medical Support	14.2	19.5		
Mission	88.8	210.9		
Launch Site Processing	58.3	122.5		

Indicates changes since the previous year's President's Budget Submit

Indicates budget numbers in full cost.

Theme: International Space Station
Operations: Operations Program Integration

PURPOSE

Objectives	Performance Measures
8.4	5ISS5,9

Operations Program Integration provides the overall ISS program management functions, system engineering, analysis and integration, information technology, and safety and mission assurance activities.

OVERVIEW

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 remain a top priority, and safety and mission assurance functions provide for risk management, quality assurance, and reliability and maintainability activities, as well as overall safety and mission assurance 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 (DAA) for ISS and SSP. The DAA for ISS & SSP reports directly to the Associate Administrator for Space Flight who reports directly to the NASA Administrator. The Agency Program Management Council (PMC) has ISS oversight responsibility. Full compliance with NPG 7120.5B was achieved in FY 2003.

TECHNICAL COMMITMENT

Program Commitment Agreement signed August 19, 2003. Baseline was defined by May 2002 Cost Analysis Requirements Document (CARD).

Technical Specifications	FY 2005 President's Budget	Change from Baseline
Operational Life	Nominal operations and utilization lifetime to 2015, and a one - year decommissioning period.	--
Shuttle Logistical Flights	Five per Year.	--
Power to User Payloads	26 kW minimum continuous power and 30 kW annual average after U.S. Core Complete.	--
MicroGravity	At least 180 days annually (four 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 and Operations	Operational and mission planning, coordination, training, and real-time support to ensure flight readiness and mission success.	--

Schedule	FY 2005 President's Budget	Change from Baseline
9A - S 1 Truss	Launched October 2002	+2 Months
11A - P1 Truss	Launched November 2002	+2 Months
12A - P3/P4 Truss Segments	Feb 2005	+0 months
12A.1 - P5 Truss	Apr 2005	0 months
13A - S3/S4 Truss Segments	Jun 2005	+21 months
13A.1 - S5 Truss	Sep 2005	+24 months
15A - S6 Truss	Oct 2005	+22 months
10A - Node 2 - U.S. Core Complete	Feb 2006	+24 months

Theme: International Space Station
Operations: Operations Program Integration

ACQUISITION STRATEGY AND 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 which covers development and operations has been extended through September 2006. In FY2003, direct procurements from Boeing represented about 37% of budget authority in development and operations. Changes since FY04 President's Budget: None

Current Acquisition	Actual*	Selection Method	Actual*	Performer	Actual*
Cooperative Agreement	0%	Full & Open Competition	34%	Industry	100%
Cost Reimbursable	77%	Sole Source	66%	Government	0%
Fixed Price	7%			NASA Intramural	0%
Grants	0%		100%	University	0%
Other	16%	Sci Peer Review	%	Non Profit	0%
*As of FY 2003 direct procurement	100%	*As of FY 2003 direct procurement		*As of FY 2003 direct procurement	100%

Future Acquisition	Selection	Goals
1. Contract restructuring	Start Oct '03	TBD Full and Open Competition; 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/ESA MOU Active (1/29/98) 4.) NASA/GOJ MOU Active (2/24/98) 5.) NASA/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).

RISK MITIGATION

Risk Date: 10/17/2003

Top Risks	G	Overall	Y	Cost	Y	Schedule	G	Technical	Probability	Impact	Mitigation Plan
R	Ability to support high priority research until Shuttle return to flight								Medium	High	In place

INDEPENDENT REVIEWS

Review Types	Performer	Last Review Date	Next Review Date	Purpose
None scheduled in FY 2005				

BUDGET

Budget Authority ($ millions)	FY 2003	FY 2004	FY 2005	Comments
FY2005 PRESBUD	282.3	201.2	353.4	
Ops Program Management	227.5	161.2	279.4	
Ops System Eng'g, Analysis & Integration	25.3	18.7	30.0	
Ops Safety & Mission Assurance	29.6	21.3	44.0	
Changes since 2004 PRESBUD	+13.6	-23.3		
Ops Program Management	-2.6	-20.0		
Ops System Eng'g, Analysis & Integration	+6.5	-1.4		
Ops Safety & Mission Assurance	+9.7	-1.9		
FY2004 PRESBUD	268.7	224.5		
Ops Program Management	230.1	181.2		
Ops System Eng'g, Analysis & Integration	18.7	20.1		
Ops Safety & Mission Assurance	19.9	23.2		

Indicates changes since the previous year's President's Budget Submit
Indicates budget numbers in full cost.

Theme: International Space Station
Operations: ISS Cargo/Crew Services

PURPOSE

Objectives	Performance Measures
8.1	5ISS7,9

The objectives of the ISS Cargo/Crew Services are the purchase of launch, delivery, and earth return services for ISS cargo including the replacement of failed orbital replacement units, the replenishment of research materials and products, and the purchase of human-rated launch, delivery, and return capability for expedition crew rotation.

OVERVIEW

The Space Shuttle has been the primary U.S. transportation vehicle for assembly and operation of the Space station since 1998 when STS88 delivered and mated the Unity node to the Russian Control module, Zarya. NASA plans to continue use of the Space Shuttle as the workhorse vehicle for transporting large cargo to complete the assembly of the space station by the end of this decade. At that point, the Shuttle fleet will be retired. New U.S. vehicles with potential capability to support the ISS are not planned for operation before 2014. It is necessary for NASA to establish a transportation capability for crew and cargo for the space station program after the Shuttle is retired. NASA intends to meet this need through the purchase of services for cargo and crew transport using existing and emerging capabilities, both domestic and foreign. In the near term, the purchase of these services is necessary to enable new ISS science capabilities, deliver and retrieve cargo, and provide human-rated crew transport for enterprise crew rotation when the Shuttle and partner-provided transportation is insufficient to meet space station requirements.

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 (DAA) for ISS and SSP. The DAA for ISS & SSP reports directly to the Associate Administrator for Space Flight who reports directly to the NASA Administrator. The Agency Program Management Council (PMC) has ISS oversight responsibility.

TECHNICAL COMMITMENT

Program Commitment Agreement (PCA) planned to be signed in FY2004.

Technical Specifications	FY 2005 President's Budget	Change from Baseline
Operational Life	Nominal operations and utilization lifetime to 2016.	--
Cargo Delivery Flights	TBD	--
Cargo Return Flights	TBD	--
Crew Delivery Flights	TBD	--
Crew Return Flights	TBD	--

Schedule	FY 2005 President's Budget	Change from Baseline
Cargo Delivery Flights	TBD	--
Cargo Return Flights	TBD	--
Crew Delivery Flights	TBD	--
Crew Return Flights	TBD	--

ACQUISITION STRATEGY AND PERFORMING ORGANIZATIONS

To Be Developed.

Current Acquisition	Actual*	Selection Method	Actual*	Performer	Actual*
Cooperative Agreement	0%	Full & Open Competition	TBD	Industry	TBD
Cost Reimbursable	TBD	Sole Source	0%	Government	0%
Fixed Price	0%			NASA Intramural	0%
Grants	0%		100%	University	0%
Other	0%	Sci Peer Review	0%	Non Profit	0%
*As of FY 2003 direct procurement		*As of FY 2003 direct procurement		*As of FY 2003 direct procurement	

Theme: International Space Station
Operations: ISS Cargo/Crew Services

Future Acquisition	Selection	Goals
To be determined		

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); and 9. NASA-Brazilian Space Agency Implementing Arrangement for ISS Cooperation Active (10/14/97).

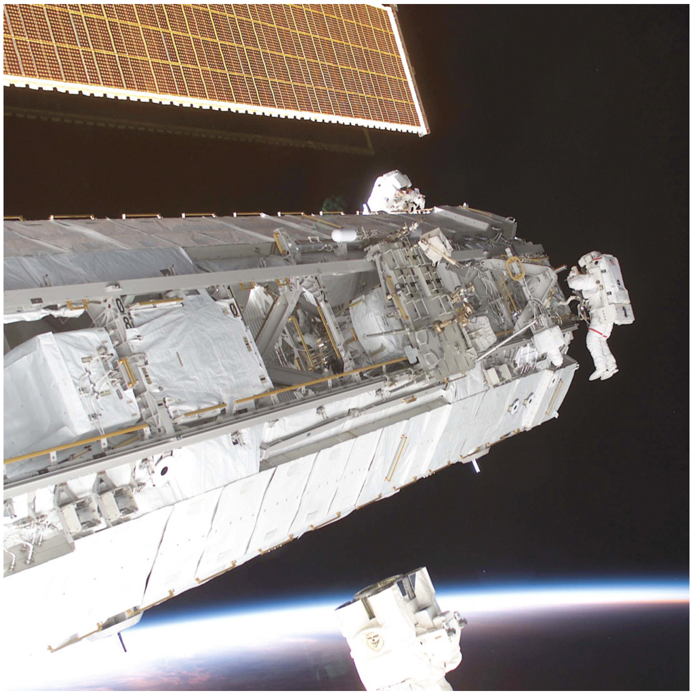
INDEPENDENT REVIEWS

Review Types	Performer	Last Review Date	Next Review Date	Purpose
TBD				

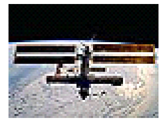
BUDGET

Budget Authority ($ millions)	F Y 2003	FY 2004	FY 2005	Comments
FY2005 PRESBUD			140.0	
ISS Cargo/Crew Services			140.0	
Changes since 2004 PRESBUD				
FY2004 PRESBUD				

Indicates changes since the previous year's President's Budget Submit
Indicates budget numbers in full cost.

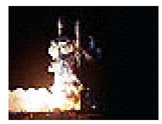


THEMES



International Space Station

Space Shuttle



Space and Flight Support

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.

SPACE FLIGHT

PURPOSE

The Space Flight Enterprise programs ensure that the Nation will have reliable, safe, and affordable access to space for NASA's human and robotic explorers and open new exploration and research opportunities through the extension of human presence in Space. The Space Flight Enterprise enables research by providing transportation systems such as the Space Shuttle, operational research facilities in space such as the International Space Station (ISS), and space communications systems and supporting space infrastructure. The Enterprise also provides the unique system--the human system--necessary to open the space frontier to the broadest extent possible.

Enterprise: Space Flight

FY 2003 ACCOMPLISHMENTS

The Space Flight Enterprise had some notable accomplishments in FY 2003. These were overshadowed by the tragic loss of the Space Shuttle Columbia on February 1, 2003. The independent Columbia Accident Investigation Board (CAIB) was formed following the loss of Columbia to determine the cause of the accident and to recommend measures to prevent similar mishaps in the future. In August of 2003, the CAIB provided its findings to NASA, and the Shuttle program began to respond to the CAIB's recommendations, findings, and observations. NASA's response to the CAIB report is provided in a publicly available and evolving implementation plan. The Return to Flight Task Group, co-chaired by Gen. Thomas Stafford and Richard Covey, is performing an assessment of NASA's actions to implement the CAIB recommendations.

Originally, NASA had planned five Shuttle flights for FY 2003 but two were put on hold until the Shuttle is safe to fly again. During the Shuttle stand down, Space Station operations used Russian launch vehicles for crew rotation and re-supply, and the international partners agreed to fully support all efforts to keep the Station crewed until Shuttle return to flight. On November 2, 2003, the International Space Station celebrated its third full year of continuous, permanent human habitation in space. 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 size now resembles that of a three-bedroom house. Before the Columbia accident, Station construction continued with the successful delivery of two truss segments, part of a series of truss segments that would greatly expand Station power generating capability. In FY 2003, the number of science investigations climbed to 70 and the crew devoted an average of ten hours per week to on-orbit research. Three Space Shuttle missions delivered crew, supplies, and assembly pieces to the Station, bringing the total number of Shuttle flights to the Station to 18. The ISS Continuing Flight Team is assessing the CAIB recommendations for applicability to the ISS program.

The Enterprise continued to maintain a high level of success for NASA missions using commercial launch services. Eight of eight payloads were successfully launched, on three different launch vehicles, from two launch sites in an eight-month period.

THEME DISTRIBUTION

Budget Authority ($ in millions)	FY 2003	FY 2004	FY 2005
International Space Station	1,462.4	1,498.1	1,862.7
Space Shuttle	3,304.4	3,945.0	4319.2
Space and Flight Support	444.5	431.8	492.1
Institutional Support	940.5	-	-
Total	6,148.8	5874.9	6674.0

Note: For all formats, the FY 2003 column reflects the FY 2003 Congressional Operating Plan, dated 9/04/03. The FY 2004 column reflects the FY 2004 Conference committee report. The FY 2005 column represents the FY 2005 President's Budget Submit.

Indicates budget numbers in full cost

International Space Station

This theme supports activities for establishing a research facility in Earth orbit aboard the International Space Station (ISS). The ISS provides a long-duration habitable laboratory for science and research activities primarily to support future human and robotic exploration of the solar system.

The ISS can also support unique, long-duration, space-based research in cell and developmental biology, plant biology, fluid physics, combustion science, materials science, and fundamental physics. It can also provide a unique platform for observing Earth's surface and atmosphere, the Sun, and other astronomical objects.

All U.S. Core assembly flight elements and the first International Partner Laboratory have been delivered to the launch site. Upon completion of final ground integration, all assembly launch packages will be placed in protected stowage awaiting the Shuttle's return to flight.

Enterprise: Space Flight

OVERALL BUDGET

The FY 2005 request is $ 1,863 million, a $276 million (or 17 percent) increase over the FY 2004 President's Request. Major features of this budget include:

- Funding is maintained throughout FY 2005 for continuous on-orbit operations and completion of U.S. Core assembly after Shuttle return to flight and for funding Node 3 and the Environmental Closed Life Support System;
- Funding reflects Administration approval to proceed beyond the U.S. and International Partner Core configuration to accommodate research requirements following the program's successful completion of program management and cost control reforms;
- New funding for the acquisition of cargo and crew services to support the ISS.

Space Shuttle

The Shuttle, first launched in 1981, provides the only capability in the United States for human access to space. The Shuttle is also a versatile cargo launch vehicle and serves as a platform to support construction activities in space. The Shuttle's primary role is to complete the assembly of the International Space Station. The Shuttle's phase out is planned for the end of the decade, following the completion of its role in the ISS assembly.

OVERALL BUDGET

The FY 2005 request is $4,319 million, a $299 million (or 7 percent) increase over the FY 2004 President's Request. This budget will enable:

- Safe return to flight;
- Continuance of Space Station assembly missions; and
- Preparation for the planned phase out of the Space Shuttle at the end of the decade, following completion of its role in the ISS assembly.

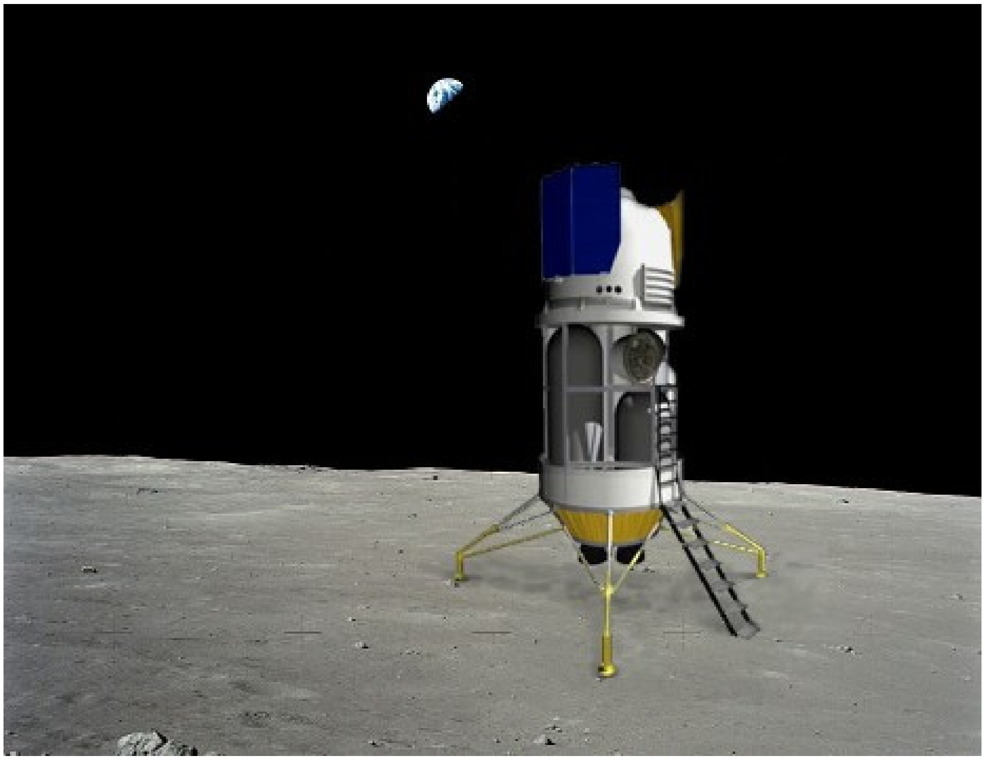
Space and Flight Support

This theme encompasses space communications, launch services, rocket propulsion testing, and environmental clean-up. Space communications consists of (1) the Tracking and Data Relay Satellite System (TDRSS), which supports the Space Shuttle, ISS, expendable launch vehicles, and research aircraft, and (2) 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. The two initiatives (Plum Brook Reactor Facility and Environmental Compliance and Restoration) 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.

OVERALL BUDGET

The FY 2005 request is $492 million, a $73 million (or 17 percent) increase over the FY 2004 President's Request. The budget supports:

- Communications support of human and science missions;
- Launch services and support;
- Rocket propulsion testing;
- Environmental compliance and the cleanup of the Plum Brook Reactor Facility; and
- The formulation phase of TDRS Continuation project.



The Crew Exploration Vehicle will be developed in an evolutionary program that emphasizes demonstrated performance in preparation for lunar test missions and future Mars exploration. Shown above is a representation of a possible configuration for the vehicle during a human lunar mission. As of Feb 1, 2004, NASA has not selected a design for the Crew Exploration Vehicle.

Transportation Systems

MAJOR EVENTS IN FY 2005

Transportation Systems has been established as a new Theme in FY 2004 in response to the President's Vision for U.S. Space Exploration. Major activities for FY 2005 will be developed prior to the start of FY 2005.

Theme: Transportation Systems

OVERVIEW

The Transportation Systems (TS) Theme will address crew transfer capabilities and launch requirements unique to NASA's needs within a developing architecture that supports exploration missions to the Moon, and later Mars and other destinations. The activities of the TS Theme will be focused on the space transportation requirements unique to NASA's human and robotic exploration activities. The TS Theme's primary near-term objective will be the development and demonstration of an exploration vehicle that can transport and support human crews traveling to destinations beyond low Earth orbit (LEO). With multi-purpose utility for the Agency, this human exploration vehicle will be developed in a "spiral" approach under the "Crew Exploration Vehicle" Budget line. Such an approach will commence with requirements formulation guided by the requirements of a space transportation architecture that will be tested on human-robotic lunar missions in preparation for future exploration of Mars and other destinations. In the spiral approach, unmanned prototypes first verify the outer moldline and ascent, re-entry, and abort modes of operation. These prototypes will then be evolved into manned flight systems with the addition of the subsystems and architectural elements required to support human life, put through a rigorous test program, and ultimately assigned to human exploration flights. In addition to developing and demonstrating prototypes of vehicles required for human exploration beyond LEO, the TS Theme will also analyze and assess possible requirements for heavy-lift launch systems to support exploration missions.

Missions	Goals supported by this Theme	Objectives supporting those Goals
Exploration Capabilities	9. Extend the duration and boundaries of human space flight to create new opportunities for exploration and discovery.	9.5 Develop crew transportation systems to enable exploration beyond low Earth orbit (LEO).

RELEVANCE

By developing and demonstrating a vehicle that will transport and support human crews during exploration of the solar system, the Transportation Systems Theme provides a critical element of the exploration architecture that NASA will use to explore the solar system. This vehicle will be developed in stages, with the first test flight in 2008, and a fully operational capability no later than 2014. Through the use of existing commercial expendable launch vehicles, and the execution of a "spiral" development predicated on incremental test and demonstration, the Transportation Systems theme will emphasize affordable engineering practices and demonstrated returns on public investment.

Education and Public Benefits
As an integral element of NASA's new approach to human-robotic solar system exploration, the Transportation Systems Theme will provide the technologies and systems that allow humans to travel to distant locations where their flexibility and insight will enable new discoveries and inspire the public.

IMPLEMENTATION

The managerial structure that will develop and manage demonstration of systems and vehicles in the Transportation Systems theme has not yet been determined. Where possible, contracts for the Orbital Space Plane and Next Generation Launch Technology programs —which will complete termination activities during 2005— will be restructured to ensure that research, development, and technological lessons learned will contribute to the cost-effective development of a Crew Exploration Vehicle and a space transportation architecture for exploration.

The NASA Enterprise official is Craig Steidle, Associate Administrator for Exploration Systems. The Program Executive Officer is Jim Nehman, Program Executive Officer for Exploration Systems. The Theme Director has not yet been determined.

IMPLEMENTATION SCHEDULE

The programs within the Transportation Systems Theme will be managed to be compliant with NPG 7120.5B.

STATUS

The Transportation Systems Theme is new in FY 2005. An in-depth review of past vehicle systems development activities within NASA and other agencies will be conducted during calendar 2004 to ensure that engineering and design processes incorporate lessons learned and existing research to the maximum extent possible.

Theme: Transportation Systems

PERFORMANCE MEASURES

Outcomes/Annual Performance Goals (APGs)	
Outcome 9.5.1	*By 2014, develop and flight-demonstrate a human exploration vehicle that supports safe, affordable and effective transportation and life support for human crews traveling from the Earth to destinations beyond LEO.*
5TS1	Conduct a detailed review of previous vehicle programs to capture lessons-learned and appropriate technology maturation; incorporate results into the human exploration vehicle requirements definition process.
5TS2	Develop and obtain approval for human exploration vehicle Level 1 and Level 2 Requirements and the resulting Program Plan.
5TS3	Complete preliminary conceptual design(s) for the human exploration vehicle, in conjunction with definition of an integrated exploration systems architecture.
5TS4	Develop launch vehicle Level 1 Requirements for human-robotic exploration within an integrated architecture, and define corresponding programs to assure the timely availability of needed capabilities, including automated rendezvous, proximity operations and docking, modular structure assembly, in space refueling, and launch vehicle modifications and developments.
Outcome 9.5.2	*By 2010, identify and develop concepts and requirements that could support safe, affordable and effective transportation and life support for human crews traveling from the Earth to the vicinity or the surface of Mars.*
5TS5	Conduct a preliminary conceptual design study for a human-robotic Mars exploration vehicle, in conjunction with definition of an integrated exploration systems architecture.
Uniform Measures	
5TS6	Distribute at least 80% of allocated procurement funding to competitively awarded contracts, including continuing and new contract activities.

INDEPENDENT REVIEWS

Review Types	Performer	Last Review Date	Next Review Date	Purpose
TBD				

BUDGET

Budget Authority ($ millions)	FY 2003	FY 2004	Change	FY 2005	Comments
Transportation Systems		**966.5**	**-277.8**	**688.7**	**--**
Technology and Advanced Concepts		966.5	-277.8	688.7	--
Crew Exploration Vehicle			+428.0	428.0	--
Space Launch Initiative		966.5	-705.8	260.7	Termination Activities

Indicates changes since the previous year's President's Budget Submit
Indicates budget numbers in full cost.

Theme: Transportation Systems
Technology and Advanced Concepts: Crew Exploration Vehicle

PURPOSE

Objectives	Performance Measures
9.6	5TS1-5

The CEV Program will provide crew transfer capabilities within a developing architecture to support exploration missions to the Moon, and later Mars and other destinations. With multi-purpose utility for the Agency, the CEV will be developed in a "spiral" approach. Such an approach will commence with requirements formulation for a vehicle defined within a larger space transportation architecture. In the spiral approach, unmanned prototypes first verify the outer moldline and ascent, re-entry, and abort modes of operation. The prototypes will then be evolved into manned flight systems with the addition of the subsystems and architectural elements required to support human life, put through a rigorous test program, and ultimately assigned to human exploration flights.

OVERVIEW

The CEV Program spiral development plan is initially comprised of three distinct vehicle development blocks: (1) prototype test vehicles, (2) Block I (unmanned) systems development, and (3) Block II (manned) systems development. For each block a design, development, and production element plan will be defined. Per NASA 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 to be conducted in FY04, preliminary design activities conducted in FY05 and FY06, a System Design Review in FY05, and a Preliminary Design Review in FY06. A decision whether to enter into implementation (proceed with the full scale development) of the CEV is scheduled to be made at the end of FY06 following the System Design Review, completion of the Non-Advocate Review, and completion of an independent cost review including a Cost Analysis Requirements Document. At that point, a decision to proceed will result in the CEV Program transitioning from formulation to implementation.

The objective of the prototype block is to provide the necessary flight demonstrations and technology development activities to enable the CEV development. The purpose of the first block is to develop the fundamental capability to test a CEV moldline during ascent and re-entry as well as to test the crew escape technologies required during all phases of atmospheric flight. Prototype vehicles will be fully instrumented to provide data on crew environments, Launch Vehicle health and status, parachute systems, orientation and landing techniques, and external aeroshell configurations. The CEV Program will not proceed to Block I development until it has implemented a strategy for mitigating systems and safety risk to levels acceptable for crewed test flight. The second step in the spiral will be to develop the Block I vehicles with the systems required to extend CEV operations beyond ascent/re-entry. Life support and long mission duration support systems will be added and interfaces to other operational elements (e.g., Service Modules) will be tested and verified. Lessons learned from development of this intermediate test platform will be incorporated into manned flight vehicles developed in the third spiral block. When combined with other architectural elements, the CEV will then become available for assignment to specific missions of exploration or possibly ISS crew transport.

PROGRAM MANAGEMENT

The NASA Enterprise official is Craig Steidle, Associate Administrator for Exploration Systems. The Program Executive Officer is Jim Nehman, Program Executive Officer for Exploration Systems. The Theme Director and Program Managers are not yet determined.

TECHNICAL COMMITMENT

There is no baseline for this Program. This Program is a new start in FY2005.

Schedule	FY 2005 President's Budget	Change from Baseline
CEV Options and Trade Studies	2004	--
System Design	2005	--
System Development	2006	--
Integration and Test	2007	--
Boilerplate demo flight	2008	--
Block I demo flight	2011	--
Block II demo flight	2013	--

Theme: Transportation Systems
Technology and Advanced Concepts: Crew Exploration Vehicle

Acquisition Strategy and Performing Organizations

Current Acquisition	Actual*	Selection Method	Actual*	Performer	Actual*
Cooperative Agreement	%	Full & Open Competition	%	Industry	%
Cost Reimbursable	%	Sole Source	%	Government	%
Fixed Price	%		0%	NASA Intramural	%
Grants	%			University	%
Other	%	Sci Peer Review	%	Non Profit	%
*As of FY 2003 direct procurement	0%	*As of FY 2003 direct procurement		*As of FY 2003 direct procurement	0%

Future Acquisition	Selection	Goals
TBD	TBD	100% Full and Open Competition

Agreements

Internal: The program is not dependent on other NASA activities outside of the control of the Associate Administrator for Exploration. External: TBD.

Risk Mitigation

Risk Date: 1/31/2004

Top Risks	G	Overall	G	Cost	G	Schedule	G	Technical	Probability	Impact	Mitigation Plan
G	TBD: Risks will be assessed when this Project enters the Formulation phase.								TBD	TBD	TBD

Independent Reviews

Review Types	Performer	Last Review Date	Next Review Date	Purpose
TBD				

Budget

Budget Authority ($ millions)	FY 2003	FY 2004	FY 2005	Comments
FY2005 PRESBUD			428.0	--
Crew Exploration Vehicle			428.0	New Program
Changes since 2004 PRESBUD				--
FY2004 PRESBUD.				--

Indicates changes since the previous year's President's Budget Submit

Indicates budget numbers in full cost.

NASA's future exploration missions into the solar system and beyond will coordinate the unique capabilities of humans and robots to maximize safety, affordability, and effectiveness.

Human and Robotic Technology

MAJOR EVENTS IN FY 2005

Human and Robotic Technology has been established as a new Theme in FY 2004 in response to the President's Vision for U.S. Space Exploration. Major activities for FY 2005 will be developed prior to the start of FY 2005.

Theme: Human and Robotic Technology

OVERVIEW

The Human and Robotic Technology (HRT) Theme represents NASA's commitment to investing in the technologies and capabilities that will make an ambitious and sustainable 21st century space exploration program possible. Through applied technology research, focused technology maturation, and timely technology transition, the HRT Theme will develop technologies that can be integrated into missions in the Lunar Exploration Theme and throughout NASA's Enterprises. The goals of exploration and of enabling human presence and activity beyond low Earth orbit will be a primary focus of HRT Theme activities and will demand a robust, ongoing commitment to focused innovation. Working with NASA and non-NASA researchers and technologists, through directed investments and innovative partnerships, the HRT Theme will advance a range of high-leverage technologies and space operations concepts, mature and validate key technologies, and transition them into applications to enable safe, affordable, effective and sustainable human-robotic exploration and discovery beyond low Earth orbit (LEO). The HRT theme will work closely with other government agencies, industry and academia to leverage common requirements and identify innovative ideas.

The Human and Robotic Technology Theme will accomplish its objectives through the execution of five programs:

- The Centennial Challenge Program is an experimental approach to stimulating innovation and competition in technical areas of interest to NASA. In commemoration of the Wright Brothers' seminal flight at Kitty Hawk, the Centennial Challenge program will establish purse awards for a portfolio of technical accomplishments that could advance the state of civil space exploration and aeronautics.
- Project Prometheus, the nuclear systems program, will develop spacecraft power and propulsion technologies to enable new space exploration capabilities and unprecedented science missions.
- The Technology Maturation Program will develop and validate novel concepts and technologies to enable safe, affordable, effective and sustainable human-robotic exploration, and will assure their timely transition into validation in the Lunar Exploration Theme and other NASA Enterprises.
- The Advanced Space Technology Program will advance and mature a range of high-leverage technologies and transition them to application in the Exploration Systems Enterprise and other NASA Enterprises.
- The Innovative Technology Transfer Partnerships Program will enable the creative use of intellectual assets both inside and outside of NASA to meet Agency technology needs and to benefit the Nation.

Missions	Goals supported by this Theme	Objectives supporting those Goals
To 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.	3.2 Improve the Nation’s economic strength and quality of life by facilitating innovative use of NASA technology.
Exploration Capabilities	9. Extend the duration and boundaries of human space flight to create new opportunities for exploration and discovery.	9.4 Develop technologies to enable safe, affordable, effective and sustainable human-robotic exploration and discovery beyond low Earth orbit (LEO).
	10. Enable revolutionary capabilities through new technology.	10.1 Improve the capability to assess and manage risk in the synthesis of complex engineering systems.
		10.3 Leverage partnerships between NASA Enterprises, U.S. industrial firms, and the venture capital community for innovative technology development.

RELEVANCE

By identifying, developing, and transitioning new technologies that have broad potential to enable novel systems concepts and capabilities, the Human and Robotic Exploration Technology Theme makes a unique contribution to NASA's goal of expanding human presence into the solar system for exploration and discovery, while assuring a robust foundation of cross-cutting technology for the broad spectrum of future NASA space missions.

Education and Public Benefits
NASA plans to partner extensively in the implementation of the program, including significant reliance on the expertise of academia in research and development efforts. This will provide educational opportunities to undergraduate and graduate students in U.S. colleges and universities. In addition, by advancing diverse, novel technologies through projects with non-traditional NASA research partners, small business and others, public benefits from HRT will include new technologies for use in industry and by the general public.

Theme: Human and Robotic Technology

IMPLEMENTATION

The NASA Enterprise official is Craig Steidle, Associate Administrator for Exploration Systems. The Program Executive Officer is Jim Nehman, Program Executive Officer for Exploration Systems. The Theme Director is not yet determined. The HRT Theme will operate through a family of technology programs that address advanced space technology, technology maturation, and technology transfer, all coordinated by an integrated team at NASA Headquarters in the Office of Exploration Systems. Several programs of the HRT Theme will be implemented in close collaboration with other NASA Enterprises and various external organizations.

IMPLEMENTATION SCHEDULE

The programs within the Human and Robotic Technology Theme are managed to be compliant with NPG 7120.5B

STATUS

The Human and Robotic Technology Theme is new in FY 2005 and incorporates a range of program elements, both new and existing. An in-depth review of current programs will be conducted early during calendar 2004 in light of the National Space Exploration Policy and the President's Vision for U.S. Space Exploration.

PERFORMANCE MEASURES

Outcomes/Annual Performance Goals (APGs)	
Outcome 3.2.1	*On an annual basis, develop 50 new technology transfer agreements with the Nation's industrial and entrepreneurial sectors.*
5HRT18	Complete 50 technology transfer agreements with the U.S. private sector for the transfer of NASA technologies, through hardware licenses, software usage agreements, facility usage agreements or Space Act Agreements.
Outcome 9.4.1	*Identify, develop and validate human-robotic capabilities by 2015 required to support human-robotic lunar missions.*
5HRT1	Establish an integrated, top-down strategy-to-task technology R&D planning process to facilitate the development of human-robotic exploration systems requirements
5HRT2	Execute two systems-focused Quality Function Deployment exercises through an Operational Advisory Group (including both technologists and operators) to better define systems attributes necessary to accomplish human-robotic exploration operational objectives.
5HRT3	Execute selected R&D-focused Quality Function Deployment exercises through an external/internal Technology Transition Team to review candidate human-robotic exploration systems technologies, and provide detailed updates to human-robotic technology road maps.
5HRT4	Test and validate preferred engineering modeling and simulation computational approaches through which viable candidate architectures, systems designs and technologies may be identified and characterized. Select one or more approaches for ongoing use in systems/technology road mapping and planning.
Outcome 9.4.2	*Identify and execute a research and development program to develop technologies by 2015 critical to support human-robotic lunar missions.*
5HRT5	Identify and analyze viable candidates and identify the preferred approach to sustained, integrated human-robotic solar system exploration involving lunar/planetary surfaces and small bodies, and supporting operations. Validate a focused technology R&D portfolio that addresses the needs of these approaches and identifies existing gaps in technological capabilities.
5HRT6	Establish and obtain approval for detailed R&D requirements, roadmaps and program planning in key focused technology development areas, including self-sufficient space systems; space utilities and power; habitation and bioastronautics; space assembly, maintenance and servicing; space transportation; robotic networks; and information technology and communications.
Outcome 9.4.3	*By 2016, develop and demonstrate in space nuclear fission-based power and propulsion systems that can be integrated into future human and robotic exploration missions.*
5HRT7	Develop Level 1/ Level 2 requirements for nuclear power and propulsion systems in support of selected human and robotic exploration architectures and mission concepts.
5HRT8	Complete a validated road map for nuclear power and propulsion R&D, and related vehicle systems technology maturation.
5HRT9	Formulate a demonstration mission plan for Jupiter Icy Moons Orbiter that will test and validate nuclear power and propulsion systems for future human-robotic exploration missions.
Outcome 9.4.4	*Develop and deliver 1 new critical technology every 2 years in at least each of the following disciplines: in-space computing, space communications and networking, sensor technology, modular systems, and engineering risk analysis.*
5HRT15	Complete an Advanced Space Technology Program technology roadmap that interfaces appropriately with the technology planning of NASA's enterprises.
5HRT16	Deliver at least one new critical technology in each key area (including: in-space computing, space communications and networking,

Outcomes/Annual Performance Goals (APGs)	
	sensor technology, modular systems, and engineering risk analysis) to NASA's enterprises, for possible test and demonstration.
5HRT17	Prepare and announce the Centennial Challenge Cycle 2 major award purses, including competition rules, regulations, and judgement criteria.
Outcome 10.1.1	*By 2005 demonstrate 2 prototype systems that prove the feasibility of resilient systems to mitigate risks in key NASA mission domains. Feasibility will be demonstrated by reconfigurability of avionics, sensors, and system performance parameters.*
5HRT10	Develop prototype design and organizational risk analysis tools to do risk identifications, assessments, mitigation strategies, and key trade-off capabilities not only between risks, but between risks and other mission design criteria.
APG 5HRT11	Develop a robust software tool for accident investigation that can help identify the causes of spacecraft, airplane, and/or other mission hardware accidents.
Outcome 10.3.1	*Promote and develop innovative technology partnerships between NASA, venture capital firms and U.S. industry for the benefit of all Enterprise mission needs, initiating three partnerships per year.*
APG 5HRT12	Establish three partnerships with U.S. industry and the investment community using the Enterprise Engine concept.
APG 5HRT13	Develop 12 industry partnerships, including the three established using the Enterprise Engine, that will add value to NASA Enterprises.
Outcome 10.3.2	*Facilitate on an annual basis the award of venture capital funds or Phase III contracts to no less than two SBIR firms to further develop or produce their technology through industry or government agencies.*
APG 5HRT14	Achieve through NASBO, the award of Phase III contracts or venture capital funds to no less than two SBIR firms to further develop or produce their technology through industry or government agencies.
Uniform Measures	
5HRT15	Distribute at least 80% of allocated procurement funding to competitively awarded contracts, including continuing and new contract activities.

Independent Reviews

Review Types	Performer	Last Review Date	Next Review Date	Purpose
TBD				

Budget

Budget Authority ($ millions)	FY 2003	FY 2004	Change	FY 2005	Comments
Human and Robotic Technology		**679.3**	**+414.4**	**1,093.7**	**--**
Technology and Advanced Concepts		679.3	+414.4	1,093.7	--
Technology Maturation			+114.9	114.9	New Program
Project Prometheus			+437.9	437.9	Transfer from Space Science
Advanced Space Technology		467.0	-107.5	359.5	Transfer from Aeronautics (MSM)
Innovative Technology Transfer Partnerships		212.3	-50.9	161.4	Transfer from Aeronautics (ITTP)
Centennial Challenges			+20.0	20.0	New Program

Indicates changes since the previous year's President's Budget Submit

Indicates budget numbers in full cost.

Theme: Human and Robotic Technology

Technology and Advanced Concepts: Centennial Challenges

PURPOSE

Objectives	Performance Measures
9.4	5HRT17

The Centennial Challenges program will establish a series of annual prizes for revolutionary, breakthrough accomplishments that advance solar system exploration and other NASA priorities. Some of the most difficult technical challenges in solar system exploration will require very novel solutions from non-traditional sources of innovation. By making awards based on actual achievements, instead of proposals, NASA will tap innovators in academia, industry and the public that do not normally work on NASA issues. Centennial Challenges will be modeled on past successes, including 19th century navigation prizes, early 20th century aviation prizes, and more recent prizes offered by the US government and private sector. Examples of potential Challenges include very low-cost robotic space missions; contests to demonstrate rover systems that are highly mobile, capable, and survivable; and fundamental advances in technical areas like lander navigation, spacecraft power systems, life detection sensors, and nano-materials.

OVERVIEW

The Centennial Challenges program will issue challenges on annual cycles in key solar system exploration and other NASA technical areas. Prize purses for each challenge will remain available until awarded or for the duration of that challenge. Challenges will be open to U.S. citizens who are not government employees or as otherwise detailed in the rules of the individual challenge.

The Centennial Challenges program plans to conduct annual workshops to solicit and examine ideas for specific challenge ideas. Initial challenges are expected to be issued in the areas of low-cost robotic space missions; highly mobile, capable, and survivable rover systems; and fundamental advances in key spacecraft technologies. The Centennial Challenges program will work closely with other Exploration Systems programs and with other NASA Enterprises to ensure that individual challenges align with NASA goals and possess an appropriate level of difficulty.

NASA expects the Centennial Challenges program to generate innovative solutions to solar system exploration and other NASA technical issues that would not be invented or demonstrated through standard NASA procurement processes. By issuing challenges without judging or proscribing their solution, NASA will attract diverse teams applying multiple, unconventional, low-cost approaches from non-traditional sources to NASA's engineering problems.

PROGRAM MANAGEMENT

The NASA Enterprise official is Craig Steidle, Associate Administrator for Exploration Systems. The Centennial Challenges Program Manager is not yet determined, but will report directly to the Associate Administrator for Exploration.

TECHNICAL COMMITMENT

This Program will establish a baseline during FY 2004.

Schedule	FY 2005 President's Budget	Change from Baseline
Organizational workshop	Oct. 2004	--
Issue 1st set of Challenges	Dec. 2004	--
Rules and judges for specific Challenges finalized	Dec. 2004	--
Selection of 2nd set of Challenges	Sept. 2005	--
Issue 2nd set of Challenges	Oct. 2005	--
Selection of 3rd set of Challenges	Sept. 2006	--

ACQUISITION STRATEGY AND PERFORMING ORGANIZATIONS

The Program is a new start in FY 2005. NASA will seek additional authority to conduct large prizes in the NASA FY 2005 authorization bill. U.S. citizens who are not employees of NASA or other federal agencies, including FFRDCs, can compete unless otherwise stated in the rules of a specific challenge.

Theme: Human and Robotic Technology

Technology and Advanced Concepts: Centennial Challenges

Current Acquisition	Actual*	Selection Method	Actual*	Performer	Actual*
Cooperative Agreement	0%	Full & Open Competition	100%	Industry	50%
Cost Reimbursable	0%	Sole Source	0%	Government	0%
Fixed Price	0%		100%	NASA Intramural	0%
Grants	0%			University	50%
Other	100%	Sci Peer Review	%	Non Profit	0%
* as of FY03 direct procurement	100%	* as of FY03 direct procurement		* as of FY03 direct procurement	100%

Future Acquisition - Major	Selection	Goals
Cooperative Agreement	0%	Full & Open Competition

AGREEMENTS

Internal: The program is not dependent on other NASA activities outside of the control of the Associate Administrator of Exploration. External: The Program does not currently have agreements with any external organization.

RISK MITIGATION

Risk Date: 1/31/2004

Top Risks	G	Overall	G	Cost	G	Schedule	G	Technical	Probability	Impact	Mitigation Plan
G	TBD: Risks will be assessed when this Program enters the Formulation phase.								TBD	TBD	TBD

INDEPENDENT REVIEWS

Review Types	Performer	Last Review Date	Next Review Date	Purpose
Relevance	TBD		9/05	Assess Challenge selection process

BUDGET

Budget Authority ($ millions)	FY 2003	FY 2004	FY 2005	Comments
FY2005 PRESBUD			20.0	
Centennial Challenges			20.0	New Program
Changes since 2004 PRESBUD				
FY2004 PRESBUD				

	Indicates changes since the previous year's President's Budget Submit
	Indicates budget numbers in full cost.

Theme: Human and Robotic Technology
Technology and Advanced Concepts: Project Prometheus

PURPOSE

Objectives	Performance Measures
9.4	5HRT7-9

Project Prometheus, the nuclear systems program, will develop and demonstrate nuclear fission-based spacecraft power and propulsion systems. The Prometheus power and propulsion systems will enable human and robotic exploration, will enhance scientific capabilities, and will facilitate unprecedented levels of scientific return.

OVERVIEW

Project Prometheus activities fall into two categories: 1) the development of nuclear fission-based power and propulsion systems that can be employed on multiple types of missions; and 2) the demonstration of those systems on the Jupiter Icy Moons Orbiter (JIMO) mission.

Requirements for nuclear fission reactors and dependent propulsion technologies will be defined as elements of a developing architecture that will be employed in science-driven human and robotic exploration of the solar system. Those activities in the existing Project Prometheus that are geared specifically towards space science mission objectives will remain in the Space Science Enterprise. Those include development of radioisotope power systems (RPS) for science spacecraft including the New Horizons mission and the scientific research and instrument development that will prepare for the JIMO mission to Jupiter's moons. The Exploration Systems Enterprise will manage requirements definition, formulation, and development of the JIMO mission under the guidance of Space Science Enterprise scientific mission objectives.

JIMO will use nuclear electric power and propulsion technologies to enable an extended search for evidence of water on the icy Jovian moons, Ganymede, Callisto and Europa. With unprecedented power from a nuclear fission reactor and a highly efficient electric propulsion system, the JIMO spacecraft will take advantage of its ability to orbit multiple destinations at close range and use its vast array of high-capability science instruments (both active and passive) to return a volume of data orders of magnitude greater than that which could be returned by existing technologies. The technologies demonstrated on JIMO will be used to provide power and propulsion for human missions across the solar system and for a new generation of space science missions.

PROGRAM MANAGEMENT

The NASA Enterprise official is Craig Steidle, Associate Administrator for Exploration Systems. The Program Executive Officer is Jim Nehman, Program Executive Officer for Exploration Systems. The Project Prometheus Program Director is Alan Newhouse. 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		FY 2005 Budget Submit							Change from Baseline
		FY03	FY04	FY05	FY06	FY07	FY08	FY09	
Project Prometheus: Nuclear Propulsion (fission) - NRAs for Power Conversion	TRL	3	3	TBD					--
	$M	3.20	8	TBD					--
Project Prometheus: Nuclear Propulsion (fission) - NRAs for High Power Nuclear Propulsion	TRL	3	4	TBD					--
	$M	2	3.70	TBD					--

Schedule	FY 2005 President's Budget	Change from Baseline
TBD	--	--

Theme: Human and Robotic Technology
Technology and Advanced Concepts: Project Prometheus

ACQUISITION STRATEGY AND PERFORMING ORGANIZATIONS

Current Acquisition	Actual*	Selection Method	Actual*	Performer	Actual*
Cooperative Agreement	0%	Full & Open Competition	100%	Industry	85%
Cost Reimbursable	100%	Sole Source	0%	Government	5%
Fixed Price	0%		100%	NASA Intramural	10%
Grants	0%			University	0%
Other	0%	Sci Peer Review	%	Non Profit	0%
* as of FY03 direct procurement	100%	* as of FY03 direct procurement		* as of FY03 direct procurement	100%

Future Acquisition - Major	Selection	Goals
TBD		

AGREEMENTS

Project Prometheus is currently working on a Memorandum of Agreement with the Department of Energy. Changes since FY04 Presidents Budget: JIMO received FY03 funding from Congress.

INDEPENDENT REVIEWS

Review Types	Performer	Last Review Date	Next Review Date	Purpose
TBD				

BUDGET

Budget Authority ($ millions)	FY 2003	FY 2004	FY 2005	Comments
FY2005 PRESBUD			437.9	
Project Prometheus			437.9	
Changes since 2004 PRESBUD			+437.9	Transfer from Space Science
FY2004 PRESBUD.				

	Indicates changes since the previous year's President's Budget Submit
	Indicates budget numbers in full cost.

Theme: Human and Robotic Technology
Technology and Advanced Concepts: Technology Maturation

PURPOSE

Objectives	Performance Measures
9.4	5HRT1-6

The Technology Maturation Program will develop and validate novel concepts and technologies to enable safe, affordable, effective and sustainable human-robotic exploration, and will assure their timely transition into Lunar Exploration Theme demonstrations and operations.

OVERVIEW

In order to make possible an ambitious future space program, NASA is now committing itself to strategically focused innovation through applied technology research, focused technology maturation, and timely demonstrations. The goals of enabling human presence and activity beyond low Earth orbit are particularly challenging and will demand a robust, ongoing commitment to innovation and new technology development. The Exploration Systems Enterprise Technology Maturation Program will further develop and validate novel concepts and technologies emerging from NASA and non-NASA advanced technology programs and assure their timely transition into system development programs and projects to enable safe, affordable, effective, and sustainable human-robotic exploration and discovery in the solar system.

PROGRAM MANAGEMENT

The NASA Enterprise official is Craig Steidle, Associate Administrator for Exploration Systems. The Program Executive Officer is Jim Nehman, Program Executive Officer for Exploration Systems. The Theme and Program Management is not yet determined. The Technology Maturation Program will operate through a family of focused technology projects, lead by a team at NASA Headquarters in the Office of Exploration Systems. The Technology Maturation Program will be implemented in close collaboration with other NASA Enterprises and various external organizations.

TECHNICAL COMMITMENT

There is no baseline for this Program. This Program is a new start in FY2005.

Schedule	FY 2005 President's Budget	Change from Baseline
Validate a focused technology R&D portfolio	2005	--
Obtain approval for detailed R&D requirements, roadmaps and program planning	2005	--
Execute two systems-focused Quality Function Deployment exercises	2005	--
Establish an integrated top-down strategy-to-task R&D planning process	2005	--

ACQUISITION STRATEGY AND PERFORMING ORGANIZATIONS

Current Acquisition	Actual*	Selection Method	Actual*	Performer	Actual*
Cooperative Agreement	%	Full & Open Competition	%	Industry	%
Cost Reimbursable	%	Sole Source	%	Government	%
Fixed Price	%		0%	NASA Intramural	%
Grants	%			University	%
Other	%	Sci Peer Review	%	Non Profit	%
* as of FY03 direct procurement	0%	* as of FY03 direct procurement		* as of FY03 direct procurement	0%

Future Acquisition - Major	Selection	Goals
TBD		

Theme: Human and Robotic Technology
Technology and Advanced Concepts: Technology Maturation

RISK MITIGATION

Risk Date: 1/31/2004

Top Risks	G	Overall	G	Cost	G	Schedule	G	Technical	Probability	Impact	Mitigation Plan
G	TBD: Risks will be assessed when this program enters the Formulation phase										

INDEPENDENT REVIEWS

Review Types	Performer	Last Review Date	Next Review Date	Purpose
Overall				Will be used where appropriate to evaluate quality of program implementation.

BUDGET

Budget Authority ($ millions)	FY 2003	FY 2004	FY 2005	Comments
FY2005 PRESBUD			114.9	
Technology Maturation			114.9	
Changes since 2004 PRESBUD			+114.9	New Program
FY2004 PRESBUD.				

Indicates changes since the previous year's President's Budget Submit
Indicates budget numbers in full cost.

Theme: Human and Robotic Technology
Technology and Advanced Concepts: Advanced Space Technology

PURPOSE

Objectives	Performance Measures
10.1, 9.4	5HRT10-11,15-16

The Advanced Space Technology Program will advance and mature a range of high-leverage technologies and transition them to application in the Exploration Systems Enterprise and other NASA Enterprises. The Program research and development portfolio will specifically focus on the requirements of exploration and science missions in five critical areas: in-space computing, space communications and networking, sensor technology, modular systems, and engineering risk analysis.

OVERVIEW

The Advanced Space Technology (AST) Program enables revolutionary capabilities through new technology. Its investment portfolio will be focused on enabling exploration and science-driven architectures and capabilities. Technologies developed in AST will allow NASA Enterprises to conduct new human and robotic exploration missions, gather new types of scientific data, and execute revolutionary mission operations concepts to better assess and manage mission risk. The primary customers for AST technologies are the Exploration Systems Enterprise and other NASA Enterprises. The advanced system concepts, fundamental technologies, and engineering tools on which the AST Program is focused are unique to NASA needs, and are applicable across many classes of missions in multiple Enterprises. Accordingly, research activities in the AST Program will address at least five categories of technology that are fundamentally critical to missions in all NASA Enterprises: in-space computing, space communications and networking, sensor technology, modular systems, and engineering risk analysis. These products may require many years to progress from initial concept definition to mission infusion. Advanced Space Technology incorporates the previous Mission and Science Measurement Theme from the former Aerospace Technology Enterprise.

PROGRAM MANAGEMENT

During calendar 2004, Exploration Systems Enterprise management will conduct a full review of ongoing activities in the Computing, Information, and Communications Technologies Program, the Engineering for Complex Systems Program, and the Enabling Concepts Technology Program. That review will examine existing Technical Commitments in the former Mission and Science Measurement Technology Theme and approaches to program management within the Theme. The review's results will be used in coordination with architecture and requirements definition processes within the Office of Exploration Systems to determine whether any realignment of technical commitments may be necessary.

The NASA Enterprise official is Craig Steidle, Associate Administrator for Exploration Systems. The Program Executive Officer is Jim Nehman, Program Executive Officer for Exploration Systems. The Theme and Program Management is not yet determined.

TECHNICAL COMMITMENT

Technical Commitments in the former Mission and Science Measurement Technology Theme and approaches to program management will be under review during calendar 2004.

Schedule	FY 2005 President's Budget	Change from Baseline
TBD	TBD	--

ACQUISITION STRATEGY AND PERFORMING ORGANIZATIONS

Current Acquisition	Actual*	Selection Method	Actual*	Performer	Actual*
Cooperative Agreement	%	Full & Open Competition	%	Industry	%
Cost Reimbursable	%	Sole Source	%	Government	%
Fixed Price	%		0%	NASA Intramural	%
Grants	%			University	%
Other	%	Sci Peer Review	%	Non Profit	%
* as of FY03 direct procurement	0%	* as of FY03 direct procurement		* as of FY03 direct procurement	0%

Theme: Human and Robotic Technology
Technology and Advanced Concepts: Advanced Space Technology

Future Acquisition - Major	Selection	Goals
TBD		

INDEPENDENT REVIEWS

Review Types	Performer	Last Review Date	Next Review Date	Purpose
TBD				

BUDGET

Budget Authority ($ millions)	FY 2003	FY 2004	FY 2005	Comments
FY2005 PRESBUD		467.0	359.5	
Advanced Space Technology		467.0	359.5	
Changes since 2004 PRESBUD		+467.0		Transferred from Aerospace Technology (MSM)
Advanced Space Technology		+467.0		
FY2004 PRESBUD				

Indicates changes since the previous year's President's Budget Submit
Indicates budget numbers in full cost.

Theme: Human and Robotic Technology
Technology and Advanced Concepts: Innovative Technology Transfer Partnerships

PURPOSE

Objectives	Performance Measures
10.3	5HRT12-14

The Exploration Systems Enterprise's Innovative Technology Transfer Partnerships (ITTP) Program enables the creative use of intellectual assets both inside and outside of NASA to meet the technology needs of the Exploration Systems Enterprise and other NASA Enterprises. ITTP serves to capture, manage, and support the full lifecycle of NASA's intellectual property and technology assets in ways that foster innovative application to generate benefits for NASA missions, U.S. industry, and the Nation. Primarily through developing joint agreements, ITTP helps to introduce new technologies and reduce technology development costs for the NASA Enterprises. Under this objective, NASA seeks collaborative technology development with U.S. industry for the benefit of NASA Enterprises and to make NASA technologies available to industry, academia, and government for use in creating new innovative products and competitive business opportunities that help to strengthen the U.S. economy. ITTP also provides continuing management of NASA's Small Business Innovation Research and Small Business Technology Transfer programs to both develop technologies for NASA mission needs and provide industry with commercially viable technology. ITTP personnel foster an awareness of, and enable efficient and effective U.S. industry access to, NASA intellectual property for the purposes of transfer and collaborative technology development.

OVERVIEW

The Innovative Technology Transfer Partnerships Program will primarily focus on providing technological solutions to NASA for meeting Exploration Systems Enterprise and other Enterprise mission needs by seeking technologies not only from within NASA but also from other federal agency programs and by obtaining technology from U.S. industry and academia. Where technological solutions do not currently exist, the ITTP theme will seek dual-use technology collaborations among NASA, non- aerospace industrial firms, and the venture capital community. NASA will continue to support regulatory requirements associated with the transfer of NASA developed technology to U.S. industry/academia, and enhance NASA technology spin-in objectives through the Small Business Innovation Research and Small Business Technology Transfer (SBIR/STTR) programs. Efforts to document and license technologies, to transfer these technologies to the private sector as legislatively mandated, and to prudently manage NASA's intellectual property, will be very limited. The Enterprise Engine program will focus on establishing dual-use technology collaborations among NASA, non-aerospace industrial firms, and the investment community to address NASA's new technology needs. SBIR/STTR programs will continue to support innovative technology development by the Small Business community and the National Technology Transfer Center (NTTC) will continue to provide support to the Technology Transfer Partnerships activity. The Innovative Technology Transfer Partnerships program incorporates the previous Innovative Technology Transfer Partnerships Theme from the former Aerospace Technology Enterprise.

PROGRAM MANAGEMENT

The NASA Enterprise official is Craig Steidle, Associate Administrator for Exploration Systems. The Program Executive Officer is Jim Nehman, Program Executive Officer for Exploration Systems. The Theme Director is John Mankins, Director for Human and Robotic Technology. The Innovative Technology Transfer Program Director is Benjamin Neumann. The Technology Transfer Partnerships Program Manager is Benjamin Neumann. The SBIR/STTR Program Manager is Carl Ray.

TECHNICAL COMMITMENT

Schedule	FY 2005 President's Budget	Change from Baseline
TBD	--	--

ACQUISITION STRATEGY AND PERFORMING ORGANIZATIONS

Current Acquisition	Actual*	Selection Method	Actual*	Performer	Actual*
Cooperative Agreement	%	Full & Open Competition	%	Industry	%
Cost Reimbursable	%	Sole Source	%	Government	%
Fixed Price	%		0%	NASA Intramural	%
Grants	%			University	%
Other	%	Sci Peer Review	%	Non Profit	%
* as of FY03 direct procurement	0%	* as of FY03 direct procurement		* as of FY03 direct procurement	0%

Theme: Human and Robotic Technology
Technology and Advanced Concepts: Innovative Technology Transfer Partnerships

Future Acquisition - Major	Selection	Goals
TBD		

INDEPENDENT REVIEWS

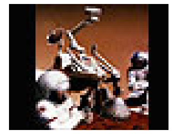
Review Types	Performer	Last Review Date	Next Review Date	Purpose
TBD				

BUDGET

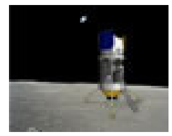
Budget Authority ($ millions)	FY 2003	FY 2004	FY 2005	Comments
FY2005 PRESBUD		212.3	161.4	
Innovative Tech Transfer Partnerships			161.4	
SBIR		116.5		
STTR		14.0		
Technology Transfer Programs		35.8		
Commercial Programs		42.0		
SBIR/STTR Programs Management		4.0		
Changes since 2004 PRESBUD		+212.3		
SBIR		+116.5		
STTR		+14.0		
Technology Transfer Programs		+35.8		
Commercial Programs		+42.0		
SBIR/STTR Programs Management		+4.0		
FY2004 PRESBUD				

Indicates changes since the previous year's President's Budget Submit
Indicates budget numbers in full cost.

THEMES



Human and Robotic Technology



Transportation Systems

Future exploration missions into the solar system and beyond will employ humans where their capabilities are unique and critical. Among those capabilities are their physical adaptability, intellectual flexibility, capacity for innovation in operations, and ability to inspire Earth's population. NASA's missions will also employ increasingly capable robotic spacecraft, which will execute science activities and infrastructure functions using revolutionary advances in power, propulsion, intelligence, mobility, and communications. As a result of current investments in Exploration Systems Enterprise programs, today's youth will watch humans explore Mars in their lifetime and will see their understanding of the Universe expand through scientific discoveries we have not yet imagined.

EXPLORATION SYSTEMS

PURPOSE

The relationship between discovery and exploration has driven human curiosity throughout global and American history. New World pioneers and American frontiersmen demonstrated the great value of exploration, as they obtained knowledge, technology, resources, and inspiration for our nation. At the beginning of the 21st century, we stand at a unique time in our exploration of the heavens. The exploratory voyages of the next few decades have the potential – within our lifetimes – to answer age-old questions about how life begins, whether life exists elsewhere, and how humans will exist in the future.

These voyages will not be easy. Mars is 100,000 times farther away from Earth than is the International Space Station. At the moons of Jupiter, the power supplied by sunlight is 27 times weaker than on Earth. Radiation presents an ever-present challenge to human and robotic explorers. Using existing systems and technology, it takes over a decade-and-a-half to reach the boundaries of our solar system.

To enable an effective and exciting program of solar system exploration, the constraints of distance, energy, and time must be overcome. Meeting these challenges will require innovative approaches, new vehicles, and breakthrough technologies. The Exploration Systems Enterprise is responsible for developing and demonstrating the strategies and systems that will allow human and advanced robotic exploration of other worlds. Consistent with the National Space Exploration Policy, the NASA Strategic Plan, and the Vision for Space Exploration, the Exploration Systems Enterprise will:

Support Research at Key Research Destinations: The development of exploration strategies, systems, and technologies will be guided by requirements for conducting research at key destinations in the search for habitable environments and life. These destinations include, but are not limited to, the Moon, the planet Mars, the moons of Jupiter and other outer planets, and deep space telescopes that will search for planets outside our solar system.

Enable Sustainable Exploration: Exploration architectures and vehicles will be developed with the goal of enabling sustainable, affordable, and flexible exploration of the solar system.

Employ Humans and Robots: Exploration Systems will design architectures and missions that use humans and robots in partnership, leveraging the capabilities of each where most useful.

Enterprise: Exploration Systems

Use the Moon as a Testing Ground for Mars and Beyond: The Exploration Systems Enterprise, working with the Lunar Exploration and Mars Exploration Themes, will use robotic and human missions to further science, and to develop and test new approaches, technologies, and systems, including the use of lunar and other space resources, to support sustained human space exploration of Mars and other destinations.

Management Philosophy: The Exploration Systems Enterprise will be guided by a philosophy that ensures that operators and technologists work together to enable the leveraging of technology research and development. Technology will be matured prior to development through performance demonstration. A disciplined Strategy-to-Task-to-Technology process will be instituted for purposes of requirements definition. Rigorous trade study analysis, utilizing modeling and simulation, will be performed by operators and technologists jointly. A focused program management process, using best practices such as earned value management, will be at the core of this enterprise.

Work Closely With Customers and Partners: The Exploration Systems Enterprise will work closely with NASA's Space Architect, Space Science Enterprise, Biological and Physical Research Enterprise, Space Flight Enterprise, other government agencies, potential international partners, academia, and industry in the development of new exploration strategies, architectures, vehicles, systems, and technologies.

The Exploration Systems Enterprise includes two new Themes that will function cooperatively to enable sustainable exploration and scientific discovery in the solar system and beyond. The Themes are Human and Robotic Technology and Transportation Systems.

FY 2003 Accomplishments

Exploration Systems is a new Enterprise. Planned FY 2004 accomplishments are described below.

Theme Distribution

Budget Authority ($ in millions)	FY 2003	FY 2004	FY 2005
Human and Robotic Technology		679.3	1,093.7
Transportation Systems		966.5	688.7
Total		1,645.8	1,782.4

Note: For all formats, the FY 2003 column reflects the FY 2003 Congressional Operating Plan, dated 9/04/03. The FY 2004 column reflects the FY 2004 Conference committee report. The FY 2005 column represents the FY 2005 President's Budget Submit.

(Yellow) Indicates budget numbers in full cost

Human and Robotic Technology

The Human and Robotic Technology (HRT) Theme is responsible for developing innovative technologies to enable sustainable exploration of our solar system. Through applied technology research, focused technology maturation, and timely technology transition, the HRT Theme will develop technologies that can be integrated into LE Theme missions and applied in the exploration activities of other NASA Enterprises.

For sustainable solar system exploration, NASA requires safe, affordable, effective, and flexible architectures, vehicles, and systems. This may require systems that can be reused, systems that are highly reliable and require limited maintenance and support, systems that can be applied to more than one destination, systems that can operate intelligently without human control, and/or architectures that use space resources to improve efficiency. NASA plans to invest in a number of new approaches and technologies for exploration that could enable these kinds of architectures, vehicles, and systems. These technologies will be demonstrated on the ground, at the Space Station and other locations in Earth orbit, and at the Moon starting this decade and into the next. Where they provide for safety, affordability, effectiveness, and flexibility in architectures, these new tools will be incorporated in full-scale, operational exploration systems.

The HRT Theme consists of five programs: Centennial Challenges, Project Prometheus, Technology Maturation, Advanced Space Technology, and Innovative Technology Transfer Partnerships.

Overall Budget

FY 2005 request is $1,093.7 million (full cost).

Centennial Challenges

Request includes funding to establish a series of annual prizes for revolutionary, breakthrough accomplishments that advance exploration of the solar system and beyond and other NASA goals. Some of the most difficult technical challenges to exploration will require very novel solutions from non-traditional sources of innovation. By making awards based on actual achievements instead of proposals, NASA will tap innovators in academia, industry, and the public who do not normally work on NASA issues. Centennial Challenges will be modeled on past successes, including 19th century navigation prizes, early 20th century aviation prizes, and more recent prizes offered by the U.S. government and private sector. Examples of potential Centennial Challenges include very-low-cost space missions, contests to demonstrate highly mobile, capable, and survivable robotic systems, and fundamental advances in technical areas like lander navigation, spacecraft power systems, life detection sensors, and nano-materials.

Project Prometheus

Request includes funding for development of space nuclear fission power systems and space nuclear propulsion systems to support advanced robotic and human exploration of the solar system. These technologies are critical to in-depth robotic exploration of the outer solar system, power for sustained human planetary surface operations, and propulsion for human exploration missions. The technologies developed by Project Prometheus will be first demonstrated on NASA's Jupiter Icy Moons Orbiter (JIMO) mission during the next decade and applied to future robotic and human missions thereafter.

Project Prometheus was previously managed by NASA's Space Science Enterprise. The Space Science Enterprise retains funding for JIMO instrumentation and research, and Project Prometheus will continue to work closely with the Space Science Enterprise to enable the JIMO mission.

Technology Maturation

Request includes funding for development and demonstration of novel concepts and technologies for sustainable exploration of our solar system. Historically, the development of new space technologies from initial research to mission application is a difficult process. Enabling safe, affordable, effective, and flexible exploration architectures, vehicles, and systems will require a robust, ongoing commitment to focused innovation. Funding assumes architecture and systems design, technology research and development, and ground and in-space demonstration activities this decade in areas like robotic networks, propellant pre-positioning, advanced power and propulsion, in-space assembly, and space resource utilization. Technology Maturation will work closely with other programs developing and demonstrating breakthrough exploration technologies, including Lunar Exploration, Project Prometheus, Mars Exploration Program, and the Astronomical Search for Origins.

Working with NASA and non-NASA researchers and technologists, through both directed investments and partnerships, Technology Maturation will advance a range of high-leverage technologies and space operations concepts, mature and validate key technologies, and transition them into applications. Technology Maturation will coordinate with the NASA Space Architect, NASA's Space Science and Biological and Physical Research Enterprises, other government agencies, industry, academia, and potential international partners to leverage common requirements and identify innovative ideas.

Advanced Space Technology

Request includes funding for research and development of high-leverage space technologies to support solar system exploration and other NASA applications. Advanced Space Technology will conduct fundamental research, technology development, and tool development in areas like in-space computing, space communications and networking, sensors, modular systems, and engineering risk analysis. Advanced Space Technology will work closely with Technology Maturation to identify technologies to meet solar system exploration needs.

Advanced Space Technology incorporates the previous Mission and Science Measurement Theme from the former Aerospace Technology Enterprise. The Exploration Systems Enterprise will review ongoing Mission and Science Measurements Technology projects and processes in 2004 to determine which will be carried forward into the Advanced Space Technology Program. This review will leverage the findings published recently at the conclusion of the National Research Council's review of Mission and Science Measurement program activities. Program Management will, to the extent feasible, openly compete research funding so that R&D work is carried out by the best researchers and technologists in academia, industry, NASA field centers, and other government agencies.

Innovative Technology Transfer Partnerships

Request includes funding for joint technology development agreements with industry, NASA's Small Business Innovation Research and Small Business Technology programs, and other regulatory technology transfer requirements at NASA. Innovative Technology Transfer Partnerships will provide technological solutions for meeting solar system exploration and other NASA needs through novel partnerships with the non-aerospace industrial firms, the venture capital community, small businesses, and universities.

The Innovative Technology Transfer Partnerships program incorporates the previous Innovative Technology Transfer Partnerships Theme from the former Aerospace Technology Enterprise. Enterprise reviews in CY 2004 will align ongoing activities in Innovative Technology Transfer Partnerships.

Transportation Systems

The Transportation Systems (TS) Theme will provide crew transfer and other NASA-unique space transportation capabilities to support exploration of the solar system. The near-term activities of the TS Theme will be focused on development and demonstration of a Crew Exploration Vehicle (CEV) that can transport and support human crews traveling to destinations beyond low Earth orbit. The TS Theme will also be responsible for planning for potential future NASA-unique space transportation needs, such as in-space transportation systems and heavy lift launch systems, that cannot be met through commercial or international partner capabilities.

The TS Theme includes transition and closeout activities for the Space Launch Initiative Theme of the former Aerospace Technology Enterprise, including the Orbital Space Plane and Next Generation Launch Technology programs.

OVERALL BUDGET

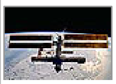
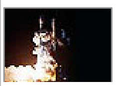
FY 2005 request is $688.8 million (full cost).

Crew Exploration Vehicle

The CEV will support human missions to the Moon and later to the planet Mars and other deep space destinations. The CEV might also supplement international partner crew transport systems to the Space Station. CEV capabilities will be demonstrated in phases with the following major milestones:

- 2008 – First Unmanned Prototype Test Flight.
- 2010 – Initiate Advanced Test Flights.
- No Later Than 2014 – Initial Human-rated Capability.

Appropriation Summary: Exploration Capabilities

Millions of Dollars	FY 2003 Op Plan 9/04/03	FY 2004 Conference Report	FY 2005 President's Budget
EXPLORATION SYSTEMS	—	**1,645.8**	**1,782.4**
 **Human and Robotic Technology**	—	679.3	1,093.7
 **Transportation Systems**	—	966.5	688.7
SPACE FLIGHT	**6,148.8**	**5,874.9**	**6,674.0**
 **International Space Station**	1,462.4	1,498.1	1,862.7
 **Space Shuttle**	3,301.4	3,945.0	4,319.2
 **Space and Flight Support**	352.2	431.8	492.1
Institutional Support	1,032.8	—	—
AEROSPACE TECHNOLOGY (Crosscutting Technologies)	**1,881.6**	—	—
Space Launch Initiative	815.3	—	—
Mission and Science Measurement Technology	304.4	—	—
Innovative Technology Transfer Partnerships	161.5	—	—
Institutional Support	600.4	—	—
TOTAL APPROPRIATION	**8,030.4**	**7,520.7**	**8,456.4**

Note: For all formats, the FY 2003 column reflects the FY 2003 Congressional Operating Plan dated 9/04/03 (not in full cost). The FY 2004 column reflects the Conference Report in full cost. FY 2005 column is in full cost.

(yellow)	Indicates budget numbers in full cost.

Barbara Morgan, educator-astronaut, in the classroom.

Education Programs

MAJOR EVENTS IN FY 2005

- The NASA Explorer Schools program enters its third phase, selecting 50 new schools for a total of 150 participating schools.
- The first class of students will be selected for the Science and Technology Scholarship program.
- NASA will capitalize on the ongoing training of the new class of Educator Astronauts by developing learning modules for K-12 students and teachers.
- The Explorer Institute program will move into its first full year of implementation, building relationships with, and professional development opportunities for, museums, science centers, planetaria, and other informal education institutions across the country.

Theme: Education Programs

OVERVIEW

NASA's mission--to understand, to explore, and to inspire--depends upon educated, motivated people with the ingenuity to invent new tools, the passion to solve problems, and the courage to ask the difficult questions. It is not enough to depend on the excitement generated by our images. NASA must use its discoveries and achievements to engage the education community. To do so, we provide meaningful, educational, and content-rich programs that inspire and motivate students at all levels to pursue careers in science, technology, engineering, and mathematics (STEM). We partner with academia, professional associations, industry, and other agencies to provide teachers and faculty with experiences that capitalize on the excitement of NASA's missions to spark student interest and involvement. We provide opportunities for involvement in NASA's research efforts to encourage students to pursue higher education in STEM areas. Finally, we engage the public in shaping and sharing the experience of exploration and discovery. With the FY05 budget request, NASA will fully implement the initiatives piloted in FY03 (Educator Astronaut and NASA Explorer Schools programs); continue the pilot initiatives implemented in FY04 (NASA Explorer Institutes and NASA Science and Technology Scholarship program); and fully integrate all NASA Education programs and activities into a seamless pipeline of exemplary programs that inspire the next generation of explorers and expands the pool of human capital available to meet NASA's needs.

Missions	Goals supported by this Theme	Objectives supporting these Goals
To Inspire the Next Generation of Explorers	6. Inspire and motivate students to pursue careers in science, technology, engineering, and mathematics.	6.1 Increase the number of elementary and secondary students and teachers who are involved in NASA-related education opportunities.
		6.2 Support higher education research capability and opportunities that attract and prepare increasing numbers of students and faculty for NASA-related careers.
		6.3 Increase the number and diversity of students, teachers, faculty and researchers from underrepresented and underserved communities in NASA related Science, Technology, Engineering and Mathematics (STEM) fields.
		6.4 Increase student, teacher, and public access to NASA education resources via the establishment of e-Education as a principal learning support system
	7. Engage the public in shaping and sharing the experience of exploration and discovery.	7.1 Improve public understanding and appreciation of science and technology, including NASA aerospace technology, research, and exploration missions.

RELEVANCE

A lack of public understanding of scientific inquiry, a retiring aerospace workforce, a shrinking pipeline of students with science and engineering skills, and job recruitment competition put future advancements in science, aeronautics and space at risk. Research shows a shortage of students pursuing degrees in disciplines of critical importance to NASA--science, mathematics, and engineering. Several recent National Science Foundation (NSF) reports document the shrinking of the science and engineering (S&E) pipeline over the past decade. This trend begins at the elementary and secondary level and extends through the ranks of the doctoral graduates. This shrinking pipeline has great significance to NASA as nearly 60% of the total NASA workforce is in the S&E fields, and half of these employees have Master's or Doctorate degrees. Nationally, employment opportunities in the S&E fields are projected to increase about three times faster than the rate for all occupations between 2000 and 2010. The number of retirees in these fields is projected to increase dramatically over the next 20 years. NASA faces the challenge of building a workforce that captures the untapped capacity reflected by the Nation's diversity, while the competition for these talented individuals is keen. These trends provide immediate warning signals that NASA must take significant measures to address workforce imperatives that ultimately impact NASA's mission capability. To address these challenges, NASA's Education Enterprise will inspire students from all walks of life to understand the need for and power of scientific discovery and to motivate students to ultimately pursue STEM careers. NASA's Education Enterprise has already begun to address these issues.

Education and Public Benefits
By supporting excellence in mathematics and science education and by coordinating with the Department of Education in the Math/Science Partnership, the NASA Education program helps broaden the reach of science and technology literacy programs to the education community and the general public. The NASA Education program is fully responsive to its stakeholders--taxpayers--by actively engaging with other Federal agencies and non-governmental professional education organizations.

Theme: Education Programs

IMPLEMENTATION

To achieve the stated Education Enterprise objectives, an Education Enterprise strategy has been developed that delineates the roles of the Enterprise; implements evaluation and research as a core element of each Enterprise program; and further defines the education strategic initiatives.

During our storied 46-year history, NASA has had a strong connection with education in this country, as a beneficiary receiving top talent, and as a catalyst for inspiring interest in science and technology. Building on this foundation, and under the leadership of the new Education Enterprise, NASA is poised to launch a bold new future. Today, our Minority University Research and Education Program (MUREP) continues to broaden the participation of underrepresented minorities and minority institutions in NASA's research and development programs through a variety of program offerings, including programs for Principal Investigators, mathematics and science programs, partnerships, and institutional awards. The National Space Grant College and Fellowship Program provides NASA with a presence in 50 states, the District of Columbia, and the Commonwealth of Puerto Rico, supporting NASA research, the training of undergraduate and graduate students, and public service programs. The Space Science, Earth Science, and Biological and Physical Research Enterprises engage their scientific communities to bring the excitement of knowledge from discoveries to the classroom and campuses throughout the nation. The Aeronautics, Space Flight, and Exploration Systems Enterprises share their unique facilities, both on ground and in orbit, with students, teachers and faculty. The ten NASA field centers implement national programs for elementary school, high school, undergraduate, and graduate students, teachers, and faculty while also providing Center-unique education programs supporting their communities and states.

Establishing "to inspire the next generation of explorers" as a core mission of NASA is a bold decision, and bold action is required to ensure mission success. Building on what has previously been done, NASA has identified four initiatives that will strengthen the existing portfolio: the NASA Educator Astronaut program, NASA Explorer Schools, NASA Explorer Institutes, and the NASA Science and Technology Scholarship program. These pathfinder initiatives are designed to stimulate student, educator, and public interest in science, technology, engineering, and mathematics by providing NASA-sponsored educational opportunities that inspire and motivate the next generation of explorers. Although each of these initiatives is in the early stage of implementation, each is designed to trigger significant progress toward achieving NASA's strategic education objectives.

IMPLEMENTATION SCHEDULE

Theme Element	Schedule by Fiscal Year 95 96 97 98 99 00 01 02 03 04 05 06 07 08	Purpose
NASA Science and Technology Scholarship		Provides pipeline development in critical discipline areas for NASA through scholoarships with a service obligation.
NASA Explorer Institutes		Improve opportunities for science centers, museums, planetariums, and community-based organizations to translate and deliver engaging NASA content through partnerships and engaging/educating the general public.
Educator Astronaut Program		To develop new ways to connect exploration with the classroom, motivate students and educators, enhance status of teachning profession: and enable leading educators to move from local to national impact.
NASA Explorer Schools		Provides student opportunities to explore NASA science, technology, engineering, mathematics in a variety of engaging ways; susstained professional development for educators with unique teaching tools/NASA content; family involvement with NASA in support of student learning/career exploration
Minority University Base Program		Comprrehensive program of opportunities for students and faculty in minority-serving institutions. Program was reviewed in 2003 for alignment with new Education priorities. New program direction will be developed in 2004 according to the outcomes
Education Base Program		Comprehensive, national program of opportunities for students, faculty, and state based institutions. Program was revieweed in 2003 for alignment with new Education priorities. New program direction will be developed in 2004 according to the outcomes

Tech & Adv Concept   Development   Operations   Research

No exceptions to NPG 7120.5B have been taken.

STATUS

Education was established as a core mission of NASA in FY 2002 and a new Enterprise was established in FY 2003 that organizes, focuses, and unifies all NASA-sponsored education activities, providing a single office for policy, accountability, program standards, and evaluation. During FY 2003, the new Education Enterprise:

- Developed and launched the Educator Astronaut program, designed to select teachers who, as Mission Specialists, will create revolutionary teaching tools and ways to share the training and spaceflight experience with students and other educators. More than 1,600 applications were considered for astronaut candidate selection, and more than 58,200 Earth Crew team members have signed up to participate with NASA on a variety of spaceflight related activities.

- Developed and launched the NASA Explorers Schools program, a unique partnership between NASA and 50 school teams from underserved populations around the country. The program provides linkages with NASA centers and on-going educator professional development and student opportunities.
- Recently redesigned NASA Portal and web resources to support efforts to inspire the next generation of explorers and to support the goals of the President's Management Agenda for e-government.
- Funded 20 scholars in Master's and Doctoral programs at universities around the country through the Harriet Jenkins Predoctoral Fellowship, and selected new Curriculum Improvement Partnership Awards (CIPA) at two- and four-year minority-serving institutions.

PERFORMANCE MEASURES

Outcomes/Annual Performance Goals (APGs)	
Outcome 6.1.1	*By 2008, increase by 20%, student participation in NASA instructional and enrichment activities.*
5ED1	Increase NASA student participation by 5% above baseline
Outcome 6.1.2	*By 2008, increase by 20%, the number of elementary and secondary educators effectively utilizing NASA content-based STEM materials and programs in the classroom.*
5ED2	Increase NASA teacher participation by 5% above baseline.
Outcome 6.1.3	*By 2008, increase by 20%, family involvement in NASA-sponsored elementary and secondary education programs.*
5ED3	Increase existing NASA-sponsored family involvement activities and existing and potential partners by 5% over baseline
Outcome 6.1.4	*By 2008, 90% of NASA elementary and secondary programs are aligned with state or local STEM educational objectives.*
5ED4	25% of NASA elementary and secondary programs are aligned with state or local STEM educational objectives.
Outcome 6.2.1	*By 2008, attain a statistically significant increase in the number and diversity of NASA-supported students graduating in NASA-related fields.*
5ED5	Establish a NASA-wide baseline of the diversity of NASA-supported students.
Outcome 6.2.2	*By 2008, attain a statistically significant increase in the number of faculty in higher education institutions who are first-time proposers in NASA research and development opportunities.*
5ED6	Use existing higher education programs to assist and encourage first time faculty proposers for NASA research and development opportunities.
Outcome 6.2.3	*By 2008, increase by 20% the number of higher education institutions that align their NASA research and development activities with STEM teacher preparation departments to improve STEM teacher quality.*
5ED7	Establish a baseline of institutions receiving NASA research and development grants and contracts that link their research and development to the institution's school of education.
Outcome 6.2.4	*By 2008, increase by 10% the number and diversity of students conducting NASA-relevant research.*
5ED8	Establish a baseline of the number and diversity of students conducting NASA-relevant research.
Outcome 6.3.1	*By 2008, increase by 20%, underrepresented/underserved NASA-sponsored students who pursue academic degrees in NASA-related STEM disciplines.*
5ED9	Increase NASA underrepresented/underserved student participation by 5% over baseline.
Outcome 6.3.2	*By 2008, increase by 20%, the number and diversity of teachers and faculty from underrepresented/underserved communities and institutions who participate in NASA-related STEM programs.*
5ED10	Increase NASA underrepresented/underserved teacher/faculty participation in NASA STEM-related learning environments by 5% over baseline.
Outcome 6.3.3	*By 2008, increase by 20% the number of underrepresented/underserved researchers and minority serving institutions that compete for NASA research and development opportunities.*
5ED11	Increase the numbers of underserved/underrepresented researchers and minority serving institutions competing for NASA research announcements by 5% above baseline.
Outcome 6.3.4	*By 2008, increase family involvement in underrepresented/underserved NASA-sponsored student programs.*
5ED12	Establish a baseline of family involvement in underrepresented/underserved NASA-sponsored student programs.
Outcome 6.4.1	*By 2008, identify and implement 4 new advanced technology applications that will positively impact learning.*
5ED13	Prototype 1 new advanced technology application.
Outcome 6.4.2	*By 2008, demonstrate the effectiveness of NASA digital content materials in targeted learning environments.*

Theme: Education Programs

Outcomes/Annual Performance Goals (APGs)	
5ED14	Evaluate the 50 pilot NASA Explorer Schools, utilizing a design experiment approach.
Outcome 6.4.3	*By 2008, establish a technology infrastructure that meets citizen demand for NASA learning services.*
5ED15	Develop a plan for establishing a technology infrastructure.
Outcome 7.1.1	*By 2008, establish a national program to engage the informal education community with NASA Science and Technology.*
5ED16	Implement Phase 1 of a plan to increase appreciation of the relevance and role of NASA science and technology.
Outcome 7.1.2	*By 2008 provide instructional materials derived from NASA research and scientific activities that meet the needs of NASA's informal education partners.*
5ED17	Develop a plan to assess and prioritize high-leverage and critical informal education programs and educational involvement activities.
Outcome 7.1.3	*By 2008 provide professional development for NASA's informal education partners.*
5ED18	Develop a plan to assess current NASA professional development programs for relevance to the targeted informal learning environments.
Uniform Measures	
5ED19	At least 80%, by budget, of research projects will be peer-reviewed and competitively awarded.

INDEPENDENT REVIEWS

Review Types	Performer	Last Review Date	Next Review Date	Purpose
Program Review	External panel		9/04	Review/evaluate programs according to new direction.

BUDGET

Budget Authority ($ millions)	FY 2003	FY 2004	Change	FY 2005	Comments
Education Programs	**198.6**	**226.3**	**-57.8**	**168.5**	
Education	198.6	226.3	-57.8	168.5	
EDUCATION	114.6	137.1	-59.4	77.7	
Minority University Research & Education Program	84.1	89.2	+1.6	90.8	

Indicates changes since the previous year's President's Budget Submit.

Indicates budget numbers in full cost.

Theme: Education Programs
Education: Minority University Research and Education Program

PURPOSE

Objectives	Performance Measures
6.2, 6.3	5ED5-12, 19

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; 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) providing and 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. Participants in the program include more than 150 Historically Black Colleges and Universities (HBCU), Hispanic Serving Institutions (HSI), Tribal Colleges and Universities (TCU), and Other Minority Universities (OMU). MUREP K-12 awards focus on building and supporting successful pathways for students to progress to the next level of mathematics and science through a college preparatory curriculum and enrollment in college. Higher education awards seek to improve the rate at which underrepresented minorities are awarded degrees in STEM disciplines through increased research training and exposure to cutting-edge technologies that better prepare them to enter STEM graduate programs, the NASA workforce pipeline, or employment in NASA-related industries. Examples of accomplishments in FY 2003 included the funding of 20 scholars in Master's and Doctoral programs at universities around the country through the Harriet Jenkins Predoctoral Fellowship, and the selection of new Curriculum Improvement Partnership Awards (CIPA) at two- and four-year minority-serving institutions. For more information, go to: http://www.education.nasa.gov/ .

PROGRAM MANAGEMENT

Minority University Research and Education Program responsibility is maintained at NASA Headquarters (HQ), 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 table below includes information on the types of programs conducted within MUREP, including specific information on selected programs.

Technical Specifications	FY 2005 President's Budget	Change from Baseline
Math and Science Education	This activity increases the participation and achievement of underrepresented students in the STEM fields at all levels of education.	--
	--The Science, Engineering, Mathematics, and Aerospace Academy (SEMAA) provides NASA-related curricula to historically underserved K-12 schools.	--
	--The Precollege Awards for Excellence (PACE) is a program to enhance the performance of students in college preparatory courses in science and mathematics.	--
	--Mathematics, Science & Technology Awards for Teacher Education increase the number and percentage of state-certified math, science or technology teachers on all levels of hard-to-staff schools.	--
Institutional Sciences, Engineering, Technology	--The University Research Center program (URC) increases the research capacity of minority institutions in NASA fields.	--
	--The Institutional Research Awards program (IRA) improves the academic, scientific, and research infrastructure at minority institutions.	--
Principal Investigators	This activity increases the participation of faculty/other professionals in conducting NASA research, research training, and/or administration.	--

Theme: Education Programs
Education: Minority University Research and Education Program

Technical Specifications	FY 2005 President's Budget	Change from Baseline
Principal Investigators (continued)	--The NASA Administrator's Fellowship program enhances the professional development of NASA employees and faculty from minority institutions.	--
	-The Faculty Award for Research (FAR) provides an opportunity for faculty from minority-serving institutions to participate in NASA-related research.	--
Partnerships	This activity enhances the academic infrastructure in NASA-related disciplines with a focus on interdisciplinary collaborations.	--
	--The Curriculum Improvement Partnership Award (CIPA) program focuses on curriculum improvement and enhanced teaching strategies.	--

Schedule	FY 2005 President's Budget	Change from Baseline
Precollege Awards for Excellence (PACE)	Will be awarded in FY 05	--
Minority University Mathematics, Science, and Tech Awards for Teacher Education	Will be awarded in FY 05	--
University Research Centers	Will be awarded in FY 05	--

Acquisition Strategy and Performing Organizations

MUREP 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 FY04 Pres. Budget: None.

Current Acquisition	Actual*	Selection Method	Actual*	Performer	Actual*
Cooperative Agreement	40%	Full & Open Competition	79%	Industry	0%
Cost Reimbursable	0%	Sole Source	21%	Government	0%
Fixed Price	0%		100%	NASA Intramural	0%
Grants	46%			University	75%
Other	14%	Sci Peer Review	100%	Non Profit	25%
* as of FY03 direct procurement	100%	* as of FY03 direct procurement		* as of FY03 direct procurement	100%

Future Acquisition	Selection	Goals
Faculty Awards for Research (FAR)	4th Qtr, FY04	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 2004 President's Budget: None.

Independent Reviews

Review Types	Performer	Last Review Date	Next Review Date	Purpose
Site reviews at each award location	External Panel	9/02	9/04	Review/evaluate program progress.
Program review	External panel	9/02	9/04	Review/evaluate Programs according to new direction.

Theme: Education Programs

Education: Minority University Research and Education Program

BUDGET

Budget Authority ($ millions)	FY 2003	FY 2004	FY 2005	Comments
FY2005 PRESBUD	84.1	89.2	90.8	
Base Program	84.1	89.2	90.8	
Changes since 2004 PRESBUD	+2.0	-2.4		
Base Program	+7.0	+11.3		Full cost adjustments. Includes FY04 new initiatives.
New Initiative	-5.0	-13.7		FY04 new initiatives funding rolled into Base Program for FY05.
FY2004 PRESBUD	82.1	91.6		
Base Program	77.1	77.9		
New Initiative	5.0	13.7		

Indicates changes since the previous year's President's Budget Submit.

Indicates budget numbers in full cost.

Theme: Education Programs
Education

PURPOSE

Objectives	Performance Measures
6.1, 6.2, 6.4, 7.1	5ED1-8,13-19

To inspire the next generation of explorers, NASA will use an integrated, focused approach to improve student proficiency in science, technology, engineering, and 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 research and development (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 elementary and secondary, higher education, informal education, and educational technology. These programs provide students and educators an opportunity to conduct NASA-related research on flight platforms such as the International Space Station, Shuttle, sounding rockets, scientific balloons, and scientific aircraft. In FY 2005, NASA will fully implement the two new initiatives piloted in FY 2003 (Educator Astronaut and NASA Explorer Schools) and will continue the pilot initiatives implemented in FY 2004 (NASA Explorer Institutes and the NASA Science and Technology Scholarship program). The program will continue the implementation of a comprehensive, national program of opportunities for students, faculty, and state-based institutions through a variety of programmatic offerings, such as summer research opportunities for high school and undergraduate students, graduate fellowships, faculty research, state-based activities such as Space Grant and the Experimental Program to Stimulate Competitive Research (EPSCoR), and an educational technology portfolio that includes the NASA Classroom of the Future. For more information go to: http://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 table below includes information on the types of programs conducted within the Education program, including specific information on selected programs.

Technical Specifications	FY 2005 President's Budget	Change from Baseline
Student Support	Programs enhance the student pipeline, creating a culture of achievement with opportunities based on NASA's unique missions, and improve STEM instruction with unique teaching tools and experiences.	--
	--The Educator Astronaut program will select teachers and transport them into space to inspire and motivate students.	--
	--The NASA Explorer Schools program will provide target middle schools with a customized and sustained learning environment to encourage greater interest in science and engineering careers.	--
	--The Summer High School Apprentice Researcher Program (SHARP) provides selected junior & senior high school students with opportunities to work with mentors at NASA Field Centers or universities.	--
Higher Education	Programs strengthen involvement with higher education institutions to ensure NASA can meet its workforce needs, and influence students to earn advanced degrees.	--
	--The Science and Technology Scholarship program will link scholarship with service at a NASA Center and help NASA better attract top students into its workforce.	New Program
	--Space Grant is authorized by legislation to support universities in all states, DC, and Puerto Rico by enabling research and outreach activities to improve capabilities in NASA-related work.	--

Higher Education (continued)	--EPSCoR, the Experimental Program to Stimulate Competitive Research, supports competitively selected universities in designated states to build their research capability in areas important to NASA.	--
	--USRP, the Undergraduate Student Researchers Program, competitively selects students to engage in research projects working with mentors at NASA centers.	--
	--GSRP, the Graduate Student Researchers Program, provides fellowships to Master's and Doctoral graduate students who are studying disciplines aligned with NASA mission requirements.	--
Informal Education	Programs engage the public & education community through partnerships with informal education institutions (science centers, museums, planetaria, community organizations).	--
	--Explorer Institutes is a program to provide engaging NASA experiences and information to the informal education community, including science centers, museums, and planetariums.	--
Educational technology	Programs research and develop products and services facilitating the application of technology to enhance the educational process for formal and informal education.	--
	--The Classroom of the Future (CoTF) is NASA's primary research and development program for educational technologies that bridge the gap between educators, NASA explorers, and researchers.	--
	--Spacelink provides electronic access to all NASA educational materials and resources.	--
	--Educator Resource Centers (ERC) are located at universities or other educational organizations in each state and provide teachers with physical access to NASA materials.	--
Student Support	Programs enhance the student pipeline, creating a culture of achievement with opportunities based on NASA's unique missions, and improve STEM instruction with unique teaching tools and experiences.	--
	--The Educator Astronaut program will select teachers and transport them into space to inspire and motivate students.	--

Schedule	FY 2005 President's Budget	Change from Baseline
NASA Explorers Institute	Implement pilot program	--
Educator Astronaut	Core operations at Johnson Space Center	--
NASA Explorer Schools	Program fully implemented	--
NASA Science and Technology Scholarship	Implement pilot program	--

Acquisition Strategy and Performing Organizations

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 2004 President's Budget: None.

Current Acquisition	Actual*	Selection Method	Actual*	Performer	Actual*
Cooperative Agreement	23%	Full & Open Competition	62%	Industry	0%
Cost Reimbursable	0%	Sole Source	38%	Government	0%
Fixed Price	4%		100%	NASA Intramural	0%
Grants	68%			University	62%
Other	5%	Sci Peer Review	95%	Non Profit	38%
* as of FY03 direct procurement	100%	* as of FY03 direct procurement		* as of FY03 direct procurement	100%

Future Acquisition - Major	Selection	Goals
Science & Technology Scholarship Management Contract	Summer 2004	100% Full & Open Competition, Peer Review

Theme: Education Programs

Education

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 FY04 Pres. Budget: None.

INDEPENDENT REVIEWS

Review Types	Performer	Last Review Date	Next Review Date	Purpose
Program review	External Panel	9/03	9/04	Review/evaluate programs according to new direction.

BUDGET

Budget Authority ($ millions)	FY 2003	FY 2004	FY 2005	Comments
FY2005 PRESBUD	114.6	137.1	77.7	
Base Program	114.6	137.1	77.7	
Changes since 2004 PRESBUD	+53.0	+58.8		
Base Program	+58.0	+72.5		Full cost adjustment. Includes FY04 new initiatives.
New Initiative	-5.0	-13.7		FY04 new initiatives funding rolled into Base Program for FY05.
FY2004 PRESBUD	61.6	78.3		
Base Program	56.6	64.6		
New Initiative	5.0	13.7		

Indicates changes since the previous year's President's Budget Submit

Indicates budget numbers in full cost.

NASA inspires the next generation of explorers.

THEMES

Education Programs

EDUCATION

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; NASA must capitalize on that interest to provide meaningful education programs that will benefit the Agency and the Nation. To meet this challenge, education has become a core part of NASA's mission, and education programs are an integral part of every major NASA activity. To ensure a pipeline of highly trained people to meet mission requirements, NASA must motivate students to pursue careers in science, technology, engineering, and mathematics; provide educators with unique teaching tools and compelling teaching experiences; ensure that public resources are invested wisely; and fully engage minority and underrepresented students, educators, and researchers in NASA's education programs. The Education Enterprise will strive to reach every young person in the Nation to inspire the next generation of scientists, inventors, technicians, and explorers.

THEME DISTRIBUTION

Budget Authority ($ in millions)	FY 2003	FY 2004	FY 2005
Education Programs	198.6	226.3	168.5
Total	198.6	226.3	168.5

Note: For all formats, the FY 2003 column reflects the FY 2003 Congressional Operating Plan, dated 9/04/03. The FY 2004 column reflects the FY 2004 Conference committee report. The FY 2005 column represents the FY 2005 President's Budget Submit.

Indicates budget numbers in full cost

Education Programs

The Education Enterprise will provide unique teaching and learning experiences, as only NASA can, through the Agency's research and flight missions. Students and educators will be able to work with NASA and university scientists to use real data to study Earth, explore Mars, and conduct 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, the Education Enterprise's programs pay particular attention to under-represented groups. NASA Education will support the 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.

OVERALL BUDGET

The FY 2005 request is $168.5 million, a $57.8 million (or 26 percent) decrease from the FY 2004 President's Request (as amended by likely enacted Conference committee report):

- $77.7 million is requested for education programs, including the continuation of pipeline programs for students at all educational levels and the continuation of the Space Grant and EPSCOR programs, providing a national link with the higher education community.
- $90.8 million is requested for minority university research and education, including funding opportunities for minority institutions to expand NASA's scientific and technical base through partnerships with Historically Black Colleges and Universities (HBCUs), Hispanic Serving Institutions (HSI), Tribal Colleges and Universities (TCU), and Other Minority Universities (OMUs).
- Another estimated $70 million in education-related funding is managed by the NASA scientific and technical Enterprises, in coordination with the Education Enterprise.

PATHFINDER INITIATIVES

The FY 2005 request includes $27.4 million to continue initiatives begun in FY 2003 or FY 2004:

- $2.1 million is requested for the Educator Astronaut program, which will select teachers and transport them into space to inspire and motivate students.
- $13.7 million is requested for the NASA Explorer Schools program, which will provide target middle schools with a customized and sustained learning environment using NASA's most recent discoveries and latest technologies to encourage greater interest in science and engineering careers.
- $9.5 million is requested for the Science and Technology Scholarship program that will link scholarship with service at NASA Centers and help NASA better attract top students into its workforce.
- $2.1 million is requested for Explorer Institutes, NASA's direct link with the informal education community (science centers, museums, planetaria, and other informal education institions) through openly competed grants.

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, and environmentally-friendly air transportation system.

Aeronautics Technology

MAJOR EVENTS IN FY 2005

- Demonstrate 70% reduction in nitrous oxides emissions in full-scale tests of combustor configurations suitable for a large subsonic vehicle.
- Demonstrate integrated technologies and polices that would allow routine UAV flight operations in the National Airspace System above an altitude of 40,000 feet.
- Complete Human in the Loop concept and technology evaluation of shared aircraft separation.
- Conduct experimental flight evaluation of key Small Airplane Transportation System enabling technologies.
- Accomplish objective of developing technologies that will enable a 50% reduction in the fatal accident rate from the 1991-1996 level.

Theme: Aeronautics Technology

OVERVIEW

From the Wright Flyer in 1903 to the jet transports of today, our Nation progressed from a single flight to over 25,000 each day. 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. As a result of the research and technology developed by NASA and its National Advisory Committee for Aeronautics, NASA has achieved this level of performance. The critical role of aviation has brought with it 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 or government partners cannot address on their own.

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 continue to work closely and partner with the Department of Defense (DoD), the Department of Transportation (DoT), the Federal Aviation Administration (FAA), the Department of Homeland Security, the Transportation Security Administration, 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 these Goals
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, reduce the vulnerability of the air transportation system to hostile threats, and mitigate the consequences of accidents and hostile acts.
		2.2 Protect local and global environmental quality by reducing aircraft noise and emissions.
		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 through partnerships with DoD, the Department of Homeland Security and other U.S. or international government agencies.
To Inspire the Next Generation of Explorers	7. Engage the public in shaping and sharing the experience of exploration and discovery.	7.1 Improve public understanding and appreciation of science and technology, including NASA aerospace technology, research, and exploration missions.
Exploration Capabilities	10. Enable revolutionary capabilities through new technology.	10.5 Create novel aeronautics concepts and technology to support science missions and terrestrial and space applications.

RELEVANCE

Over the last century, aviation has evolved to become an integral part of our economy, a cornerstone of national defense, and an essential component of our way of every-day life. Aviation generates more than $1 trillion of economic activity in the United States every year. Military aviation forms the backbone of our national security strategy, as was demonstrated again in the Iraq conflict. 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 Nation and overseas are reaching full capacity. In 1998, airline delays in the U.S. cost industry and passengers $4.5 billion, the equivalent of a seven percent tax on every dollar collected by all the domestic airlines combined. Concerns over environmental issues such as aircraft noise and emissions are preventing the construction of additional airports and runways. NASA's investment in the Aeronautics Technology Theme plays a key role in developing the technologies that are necessary to solve these problems and create a safer, more secure, environmentally friendly, and efficient national aviation 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 advance aviation, the U.S. 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 the Nation. These challenges are intensified by the demand for safety, security, and increased capacity in highly complex aerospace systems while reducing the environmental impact of aviation operations.

Theme: Aeronautics Technology

Education and Public Benefits

The technologies that are being developed by the Aeronautics Technology Enterprise will enable a future where individuals have on-demand, as well as scheduled air mobility that will allow the public in both rural and urban areas to travel where they want, when they want, faster, safer, and 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 where the security of commercial aircraft operations is not a concern. 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 comprises three programs that are developing, demonstrating, and transferring the highest priority research and technology toward these opportunities. The Aviation Safety and Security program addresses 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 targets ground- and aircraft-based capabilities to increase the capacity and mobility of the Nation's air transportation system. In collaboration with the FAA, research in air traffic management technologies will develop new automation tools and concepts of operations and entirely new paradigms for air transportation management. The Vehicle Systems program is focused on the development of breakthrough air vehicle technologies, including advanced propulsion technologies, lightweight high-strength adaptable structures, adaptive controls, advanced vehicle designs, and new collaborative design and development tools. Technologies are targeted for all aircraft types, including subsonic, supersonic, and general aviation aircraft, extremely short-takeoff and landing aircraft, and unmanned aerial vehicles.

The Office of Aeronautics (OA) Enterprise Program Management Council has governing responsibility. The NASA Official is Dr. J. Victor Lebacqz, Associate Administrator, OA. The Aeronautics Technology Theme Director is Terrence J. Hertz, Director, Aeronautics Technology, OA.

Theme: Aeronautics Technology

IMPLEMENTATION SCHEDULE

Theme Element	Schedule by Fiscal Year 95 96 97 98 99 00 01 02 03 04 05 06 07 08 09	Purpose
2.2.2 - VS - Reduce Aviation NOx emission by 70% (re: 1996 ICAO standard)		Develop, demonstrate, and transfer technologies that improve local air quality and our global environment by enabling a significant reduction in emissions from aviation operations.
3.1.5 - VS - Develop technology both to and from the DoD		Development of technologies, in partnership with the DoD, to enhance National defense
2.1.1. Aviation Safety and Security - 50% reduction in fatal accident rate		Develop, demonstrate, and transfer technologies that will enable the reduction of the aviation fatal accident rate by 50% from the 1991-96 average to make a safe air transportation system even safer.
2.1.2 - AvSSP - Hostile Act Intervention		Develop, demonstrate, and transfer technologies that increase resiliency of the air transportation system against threats and hostile acts.
2.1.3a. - AvSSP - System Vulnerability Discovery and Management		Develop, demonstrate, and transfer technologies that identify and inform users of potential air transportation system vulnerabilities.
2.1.3b - AvSSP - Aircraft Self-Protection and Preservation		Develop, demonstrate, and transfer technologies that protect and prevent damage to aircraft due to abnormal operations and system failures.
2.1.3c - AvSSP - Human Error Avoidance (in formulation)		Develop, demonstrate, and transfer technologies that prevent unsafe flight situations due to breakdown between human and machine interface.
2.1.3d - AvSSP - Environmental Hazard Awareness & Mitigation (in formulation)		Develop, demonstrate, and transfer technologies that detect and/or eliminate natural hazards that could compromise safe Air Transportation System operations.
2.2.3 - VS - Reduce Aviation CO2 emissions by 25% (from 2000 SOA)		Develop, demonstrate, and transfer technologies that improve local air quality and our global environment by enabling a significant reduction in emissions from aviation operations.
3.1.3 AvSSP - Establish a joint technology roadmap with the DHS and the FAA		Reduce the vulnerabilty of the Air Transportation System to criminal and terrorist actions
2.2.1a - VS Reducing aviation noise by 20dB (re: 1997 SOA)		Develop, demonstrate, and transfer technologies to enable the reduction of perceived aircraft noise to improve the quality of life for airport neighbors.
2.2.2a - VS - Reduce Aviation NOx emission by 90% (re. 1996 ICAO standard)		Develop, demonstrate, and transfer technologies that improve local air quality and our global environment by enabling a significant reduction in emissions from aviation operations.
2.2.3a - VS - Reduce Aviation CO2 emissions by 45%		Develop, demonstrate, and transfer technologies that improve local air quality and our global environment by enabling a significant reduction in emissions from aviation operations.
10.5.1 - VS - Enable new HALE ROA missions		Develop technologies that enable HALE ROA to remain aloft for weeks and be used as "sub-orbital" satellites for science missions
10.5.2 - VS - Routine HALE ROA operations in the national airspace system, above 18,000 feet		Develop, demonstrate & transfer technologies that enable routine NAS access for ROAs in pursuit of homeland security, disaster management and economic growth.
Demonstrate hypersonic flight with air breathing propulsion.(X-43A)		Develop and demonstrate the world's first flight of a scramjet-powered vehicle (X-43 A) to Mach 7.
2.3.3a. - AS - Conduct trade-off analyses for future national airspace system concepts		Model and simulate the national airspace system, and explore the next generation of advanced operational concepts.
2.3.2 -AS - Enable increased utilization of local and regional airports		Provide technical basis for decisions regarding the use of small untowered airports to enhance mobility
2.3.3g -AS - Human Measures and Performance		Develop design standards, guidelines, recommended practices, recommended applications, methods, and technologies for applying human performance and human/system measures. Focus on human interaction, performance and reliability in the design of complex airspace systems.
2.3.3c -AS - Efficient Aircraft Spacing		Develop, demonstrate, and transfer technologies to aid individual aircraft in maintaining safe separation and efficient traffic flow within the NAS
2.3.3d -AS - Efficient Flight Path Management		Develop, demonstrate, and transfer tactical integrated and airborne traffic management decision support tools to evolve the National Airspace System toward the envisioned Future NAS
2.3.3b - VS Enable a 30% increase in aircrft efficiency (re: 2000 SOA)		Improve mobility by expanding the availability of air travel to a greater fraction of the population.
2.3.3e -AS - Strategic Airspace Usage		Develop strategic planning tools for Air Traffic Control System Command and Control (ATCSCC) and Air Operations Carriers (AOCs), and integrate assessment capability functions into the FAA TFM architecture.
2.3.3f - AS - Space-Based Technologies: communications, navigations and surveillance technologies / architectures		Develop demonstrate, and transfer communications, navigation, and surveillance technologies, architectures, and systems to improve efficient operations of the NAS.
2.2.1 -VS - Reducing aviation noise by 10dB (re: 1997 SOA)		Develop, demonstrate, and transfer technologies to enable the reduction of perceived aircraft noise to improve the quality of life for airport neighbors.

Tech & Adv Concept | Development | Operations | Research

The programs within the Aeronautics Technology theme are compliant with NPG 7120.5B.

Theme: Aeronautics Technology

STATUS

Aviation Safety Program:

- Performed ground-based validation testing on fire/explosion protection systems, and evaluation of assembled systems in partially simulated in-flight environment;
- Conducted simulation and flight-test evaluation of low-cost forward-fit and retrofit synthetic vision systems technologies for general aircraft;
- Reviewed a preliminary operational concept for security technologies and developed a vulnerability assessment of the aircraft and system.

Airspace Systems Program:

- Demonstrated initial functionality, and evaluated human factors for an active decision support tool for complex airspace, the, Multi-Center Traffic Management Advisor, which will enable the more efficient management of arrival flows using highly accurate time-based metering across multiple air route traffic control centers;
- Demonstrated initial functionality of a non-real time system wide modeling system for the national air space, providing multi-objective (capacity, safety, cost) trade space analysis of air traffic management. The architecture is designed to be flexible and extensible to capture and analyze system-wide effects, including network effects for propagation of delays, as well as represent the operating environment (e.g. weather, turbulence, wake vortices) and new airspace structures and traffic management and control rules.

Vehicle Systems Program:

- Completed engine testing of coated polymer matrix composites (PMC) inlet guide vanes to demonstrate coating performance and resistance to erosion. This technology demonstrated the potential to more than double the life of the PMC fan inlet guide vanes, the use of the PMC in components such as guide vanes, contribute to reduction of the overall propulsion system weight thereby improving the thrust-to-weight ratio of the engine and reducing the carbon dioxide production;
- Investigated the use of non-circular inlets mounted over the top of wings to enable a breakthrough capability in next generation subsonic aircraft. The goal was to minimize the effects of flow distortion at the engine face using active flow control. In these inlets a large boundary layer is ingested into the inlet, which distorts the flow before it reaches the engine and reduces inlet efficiency, the baseline inlet produced a total flow distortion of 29 percent. With active flow control enabled, this distortion is reduced to 13 percent.

PERFORMANCE MEASURES

Outcomes/Annual Performance Goals (APGs)	
Outcome 2.1.1	*By 2005, research, develop, and transfer technologies that will enable the reduction of the aviation fatal accident rate by 50% from the FY 1991-1996 average.*
5AT1	Evaluate and flight validate selected next generation cockpit weather information, communications, airborne weather reporting, turbulence prediction and warning technologies, Synthetic Vision System and Runway Incursion Prevention System display concepts. The flight demonstration will illustrate the increased safety of integrating selected concepts in support of fleet implementation decisions. (AvSSP)
5AT2	Demonstrate through applications and simulations safety-improvement systems that will illustrate the increased safety of integrating selected concepts in support of fleet implementation decisions. (AvSSP)
Outcome 2.1.2	*By 2009, research, develop & transfer technologies that will reduce the vulnerability exposure of the aircraft, and reduce the vulnerabilities of other components in the air transportation system.*
5AT3	Create and establish a prototype data collection system for confidential, non-punitive reporting on aviation security by functional personnel in the aviation system.
5AT16	Develop a preliminary joint research plan with the Transportation Security Administration (TSA). (AvSSP)
Outcome 2.2.1	*By 2007, develop, demonstrate and transfer technologies that enable a reduction by half, in community noise due to aircraft, based on the 1997 state of the art.*
5AT4	Using laboratory data and systems analysis, complete selection of the technologies that show the highest potential for reducing commercial air transportation noise by at least 50%. (Vehicle Systems)
Outcome 2.2.2	*By 2007, develop, demonstrate and transfer technologies for reducing NO_x emission by 70% from the 1996 ICAO standard, to reduce smog and lower atmospheric ozone.*
5AT5	Demonstrate 70% reduction NO_x emissions in full-annular rig tests of candidate combustor configurations for large subsonic vehicle applications (Vehicle Systems).
Outcome 2.2.3	*By 2007, develop, demonstrate and transfer technologies for reducing the green-house gas, CO_2, emissions by 25% based on the state of the art for airframe and engine component technologies in 2000.*
5AT6	Based on laboratory data and systems analysis, select unconventional engine or power systems for technology development that show highest potential for reducing CO_2 emissions and/or enabling advanced air vehicles for new scientific missions. (Vehicle Systems)

Theme: Aeronautics Technology

Outcomes/Annual Performance Goals (APGs)	
5AT7	Complete laboratory aerodynamic assessment of low-drag slotted wing concept. (Vehicle Systems)
5AT19	Complete supersonic inlet design requirements study that will identify technology gaps and priorities required for design of future efficient long range supersonic propulsion systems. (Vehicle Systems)
5AT27	Demonstrate through sector testing a full scale CMC turbine vane that will reduce cooling flow requirements and thus fuel burn in future turbine engine system designs. (Vehicle Systems)
Outcome 2.3.2	*By 2005, develop, demonstrate and transfer key enabling capabilities for a small aircraft transportation system.*
5AT10	Complete experimental validation of airborne systems with concept vehicle development
Outcome 2.3.3	*By 2009, develop, demonstrate, and transfer technologies that enable a further 5% increase in throughput in the terminal area and a further 10% increase in en route throughput based on 1997 NAS capacity.*
5AT8	Complete development of WakeVAS concept of operations and downselect WakeVAS architecture.
5AT9	Complete human-in-the-loop concept and technology evaluation of shared aircraft separation. (Airspace Systems)
5AT11	Complete analysis of capacity-increasing operational concepts and technology roadmaps with VAST models, simulations, and Common Scenario Set. (Airspace Systems)
5AT12	Develop display guidelines that exploit new understanding of perceptual systems and cognitive and physiological determinants of human performance. (Airspace Systems)
5AT13	Establish the fluid dynamics mechanism for alleviating wake through experimental and computational fluid mechanics studies. (Airspace Systems)
5AT14	Complete System-Wide Evaluation and Planning Tool initial simulation and field demonstration. (Airspace Systems)
5AT15	Complete communications, navigation, and surveillance requirements analysis. (Airspace Systems)
5AT22	Using laboratory data and systems analysis, complete selection of the technologies that show the highest potential for reducing takeoff/landing field length while maintaining cruise Mach, low speed controllability and low noise. (Vehicle Systems)
Outcome 3.1.5	*Transfer technology both to and from the Department of Defense.*
5AT17	Complete NASA / Industry / DoD studies of heavy-lift Vertical Take Off and Landing (VTOL) configurations to provide strategic input for future decisions on commercial / military Runway Independent Vehicles. (Vehicle Systems)
Outcome 7.1.4	*Engage the public in NASA missions, discoveries and technology through public programs, community outreach, mass media, and the Internet.*
5AT18	Partner with museums and other cultural organizations and institutions to engage non-traditional audiences in NASA missions.
Outcome 10.5.1	*Develop technologies that will enable solar powered vehicles to serve as “sub-orbital satellites” for science missions.*
5AT20	Complete flight demonstration of a second generation damage adaptive flight control system. (Vehicle Systems)
5AT21	Define requirements for a robust, fault-tolerant avionics architecture that supports fully autonomous vehicle concepts. (Vehicle Systems)
5AT24	Complete laboratory aerodynamic assessment of low-drag slotted wing concept. (Vehicle Systems)
5AT25	Based on laboratory data and systems analysis, select unconventional engine or power systems for technology development that show highest potential for reducing CO2 emissions and/or enabling advanced air vehicles for new scientific missions. (Vehicle Systems)
5AT26	Complete initial flight series for validation of improved HALE ROA aero-structural modeling tools used to reduce risk and increase mission success. (Vehicle Systems)
Outcome 10.5.2	*By 2008, develop and demonstrate technologies required for routine Unmanned Aerial Vehicle operations in the National Airspace System above 18,000 feet for High-Altitude, Long-Endurance UAVs.*
5AT23	Demonstrate integrated technologies and policies for UAV flight operations above 40,000 feet. (Vehicle Systems)
Uniform Measures	
5AT28	This Theme will complete 90% of the major milestones planned for FY 2005.

Theme: Aeronautics Technology

INDEPENDENT REVIEWS

Review Types	Performer	Last Review Date	Next Review Date	Purpose
Quality	NRC / ASEB	2/03	2/06	Assess the scientific and technical quality.
Relevance	ATAC	9/03	2/04	Assess the relevance of the Aerospace research.
Performance	EPMC and Agency PMC	11/03	1/04	Quarterly Status Reviews by Enterprise and Agency Program Management Councils.

BUDGET

Budget Authority ($ millions)	FY2003	FY 2004	Change	FY 2005	Comments
Aeronautics Technology	**599.1**	**1,034.3**	**-115.1**	**919.2**	
Development	26.8				
Hyper-X (X-43-A)	26.8				
Technology and Advanced Concepts	572.3	1,034.3	-115.1	919.2	
Aviation Security and Safety Program (AvSSP)	93.6	180.0	+8.0	188.0	Full Cost Adjustment
Airspace Systems Programs	145.4	233.9	-79.5	154.4	No Congressional Interest Items
Vehicle Systems Program	333.3	620.4	-43.6	576.8	No Congressional Interest Items

Indicates changes since the previous year's President's Budget Submit.

Indicates budget numbers in full cost.

Theme: Aeronautics Technology
Technology and Advanced Concepts: Aviation Security and Safety Program (AvSSP)

PURPOSE

Objectives	Performance Measures
2.1, 7.1	5AT1-3,16,18

AvSSP directly addresses the safety and security research and technology needs of the Nation's airspace system to either prevent the unintentional and intentional actions that would cause damage, harm, and loss of life or mitigate the consequences when these types of situation occur. AvSSP conducts prevention, intervention, and mitigation research, and develops technologies and strategies aimed at one or more causal, contributory, or circumstantial factors associated with aviation accidents and systems vulnerability to criminal and terrorist attacks while dramatically improving the efficiency of such protections. High priority is given to strategies that address factors determined to be the largest contributors to accident, vulnerability, and fatality rates, as well as those that address multiple classes of factors. The AvSSP also develops and integrates information technologies needed to build a safer aviation system, which will support the needs of both pilots and air traffic controllers, as well as providing information to assess situations and trends that might indicate unsafe conditions before they lead to accidents or security incidents. The AvSSP research and technology planning activities are conducted in close coordination with the FAA and DHS.

OVERVIEW

The goal and objectives of the AvSSP are established in the NASA Strategic Plan. In the NASA 2000 Strategic Plan, which was the governing document at the initiation of program implementation, the Aeronautics Enterprise formulated a safety objective to "Make a safe air transportation system even safer." The plan further established the following safety performance metrics: Reduce the aircraft fatal accident rate 80% within 10 years and 90% within 25 years.

Based on this safety performance metric, the AvSSP goal for the FY 2000 through FY 2005 time period is the following: develop and demonstrate technologies that contribute to a reduction in the aviation fatal accident rate by a factor of 5 by the year 2007. With the intent of addressing aviation security research and technology needs, the scope of the program was expanded in the NASA 2003 Strategic Plan to include activities targeted at the aviation security applications beginning in FY 2004. Therefore, a new NASA objective was created to cover both safety and security research: "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."

Specific safety performance goals and metrics for activities beginning in FY 2006 are under formulation. Security performance goals and metrics are being developed in partnership with the Department of Homeland Security.

To address the existing and projected objectives in aviation safety and security, the AvSSP has established strategic foci within which all safety and security research activities will be conducted. These foci and the Themes for research in each are as follows: 1) Hostile Act Intervention and Protection -Increase resiliency of the ATS against threats and hostile acts; 2) System Vulnerability Discovery and Management -Identify and inform users of potential ATS vulnerabilities; 3) Aircraft Self-Protection and Preservation -Protect and prevent damage to aircraft due to abnormal operations and system failures; 4) Human Error Avoidance -Prevent unsafe flight situations due to breakdown between human and machine interface; and, 5) Environmental Hazards Awareness and Mitigation -Detect and/or mitigate natural hazards that could compromise safe ATS operations.

PROGRAM MANAGEMENT

AvSSP is a multiple-project program within the Aeronautics Technology Theme. The Aeronautics Enterprise Program Management Council has AvSSP governing responsibility. The NASA Enterprise official is Dr. J. Victor Lebacqz, Associate Administrator, Office of Aeronautics. The Aeronautics Technology Theme Director is Terrence J. Hertz, Director, Aeronautics Technology, OA. The Program Manager is George Finelli, OA, hosted at the Langley Research Center. The program is compliant with NPG 7120.5b.

Theme: Aeronautics Technology

Technology and Advanced Concepts: Aviation Security and Safety Program (AvSSP)

TECHNICAL COMMITMENT

The baseline for this technical commitment is the FY2005 budget request.

Technical Specifications		FY 2005 President's Budget							Change from Baseline
		FY03	FY04	FY05	FY06	FY07	FY08	FY09	
Develop and demonstrate technologies that prevent unsafe flight situations due to breakdown between human and machine interface. (In formulation/Safety Follow-on)	TRL				3	3	4	5	--
	$M				35.80	35.50	42.80	39.00	--
Develop safety relevant technologies to detect and/or eliminate natural hazards that could compromise safe ATS operations. (In formulation/Safety Follow-on)	TRL				2	3	4	4	--
	$M				17.60	18.50	20.40	19.90	--
Develop and advance technologies that will identify and inform users of potential ATS vulnerabilities. (In formulation/Security SVD)	TRL		3	4	4	5	5	6	--
	$M		4.00	12.10	35.30	36.70	35.90	35.30	--
Develop and advance airborne technologies to protect and prevent damage to aircraft due to abnormal operations and system failures. (in formulation/Safety Follow-on)	TRL				3	3	4	4	--
	$M				40.40	40.90	40.40	49.10	--
Develop enabling technologies providing accurate, timely, and intuitive info during the en-route phases of flight to the flight deck to enable the detection and avoidance of atmospheric hazard.	TRL	4	5	6					--
	$M	13.10	26.70	22.80					--
Develop enabling technologies presenting accurate & timely (as verified by flight and ground experimentation) atmospheric turbulence hazard products to pilots, dispatchers, and ATC.	TRL	4	5	6					--
	$M	5.30	10.90	9.30					--
Develop a GA situational awareness enhancement system, utilizing database with display symbology and precise GPS navigational info. to create synthetic views of the current external environment.	TRL	4	5	6					--
	$M	2.70	5.20	5.80					--
Develop a commercial/business aircraft situational awareness enhancement system utilizing database, sensor and hazard detection technologies merged with display symbology and precise GPS navigation.	TRL	5	5	6					--
	$M	13.20	25.80	28.00					--
Demonstrate improved training modules, maintenance procedures, projected to reduce targeted human errors.	TRL	4	5	6					--
	$M	10.00	10.30	7.40					--
Demonstrate in flight Health and Usage Monitoring technologies for commercial transport aircraft.	TRL	4	5	6					--
	$M	23.40	27.00	32.80					--
Develop advanced structures, materials, and system designs, projected to improve crash survivability and fire hazard mitigation.	TRL	5	5	6					--
	$M	4.10	5.70	2.60					--
Develop design and analysis tools, ice protection systems technologies, and education and training tools for design, certification, and operation of aircraft.	TRL	3	3	4					--
	$M	8.70	17.80	18.10					--
Demonstrate integrated aviation system monitoring tools and infrastructure design to provide advanced indication of conditions that could lead to accidents.	TRL	3	5	6					--
	$M	13.10	21.70	17.80					--
Develop and advance technologies that increase resiliency of the ATS against threats and hostile acts. (In formulation/Security ASVM)	TRL		3	4	4	5	5	6	--
	$M		16.60	31.60	46.00	46.40	34.20	35.90	--

Schedule	FY 2005 President's Budget	Baseline	Change from Baseline
Complete Integrated Program Assessment	September 2004	September 2004	--
Complete Preliminary Aviation Security Concept of Operation	December 2004	December 2004	--
Test prototype Security Incident Report System at selected airports	December 2004	December 2004	--
Complete future Safety Operational Concept Scenarios	June 2005	June 2005	--
Validate Aviation Safety technology enabling 50% reduction in fatal accident rate	June 2005	June 2005	--

Acquisition Strategy and Performing Organizations

Leverage NASA's research and development investments through the use of cooperative agreements and cost-shared contracts whenever possible, maximize the impact of the deliverables and use NASA R&D as a catalyst for a national investment in key safety enhancing technologies. AvSSP will use standard competitive procurements when purchasing items where required specifications are known. NASA Research Announcements (NRAs) will be used to encourage new and creative approaches to technology challenges, when it is difficult to define detailed specifications. Multiple awards of grants, contracts, cost-shared contracts, and cooperative agreements may result from one solicitation. AvSSP will use the competitive NRA process to: stimulate cost-sharing from industry; leverage public and private R&D Programs and resources; and accelerate technology commercialization through broad technical teams capable of solving both the technical hurdles and the implementation and certification issues.

Current Acquisition	Actual*	Selection Method	Actual*	Performer	Actual*
Cooperative Agreement	20%	Full & Open Competition	95%	Industry	53%
Cost Reimbursable	50%	Sole Source	5%	Government	2%
Fixed Price	25%		100%	NASA Intramural	30%
Grants	5%			University	5%
Other	0%	Science Peer Review	%	Non Profit	10%
*As of FY 2003 direct procurement	100%	*As of FY 2003 direct procurement		*As of FY 2003 direct procurement	100%

Future Acquisition	Selection	Goals
Annual NASA Research Announcement	FY 05/06	100% Open Competition seeking cost and technology
Grants	FY 05/06	100% Open Competition seeking universities research studies
Interagency Agreements	FY 05/06	Increase use of other government agencies expertise

Agreements

Internal: The program is not dependent on other NASA activities outside of the control of the AA, Office of Aeronautics 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 Centers, March 1997; 4) Memorandum of Understanding #FNA/08 between the FAA and NASA concerning Aviation Safety Research, 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 #FNA/08-02-01 between the FAA and NASA concerning the Development and Evaluation of Enhanced Situational Awareness Technologies, June 2002; 9) Cooperative Agreements with Rannoch, Research Triangle Institute, Ohio University, Rockwell Collins, Jeppesen., and Honeywell International; 10) MoA with Department of Energy (Los Alamos Laboratories); and 11) MoA under development with Department of Homeland Security.

Theme: Aeronautics Technology
Technology and Advanced Concepts: Aviation Security and Safety Program (AvSSP)

RISK MITIGATION

Risk Date: 8/1/2003

Top Risks	G	Overall	G	Cost	G	Schedule	G	Technical	Probability	Impact	Mitigation Plan
G	Loss of critical workforce								moderate	moderate	in place
G	Agency reprioritization of R&D funds								moderate	moderate	in place
G	Loss of critical facilities								high	high	in place
G	Failure to gain acceptance of program output by users								moderate	moderate	in place

INDEPENDENT REVIEWS

Review Types	Performer	Last Review Date	Next Review Date	Purpose
Performance	IPAO	11/01	1/04	Assess the program performance against the approved program plan.
Quality	NRC/ASEB	2/03	2/06	Assess scientific and technical quality of the program against the current SOA.
Relevance	ATAC	6/03	2/04	Assess the relevance of the program to the potential end-users.

BUDGET

Budget Authority ($ millions)	FY 2003	FY 2004	FY 2005	Comments
FY2005 PRESBUD	93.6	180.0	188.0	
Vehicle Safety Technologies (VST)	50.0	75.7	77.8	
System Safety Technologies (SST)	23.8	30.8	21.4	Transfer to Vulnerability Mitigation
Weather Safety Technologies (WST)	19.9	45.0	44.3	
Aircraft & Systems Vulnerability Mitigation		24.9	35.5	Transfer from SST [above]
System Vulnerability Detection		1.6	5.7	
Technical Integration		2.0	3.3	
Changes since 2004 PRESBUD	-1.4	+11.5		
Vehicle Safety Technologies (VST)	+0.2	+1.2		Congressional Interest Item
System Safety Technologies (SST)	-0.5	-0.3		Transfer to Vulnerability Mitigation
Weather Safety Technologies (WST)	-1.0	+2.7		Congressional Interest Item
Aircraft & Systems Vulnerability Mitigation		+24.9		Transfer from AST [below]
System Vulnerability Detection		+1.6		Congressional Interest Item
Technical Integration		+2.0		Congressional Interest Item
Aviation Securities Technologies (AST)		-20.6		Transfer to Vulnerability Mitigation
FY2004 PRESBUD	95.0	168.5		
Vehicle Safety Technologies (VST)	49.8	74.5		
System Safety Technologies (SST)	24.3	31.1		
Weather Safety Technologies (WST)	20.9	42.3		
Aviation Securities Technologies (AST)		20.6		

Indicates changes since the previous year's President's Budget Submit.
Indicates budget numbers in full cost.

Theme: Aeronautics Technology
Technology and Advanced Concepts: Airspace Systems Programs

PURPOSE

Objectives	Performance Measures
2.1, 2.3, 7.1	5AT8-9,11-16,18

The AS program enables 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. The primary goal of the 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. This plan provides the details for the development and transition of ATM R&D from NASA to the FAA as technologies mature.

OVERVIEW

The AS Program is one of three programs within the Aeronautics Technology Theme. The AS program has identified strategic foci to guide the program toward the vision outlined in the NASA Aeronautics Blueprint. The three AS program strategic foci are: 1) Efficient Traffic Flow -Operations of individual aircraft within the NAS for efficiency of operations; 2) System-Wide Operations Technologies -Efficient operation of the NAS as an overall nation-wide system with global interaction; and 3) Airspace Human Factors -Human interaction, performance and reliability in the design of complex airspace systems. The AS Program is composed of the following projects: Advanced Air Transportation Technologies (AATT); Virtual Airspace Modeling and Simulation (VAMS); Small Aircraft Transportation System (SATS); Human Measures and Performance (HMP); Efficient Aircraft Spacing (EAS); Efficient Flight Path Management (EFPM); Strategic Airspace Usage (SAU); and Space-Based Technology (SBT). These eight projects map into the strategic foci as follows: Efficient Traffic Flow (AATT, EAS, EFPM); System-Wide Operations Technologies (VAMS, SATS, SAU, SBT); and Airspace Human Factors (HMP).

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 SATS project develops technology to enable small aircraft to operate at non-towered, non-radar small airports. The HMP project, formerly the Airspace Operations Systems project, develops fundamental knowledge, models, and tools for the efficient and safe operation of aviation systems by their human operators. In FY02, the Airspace Systems Program Office began project advocacy/formulation for an FY04 NASA Exploratory Technologies for the National Airspace System initiative. Planning efforts for this FY04 program augmentation has resulted in four new projects (EAS, EFMP, SAU, and SBT) and a new program-level cross-cutting effort, Technology Integration. The EAS project will develop technologies to aid individual aircraft in maintaining safe separation and efficient traffic flow within the NAS. The EFMP project will develop tactical traffic management tools to aid the controllers in maintaining efficient traffic flow. The SAU project will develop strategic traffic management tools and system-wide operations technologies to improve operation of the NAS as an overall nation-wide system. The SBT project will develop communications, navigation, and surveillance technologies, architectures, and systems to improve efficient operations of the NAS. Technology Integration, a program-level effort, will integrate technologies across project, domain, and infrastructure boundaries, and will conduct system studies and systems analyses.

PROGRAM MANAGEMENT

AS is a multiple-project program. The Aeronautics Enterprise Program Management Council has AS governing responsibility. The NASA Enterprise official is Dr. J. Victor Lebacqz, Associate Administrator, Office of Aeronautics (OA). The Aeronautics Technology Theme Director is Terrence J. Hertz, Director, Aeronautics Technology, OA. Program Manager is Robert Jacobsen, OA, hosted at Ames Research Center. The program is compliant with NPG 7120.5b.

TECHNICAL COMMITMENT

The FY 2005 budget request establishes the new baseline for the program.

Technical Specifications		FY 2005 President's Budget							Change from Baseline
		FY03	FY04	FY05	FY06	FY07	FY08	FY09	
Develop strategic planning tools for Air Traffic Service Providers and Airline Operations Centers, which reduce delays in the NAS while increasing system throughput	TRL		3	3	4	4	5	5	--
	$M		0.50	10.48	17.90	21.90	28.39	28.37	--
Integrate technologies across project, domain, and infrastructure boundaries, and conduct system studies and systems analyses	TRL		1	2	2	3	3	3	--
	$M		17.09	14.73	14.78	15.77	16.74	17.72	--
Develop advanced CNS technologies and architectures	TRL		1	2	2	3	3	4	--
	$M		6.35	18.59	25.60	32.42	38.90	38.89	--
Complete the development and technology transfer of ATM decision support tools (McTMA, D2, SMS) to FAA Free Flight 2 Program and complete validation and assessment of NASA-developed AATT products.	TRL	5	6						--
	$M	82.49	98.81						--
Develop and demonstrate vehicle technologies to enable increased utilization of local and regional airports	TRL	3	4	5	5				--
	$M	26.84	28.73	16.52	4.10				--
Develop future NAS operational concepts	TRL	1	2	2	3	3			--
	$M	9.30	12.30	12	12.70	12.30			--
Develop modeling and simulation capability/ environment to assess new operational concepts at the domain and system level	TRL	2	3	3	4	5			--
	$M	16.30	18.40	17.90	19	18.50			--
Develop human performance measurements and design standards	TRL	1	1	2	2	3	3	4	--
	$M	10.45	19.22	18.02	19.59	19.52	19.49	19.47	--
Develop wake vortex operation procedures and standards to increase safety and capacity in the terminal area	TRL		1	2	2	3	3	4	--
	$M		9.18	23.06	27.24	23.17	25.76	25.85	--
Develop and explore distributed air/ground traffic management concepts	TRL		1	2	2	3	3	4	--
	$M		4.99	12.48	9.83	15.11	16.23	18.27	--
Develop long-term decision support tools and strategic planning tools to evolve the NAS toward the envisioned future NAS	TRL		3	3	4	4	5	5	--
	$M		1.48	14.01	21.04	25.04	31.24	31.23	--

Schedule	FY 2005 President's Budget	Baseline	Change from Baseline
Vehicle Technologies - Initial SATSLab Flight Experiments Conducted (SATS)	Aug. 2004	Aug. 2004	--
Vehicle Technologies - System Integration Validated	June 2005	June 2005	--
Vehicle Technologies - SATS Technology Demonstration and Project Closeout	Sept. 2005	Sept. 2005	--
VA - Build 3 VAST toolboxes with cognitive human performance attributes and CNS	Aug. 2004	Aug. 2004	--
VA - Complete preliminary evaluation of selected operational concepts (R-T only)	Sept. 2005	Sept. 2005	--
Develop and evaluate Oceanic/Wide-Area Communications and Surveillance System	Sept. 2008	Sept. 2008	--
CNS - Space-based surveillance system concept validation	Sept. 2008	Sept. 2008	--
Wake Vortex - Complete ICAO-level Wake VAS performance assessment	Sept. 2009	Sept. 2009	--
Wake Vortex - Complete wake alleviation feasibility assessment	Sept. 2009	Sept. 2009	--
LT DST - Develop System-Wide Evaluation and Planning Tool (SWEPT)	Sept. 2005	Sept. 2005	--
LT DST - Develop and demonstrate Collaborative Traffic Management capabilities	Sept. 2008	Sept. 2008	--
LT DST - Complete development and demonstration of Advanced Routing Tool	Sept. 2008	Sept. 2008	--
LT DST - Development and demonstrate Advanced SMS decision support tool	Sept. 2008	Sept. 2008	--
LT DST - Integrate and demonstrate SWEPT into FAA TFM architecture	Sept. 2008	Sept. 2008	--

Schedule	FY 2005 President's Budget	Baseline	Change from Baseline
Human Perform - Develop situation displays for collaborative decision-making	Sept. 2008	Sept. 2008	--
Human Perform - Complete ATC, AOC, and flight-deck collaboration training module	Sept. 2008	Sept. 2008	--
Decision support tools to increase en-route and terminal throughput by 10%	Sept. 2004	Sept. 2004	--

ACQUISITION STRATEGY AND PERFORMING ORGANIZATIONS

The AS 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.

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 Technical Center; 2) DOT's Volpe Center; 3) Lincoln Laboratory; 4) MITRE CAASD; and 5) other FFRDCs. AS has selected a partner, National Consortium for Aviation Mobility for a joint venture to develop and demo air mobility technologies for small aircraft and airports.

Current Acquisition	Actual*	Selection Method	Actual*	Performer	Actual*
Cooperative Agreement	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	16%	Science Peer Review	%	Non Profit	9%
*As of FY 2003 direct procurement	100%	*As of FY 2003 direct procurement		*As of FY 2003 direct procurement	100%

Future Acquisition	Selection	Goals
Real-time simulation (VAMS)	Fall '04	
Non-real-time simulation (VAMS)	Oct '05	

AGREEMENTS

External: 1) MoU between FAA and NASA on "Airspace System User Operational Flexibility and Productivity," September 1995; 2) MoA between the FAA and NASA concerning Research on Airport Surface Operations in Reduced Visibility Weather Conditions, 1997; 3) MoA between FAA and NASA on the support of FAA R&D Field Offices Located at NASA Centers, March 1997; 4) MoA between the FAA Technical Center and NASA Ames Research Center on Air Traffic Management Research and Technology, June 20, 1998' 5) Agreement between FAA and NASA concerning a Partnership to Achieve Goals in Aviation and Future Space Transportation, October 9, 1998. 6. MoU between the DoT Volpe Center and ARC concerning Research, Design, Development and Demonstration of Aviation Concepts and Technologies, June 2001; 7) MoA #FNA/08-00-02 between FAA/William J. Hughes Tech. Center and NASA establishing a collaborative working relationship, November 27, 2000; 8) MoA #FNA/08-00-02 (IAI-536) Annex 001 between FAA/William J. Hughes Tech. Center (WJHTC) and NASA concerning National Airspace Systems Research and Testing Development SATS Program Activities, April 19, 2001; 9) MOU in development between LaRC and the DOT Volpe Center, establishing the shared and NASA-funded tasks for analysis of market, consumer, and community response issues related to SATS services, May 10, 2002; 10) JSRDA between LaRC and the National Consortium for Aviation Mobility on the SATS project, May 2002.

RISK MITIGATION

Risk Date: 8/6/2003

Top Risks	G	Overall	G	Cost	G	Schedule	G	Technical	Probability	Impact	Mitigation Plan
G	Some technical elements do not meet expected performance								moderate	moderate	in place
G	Customer requirements change								moderate	moderate	in place
G	Agency reprioritization of funding								moderate	moderate	in place
G	Partners do not meet resource commitments								high	high	in place
G	Inaccessibility to FAA field test sites								high	high	in place
G	Unavailability of critical R&D facilities								moderate	moderate	in place

Theme: Aeronautics Technology

Technology and Advanced Concepts: Airspace Systems Programs

Independent Reviews

Review Types	Performer	Last Review Date	Next Review Date	Purpose
Performance	IPAO	11/03	11/04	Assess the programmatic performance of the ASP against the approved program plan
Quality	NRC/ASEB	2/03	2/06	Assess scientific and technical quality of the program against the current SOA
Relevance	ATAC	12/02	9/04	Assess the relevance of the R&T program to the potential end-user

Budget

Budget Authority ($ millions)	FY 2003	FY 2004	FY 2005	Comments
FY2005 PRESBUD	145.4	233.9	154.4	
Advanced Air Transportation Technology	82.5	104.9		Planned End of Project
Small Aircraft Transportation System	26.8	31.5	16.6	Reformulation of Projects
Virtual Airspace Modeling & Simulation	25.6	33.1	29.9	Reformulation of Projects
Efficient Aircraft Spacing		20.5	35.4	Reformulation of Projects
Efficient Flight Path Management		14.8	14.0	Reformulation of Projects
Strategic Airspace Usage		1.5	7.1	Reformulation of Projects
Space-Based Technologies		0.5	18.6	Reformulation of Projects
Human Measures and Performance	10.4	7.2	18.1	Reformulation of Projects
Technical Integration		19.9	14.7	Reformulation of Projects
Changes since 2004 PRESBUD	+20.3	+16.7		
Advanced Air Transportation Technology	+10.9	-0.7		Planned End of Project
Small Aircraft Transportation System	+6.8	+0.8		Extend Schedule of Experiment
Virtual Airspace Modeling & Simulation	+2.3	-0.2		Full Cost Adjustment
Aviation Operations Systems	-10.2	-20.6		Reformulation of Projects
Next Generations Air Transportation System		-27.0		Reformulation of Projects
Efficient Aircraft Spacing		+20.5		Reformulation of Projects
Efficient Flight Path Management		+14.8		Reformulation of Projects
Strategic Airspace Usage		+1.5		Full Cost Adjustment
Space-Based Technologies		+0.5		Full Cost Adjustment
Human Measures and Performance	+10.4	+7.2		Reformulation of Projects
Technical Integration		+19.9		Reformulation of Projects
FY2004 PRESBUD	125.1	217.2		
Advanced Air Transportation Technology	71.5	105.6		
Small Aircraft Transportation System	20.0	30.7		
Virtual Airspace Modeling & Simulation	23.3	33.3		
Aviation Operations Systems	10.2	20.6		
Next Generations Air Transportation System		27.0		

Indicates changes since the previous year's President's Budget Submit

Indicates budget numbers in full cost.

Theme: Aeronautics Technology

Technology and Advanced Concepts: Vehicle Systems Program

PURPOSE

Objectives	Performance Measures
10.5, 2.2, 2.3, 3.1, 7.1	5AT4-7,17-27

The VS program is focused on the development the key enabling technologies to enable capabilities for future air vehicles. These technologies, when implemented, will reduce NO_x emissions to reduce pollution near airports and in the lower atmosphere, reduce emissions of carbon dioxide and reduce aircraft noise. These technologies will simultaneously enable air traffic growth and reduce overall environmental impact. Vehicle Systems technologies are also being developed in collaboration with the Department of Defense to ensure National security through various air vehicle concepts. Research on technologies to enable new vehicle concepts, such as High Altitude Long Endurance (HALE) Remotely Operated Aircraft (ROA) support the NASA science missions and increase quality of life for U.S. citizens.

OVERVIEW

The Vehicle Systems Program is developing enabling technologies to expand the availability of air travel that will satisfy the public's demand for increased air travel without affecting safety or degrading the environment. 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 program is focused on six technology focus areas in which key development will occur to advance the state-of-the-art of air vehicles.

1) Environmentally Friendly, Clean Burning Engines: develop innovative technologies to enable intelligent turbine engines that significantly reduce harmful emissions while maintaining high performance and increasing reliability. 2) New Aircraft Energy Sources and Management: discover new energy sources and intelligent management techniques directed towards zero emissions and enable new vehicle concepts for public mobility and new science missions. 3) Quiet Aircraft for Community Friendly Service: Develop and integrate noise reduction technology to enable unrestricted air transportation service to all communities. 4) Aerodynamic Performance for Fuel Efficiency: Improve aerodynamic efficiency, structures and materials technologies, and design tools and methodologies to reduce fuel burn and minimize environmental impact and enable new vehicle concepts and capabilities for public mobility and new science missions. 5) Aircraft Weight Reduction and Community Access: Develop ultralight smart materials and structures, aerodynamic concepts, and lightweight subsystems to increase vehicle efficiency, leading to high altitude long endurance vehicles, planetary aircraft, advanced vertical and short takeoff and landing vehicles and beyond. 6) Smart Aircraft and Autonomous Control: Enable aircraft to fly with reduced or no human intervention, to optimize flight over multiple regimes, and to provide maintenance on demand towards the goal of a feeling, seeing, sensing, sentient air vehicle.

PROGRAM MANAGEMENT

VS is a multi-project program within the Aeronautics Technology Theme. The Aeronautics Enterprise Program Management Council has VS governing responsibility. The NASA Enterprise official is Dr. J. Victor Lebacqz, Associate Administrator, Office of Aeronautics (OA). The Aeronautics Technology Theme Director is Terrence J. Hertz, Director, Aeronautics Technology, OA. The Program Manager is Dr. Richard Wlezien, OA hosted at NASA Headquarters. The program is compliant with NPG 7120.5b.

TECHNICAL COMMITMENT

The FY 2005 budget request provides a new baseline. In FY 2004 the program revamped and realigned the research and technology development to public good goals.

Technical Specifications		FY 2005 President's Budget							Change from Baseline
		FY03	FY04	FY05	FY06	FY07	FY08	FY09	
Conduct studies and system analysis to guide technology investments, evaluate progress toward goals, and provide capabilities assessments. (SVA)	TRL			3	3	3	3	3	--
	$M			22.90	22.70	22.80	23.10	24.90	--
Validate in a relevant environment selected aircraft component technologies and advanced flight operations for reducing noise by 10dB (re: CY 1997 SOA) to reduce community noise impact. (QAT)	TRL	3	3	4	5	6			--
	$M	19.20	64.80	72.30	75.70	26.00			--

Theme: Aeronautics Technology

Technology and Advanced Concepts: Vehicle Systems Program

Technical Specifications (continued)		**FY 2005 President's Budget**							**Change from Baseline**
		FY03	**FY04**	**FY05**	**FY06**	**FY07**	**FY08**	**FY09**	
Develop technologies and analytical tools for evaluation of aircraft configurations that will reduce community noise impact by 20dB, and validate these in a laboratory environment. (4X)	TRL					2	2	3	--
	$M					44.30	69.40	70.80	--
Demonstrate combustor configurations for reducing NOx emission by 70% (re: to 1996) to reduce pollution and lower atmospheric ozone formation. (UEET)	TRL	3	3	4	5	6			--
	$M	34.50	45.90	44.20	45.70	44.20			--
Develop and demonstrate combustor configurations for reducing NOx emissions by 90%. (re: to 1996 ICAO standards) (UEET-IPS follow-on)	TRL						3	3	--
	$M						44.50	44.10	--
Provide proof of concept validation of key technologies for future intelligent gas turbine engines, non-conventional propulsion systems, and hybrid electric propulsion systems. (P&P)	TRL	1	2						--
	$M	84.60	147.62						--
Develop and demonstrate technologies for reducing emissions of CO2 by 25% relative to year 2000 state of the art. (TCAT, UEET, UEET-IPS follow on, EASI)	TRL	3	3	4	4	5	5	6	--
	$M	78.10	79.20	121.90	122.40	118.50	118.40	119.00	--
Demonstrate an additional 10% emissions improvement in conventional propulsion systems while laying the foundation for proof of non-conventional systems that double the efficiency of today. (LEAP)	TRL			3	3	4	5	6	--
	$M			121.30	128.50	115.40	116.00	118.50	--
Provide proof of concept validation of self healing structures, ultra light structures, robust controls, and advanced sensor and actuator systems. (TCAT, BVT)	TRL	1	2						
	$M	58.70	155.90						--
Demonstrate lightweight high-lift technologies through subcomponent tests to reduce take-off and landing distances by 20% while maintaining high vehicle cruise performance and low noise levels. (ITAS)	TRL			3	3	4	5	6	--
	$M			71.60	70.10	70.00	69.30	71.10	--
Demonstrate autonomous vehicle technologies through flight tests and simulations that increase vehicle reliability by a factor of 2. (AuRA)	TRL			2	3	4	5	6	--
	$M			20.30	19.80	19.40	19.20	19.50	--
Develop and demonstrate technologies to enable advanced vehicle concepts. (AVC without X-43)	TRL	5	5						--
	$M	7.80	20.00						--
Develop innovative concepts and technologies for advanced instrumentation, flight test techniques, and flight testbeds to improve FR productivity by 15% while maintaining safety standards. (FR)	TRL	2	3						--
	$M	58.10	86.40						--
Develop and demonstrate technologies required for routine, safe and reliable Unmanned Aerial Vehicle operations in the NAS at and above the 18,000 ft. level. (F&SD)	TRL		3	4	5	6	7		--
	$M		8.70	18.70	19.80	24.60	29.70		--
Develop and demonstrate technologies and design methodologies to enable 7-14 day HALE ROA operations with 200 kg payload at altitude >60,000 foot. (F&SD)	TRL		3	4	4	5	5	6	--
	$M		10.00	17.00	16.00	17.00	15.00	26.90	--
Validate through flight and systems integration, technology developed while improving flight test techniques, assuring flight success and increasing productivity. (F&SD)	TRL			4	5	5	6	6	--
	$M			77.30	77.30	74.10	70.70	88.00	--

Theme: Aeronautics Technology

Technology and Advanced Concepts: Vehicle Systems Program

Schedule	FY 2005 President's Budget	Baseline	Change from Baseline
Proof of concept validation of technology to contribute a 45% CO2 reduction.	May 2006	May 2006	--
Decide the feasibility of a constant volume combustor for CO2 reduction.	June 2006	June 2006	--
Ident. the technologies that will reduce community noise impact by a factor of 4	Sept. 2006	Sept. 2006	--
Deliver an advanced adaptive, optimal neural net for air vehicle robustness.	Sept 2006	Sept 2006	--
Demonstrate on a full-size engine noise and emissions reduction.	April 2007	April 2007	--
Validate technologies that will reduce noise by 10dB (re: 1997 SOA).	June 2007	June 2007	--
Demonstrate combustor technologies that reduce NOx by 70% (re: to 1997 SOA).	June 2007	June 2007	--
Select technologies that reduce CO2 emissions by 25% (re: 1997 SOA).	August 2007	August 2007	--
Flight demo of integrated systems for UAV flight operations at or above 18,000 feet.	October 2007	October 2007	--
Validate fuel efficiency benefits of a transport wing using slotted technology.	Dec. 2008	Dec. 2008	--
Demo fully autonomous UAV ops during an emergency.	Sept 2008	Sept 2008	--
Demo a light-wt high lift system through subcomponent tests.	Sept. 2009	Sept. 2009	--
Flight Demonstrate HALE ROA above 60,000 ft of 7-14 days with 200kg payload.	August 2009	August 2009	--

ACQUISITION STRATEGY AND PERFORMING ORGANIZATIONS

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 ARC, GRC, LaRC, and DFRC. The Vehicle Systems Program is composed of projects that encompass both low and mid TRL technology development. For the low-TRL development, infusion of new ideas is encouraged through NRA's and grants. The mid-TRL technology development is brought closer to technical maturation through partnerships with the end users in 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 Acquisition	Actual*	Selection Method	Actual*	Performer	Actual*
Cooperative Agreement	9%	Full & Open Competition	90%	Industry	76%
Cost Reimbursable	42%	Sole Source	10%	Government	5%
Fixed Price	5%		100%	NASA Intramural	2%
Grants	14%			University	15%
Other	30%	Science Peer Review	14%	Non Profit	2%
*As of FY 2003 direct procurement	100%	*As of FY 2003 direct procurement		*As of FY 2003 direct procurement	100%

Future Acquisition	Selection	Goals
JSRA for HALE UAVs in the NAS	FY 04	100% Full & Open Competition
NRAs to university & industry EASI, ITAS, AuRA, LEAP	FY 05-07	100% Full & Open Competition, 50% university/50% industry

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. MoU #FNA/09 between the FAA and NASA concerning Aviation Environmental Compatibility; October 1990. 3. MoA #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. MoA #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.

Risk Mitigation

Top Risks	G	Overall	G	Cost	G	Schedule	G	Technical	Probability	Impact	Mitigation Plan
G	Loss of flight vehicle during test or demonstration								moderate	moderate	in place
G	Insufficient technology transfer to customers								moderate	moderate	in place
G	Availability of appropriate skill mix for technology and managerial work								moderate	moderate	in place
G	Availability of critical facilities								moderate	moderate	in place

Independent Reviews

Review Types	Performer	Last Review Date	Next Review Date	Purpose
Performance	IPAO	4/03	6/04	Assess the performance of the VSP against the approved program plan.
Quality	ASEB/NRC	2/03	2/06	Assess the scientific and technical quality of the R&T program against the SOA.
Relevance	ATAC	5/03	2/04	Assess the relevance of the program to other government and industry users.

Theme: Aeronautics Technology
Technology and Advanced Concepts: Vehicle Systems Program

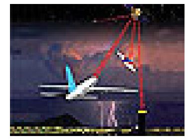
BUDGET

Budget Authority ($ millions)	FY 2003	FY 2004	FY 2005	Comments
FY2005 PRESBUD	333.3	620.4	576.8	
Quiet Aircraft Technology (QAT)	19.2	64.8	72.1	Reformulation from Prior Projects
21st Century Aircraft Technology (TCAT)	27.8	66.6		Reformulated to New Projects
Flight Research (FR)	58.1	86.4		Reformulated to New Projects
Advanced Vehicle Concepts (AVC)	17.6	31.9		Reformulated to New Projects
Breakthrough Vehicle Technologies (BVT)	58.9	122.6		Reformulated to New Projects
Ultra-Efficient Engine Technology (UEET)	67.0	91.9	88.2	New Project
Propulsion & Power (P&P)	84.6	147.5		Reformulated to New Projects
Low Emissions Alternative Power			120.9	New Project
Efficient Aerodynamic Shapes & Integration			68.0	New Project
Integrated Tailored Aerostructure (ITAS)			71.4	New Project
Autonomous Robust Avionics (AURA 10X)			20.4	New Project
Flight and System Demonstration		8.7	112.9	New Project
Strategic Vehicle Architecture			22.9	New Project
Changes since 2004 PRESBUD	+59.0	+46.8		
Quiet Aircraft Technology (QAT)	-0.8	+4.6		Congressional Interest Item
21st Century Aircraft Technology (TCAT)	-1.2	+24.5		Congressional Interest Item
Flight Research (FR)	+19.2	+1.0		Congressional Interest Item
Advanced Vehicle Concepts (AVC)	+9.8	-9.1		Portion of General Reduction
Breakthrough Vehicle Technologies (BVT)	-3.0	+7.3		Congressional Interest Item
Ultra-Efficient Engine Technology (UEET)	+17.0	+1.9		Congressional Interest Item
Propulsion & Power (P&P)	+17.9	+7.9		Congressional Interest Item
Flight and System Demonstration		+8.7		Congressional Interest Item
FY2004 PRESBUD	274.3	573.6		
Quiet Aircraft Technology (QAT)	20.0	60.2		
21st Century Aircraft Technology (TCAT)	29.0	42.1		
Flight Research (FR)	38.9	85.4		
Advanced Vehicle Concepts (AVC)	7.8	41.0		
Breakthrough Vehicle Technologies (BVT)	61.9	115.3		
Ultra-Efficient Engine Technology (UEET)	50.0	90.0		
Propulsion & Power (P&P)	66.7	139.6		

Indicates changes since the previous year's President's Budget Submit.
Indicates budget numbers in full cost.

To enable safer aircraft operations in icing conditions, NASA is developing a Smart Icing System (SIS) concept that, upon sensing the presence of ice on an aircraft, would automatically activate and manage the ice protection system

THEMES



Aeronautics Technology

AERONAUTICS

PURPOSE

Aviation is an indispensable part of our Nation's transportation system, providing unequaled speed and mobility for people and goods. The Aeronautics Enterprise 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, Department of Homeland Security, and the Federal Aviation Administration (FAA). Research areas include advanced propulsion technologies, lightweight high-strength adaptable structures, revolutionary display and control systems, adverse weather countermeasures, 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.

FY 2003 Accomplishments

During FY 2003, the Aeronautics 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.

Icing safety. 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. To enable safer aircraft operations in icing conditions, NASA is developing a Smart Icing System (SIS) concept that, upon sensing the presence of ice on an aircraft, would automatically activate and manage the ice protection systems. A SIS provides the pilot with feedback on the icing event, including the effects on aircraft performance, stability, and control. In FY 2003, the SIS concept was integrated into a desktop simulator and tested by pilots in training scenarios to identify appropriate awareness and action cues for pilots. Also in FY 2003, NASA successfully conducted an evaluation of an revolutionary synthetic vision system that provides the flight crew with a "clear weather, day time equivalent" view of terrain, ground obstacles, air traffic and other important data under all metrological conditions regardless of the time of day and demonstrated an air turbulence warning system that provided the aircrew with an 81 percent probability of detecting severe turbulence with at least 30 seconds lead time at 81 percent.

Emissions reductions. Among the chemicals produced during the combustion of aircraft fuel, two have the most significant impacts on the environment. Nitrogen oxides degrade the local air quality by creating smog and impact global air quality by contributing to the loss of ozone. Carbon dioxide is a factor in global climate change. NASA is developing critical engine and airframe technologies that provide a significant reduction in emissions. Engine testing demonstrated a 67 percent reduction in nitrogen oxide emissions below 1996 standards. In addition, a ceramic 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 carbon dioxide emissions.

More efficient aircraft engines. Aircraft inlets regulate airflow into aircraft engines. Efficient inlets improve aircraft speed and lift capabilities. Inlets are traditionally located under the wings of large aircraft, but as engine diameter increases, the weight of the engine, wing and landing gear also increases. NASA is investigating the use of non-circular inlets mounted over the top of wings to increase speed and lift capabilities for next generation subsonic aircraft without increasing engine diameter. In FY 2003, a model of an advanced top mounted inlet was studied in NASA's Basic Aerodynamics Research Tunnel. The goal was to minimize the effects of flow distortion at the engine face using active airflow control. In normal inlets, a large boundary layer (an area where air meets the surface of the engine) is ingested into the inlet. This distorts the flow before it reaches the engine and reduces inlet efficiency. The baseline inlet produced a total flow distortion of 29 percent. With active flow control enabled on the experimental inlet, the distortion was reduced to 13 percent.

Reducing sonic booms. An aircraft traveling through the atmosphere continuously produces air pressure waves similar to waves created by the bow of a ship. When the aircraft exceeds the speed of sound, the pressure waves merge to form shock waves, which are heard as a sonic boom when they reach the ground. The annoyance and damage generated by these sonic booms has been one of the limiting factors for routine supersonic flight over land. In a joint program conducted by NASA, DARPA, and the Northrop Grumman Corporation, the forebody of an F-5 fighter was modified to test the theory that by changing an aircraft's shape, the shape of the sonic boom can be adjusted to reduce its impact on the public. Subsequent flight tests verified that the modifications resulted in a substantial reduction in the strength of the resulting sonic boom. This technology will enable a generation of supersonic aircraft that are far less disturbing to the public

Reducing air traffic congestion. Dynamic, reliable air traffic control is the hallmark of safe and efficient air travel. In congested airspace with interdependent traffic flows, a delay at one center often creates a domino effect that spreads quickly to multiple centers. During FY 2003, the Advanced Air Transportation Technologies Project developed and demonstrated an initial version of an active decision support tool for complex airspace. With this tool, the Multi-Center Traffic Management Advisor, controllers will be able to manage arrival flows across multiple routes and arrival points more efficiently (See Figure X). This technology, which can be extended across the National Airspace System, will increase efficiency and capacity in some of the most [something missing here: congested areas?] through regional collaboration. Some of the key features of the Multi-Center Traffic Management Advisor include: arrival rush planning and control across multiple facilities; transition to time-based metering; scheduling information for airports and boundaries; and departure information for nearby airports.

Enterprise: Aeronautics

THEME DISTRIBUTION

Budget Authority ($ in millions)	FY 2003	FY 2004	FY 2005
Aeronautics Technology	599.1	1034.3	919.2
Institutional Support	445.0	-	-
Total	1,044.1	1,034.3	919.2

Note: For all formats, the FY 2003 column reflects the FY 2003 Congressional Operating Plan, dated 9/04/03. The FY 2004 column reflects the FY 2004 Conference committee report. The FY 2005 column represents the FY 2005 President's Budget Submit.

Indicates budget numbers in full cost

Aeronautics Technology

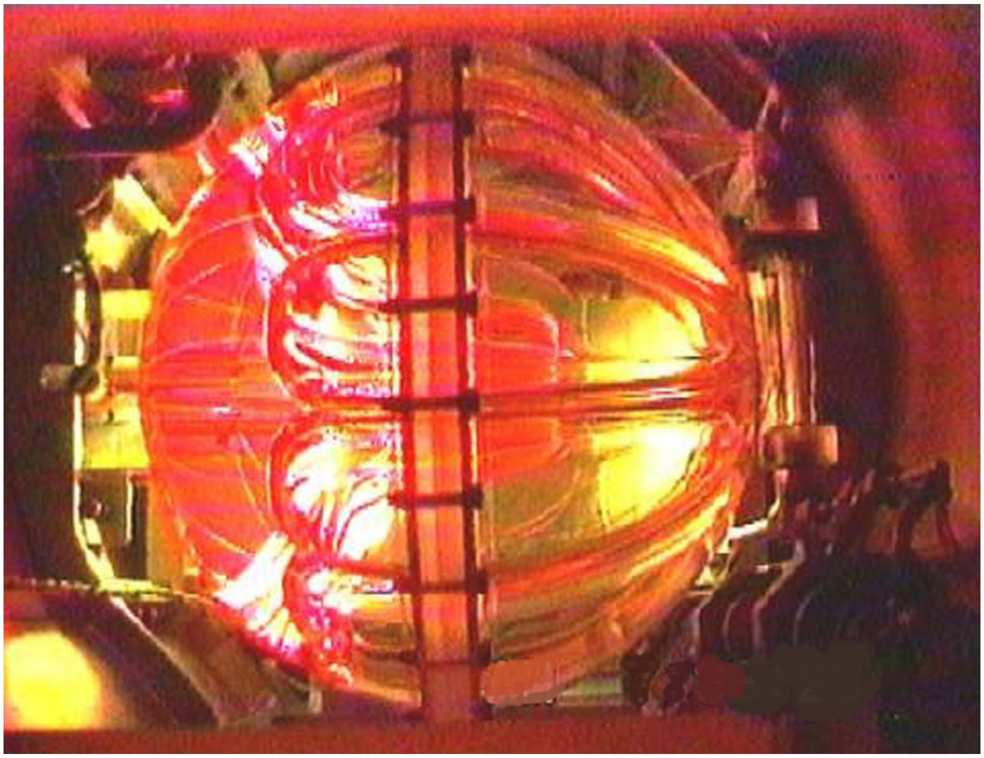
This theme plays a key role in creating a safer, more secure, environmentally friendly and efficient air transportation system, increasing performance of military aircraft, and developing new uses for science or commercial missions. This theme also enhances the Nation's security through its partnerships with the Department of Defense, the Department of Homeland Security and the Federal Aviation Administration. Aeronautics Technology consists of three integrated programs. The Aviation Safety and Security Program directly addresses the safety and security research & technology development needs of the nation's aviation system to either prevent both unintentional and intentional actions that would cause damage, harm, and loss of life or mitigate the consequences when these types of situations occur. The Airspace Systems Program conducts research and technology development that will enable 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 air traffic management system. The Vehicle Systems Program develops enabling technologies that will produce future vehicles that are environmentally friendly, quieter, faster, more efficient, and technologically superior and / or support science missions and commercial applications requiring high altitude, long endurance, and remote operations. Highlights for FY 2005 include:

- Conduct experimental flight evaluation of key Small Airplane Transportation System enabling technologies.
- Demonstrate 70% reduction in nitrous oxides emissions in full-scale tests of combustor configurations suitable for a large subsonic vehicle.
- Complete Human in the Loop concept and technology evaluation of shared separation.
- Demonstrate integrated technologies and polices that would allow routine UAV flight operations in the National Airspace System above an altitude of 40,000.
- Accomplish objective of developing technologies that will enable a 50% reduction in the fatal accident rate from the 1991-1996 levels.

OVERALL BUDGET

FY 2005 request is $919 million, a 4.5% decrease from the FY 2004 President's Request.

- $188 million for Aviation Safety and Security projects aimed at reducing accident and fatality rates.
- $154 million for Airspace Systems projects to provide technologies that can dramatically increase the capacity and mobility of the nation's air transportation system.
- $577 million for Vehicle Systems projects focused on development of breakthrough technologies that enable people and goods to travel faster and farther with fewer delays and reduce aircraft noise and emissions.



Liquid at rest in a transparent spherical tank under low gravity shows one aspect of the surprising behavior of fluid systems in space.

Physical Sciences Research

MAJOR EVENTS IN FY 2005

All Physical Sciences Research (PSR) major events listed below will be accomplished **pending the Exploration Replanning**.

- PSR will complete three (3) Microgravity Science Glovebox experiments.
- PSR will initiate Advanced Life Support research flight experiment development.
- PSR will initiate design an In-space Fabrication and Repair experiment.
- PSR will publish STS-107 research results together with International Space Station (ISS) flight experiments.

Theme: Physical Sciences Research

OVERVIEW

PENDING EXPLORATION REPLANNING. 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, 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. (Note: PSR will be conducting a major review of priorities to ensure alignment of activities with the new Exploration vision. Some of the specific activities described here may change.)

Missions	Goals supported by this Theme	Objectives supporting these Goals
To 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.	3.2 Improve the Nation's economic strength and quality of life by facilitating innovative use of NASA technology.
		3.3 Resolve scientific issues in the low gravity environment of space that enrich life on Earth by leading to better design tools in energy, materials, medical, and communication technologies.
To 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 Expand understanding of fundamental physical processes and insight into the laws of nature through space-based investigation.
Exploration Capabilities	9. Extend the duration and boundaries of human space flight to create new opportunities for exploration and discovery.	9.2 Develop new human support systems and solutions to low gravity technological challenges to allow the next generation of explorers to go beyond low earth orbit.

RELEVANCE

The PSR theme addresses high priority research as identified by the science community. The PSR theme improves 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) the development of radiation protection structure technology. At the same time, this research seeks to improve Earth-based science and technologies in a range of disciplines: combustion, fluids, materials, biophysics, structural biology, and fundamental physics and chemistry.

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 these effects, their positive impacts to our quality of life is evident. 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

The Enterprise Official for the Physical Sciences Research Theme is Mary Kicza, Associate Administrator for Biological & Physical Research. The HQ Division Director for Physical Sciences Research is Dr. Eugene Trinh. PSR is a multiple project and single program theme with program responsibility in the Office of Biological and Physical Research at NASA HQ. 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. 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 the International Space Station (ISS) and the Shuttle 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 (e.g., Physics of Colloids in Space (PCS)). Progress toward accomplishing Annual Performance Goals will be assessed by an advisory committee.

Implementation Schedule

Theme Element	Schedule by Fiscal Year 95 96 97 98 99 00 01 02 03 04 05 06 07 08 09 10	Purpose
Combustion Integrated Rack (CIR)		Flight-based research facility for fundamental research in energy and pollutant production processes and spaceflight fire safety issues.
Microgravity Science Glovebox Research & Development		Low-gravity laboratory facility for real-time astronaut interaction.
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.

Tech & Adv Concept   Development   Operations   Research

Full compliance with NPR 7120.5B will be achieved in FY04 for the relevant portions.

Status

The PSR theme carried out numerous research investigations on STS (Space Transportation System)-107 related to three-dimensional tissue growth, fluid viscosity, granular materials, laminar soot, flame ball structure, and fire behavior. PSR initiated the Space Radiation Shielding Program, aimed at developing radiation shielding appropriate for long-duration lunar or Mars missions and validated a 50-year-old hypothesis explaining how liquid metals resist turning in to solids using the Electrostatic Levitator. PSR also completed ISS Microgravity Glovebox research investigation on colloidal physics and initiated materials science research on particle growth in liquids. Other achievements included: investigated fundamental and unresolved issues in condensed matter physics and atomic physics, and carried out atomic clock development for space-based utilization; designed and developed flight experiment apparatus for low-temperature physics, laser cooling, and atomic physics investigations on the ISS; and selected 35 ground research proposals in the first-half of CY 2003. Please follow this link for additional data: http://spaceresearch.nasa.gov/.

Performance Measures

Outcomes/Annual Performance Goals (APGs)	
Outcome 3.2.5	*By 2008, increase by 30% (from the 2003 level) the utilization of NASA/OBPR-derived technologies by other agencies, private sector, and academia to advance basic and applied research goals of practical impact.*
5PSR1	Develop a multi-agency collaboration for research at the interface between the physical and life sciences, and enhance collaborative efforts with other agencies and the private sector on biotechnology, materials research, and optical diagnostics for health research.
Outcome 3.3.1	*By 2008, analyze the impact of the results of the first phase of ISS and ground-based research in Biotechnology, fundamental science, and engineering to demonstrate the introduction of at least two new design tools and/or process improvements to existing technologies and industrial practices.*
5PSR2	Continue a productive ground and flight-based research program in Combustion, Fluid Physics, Biotechnology, and Materials science, and carry out the milestones for all ISS research projects.
Outcome 3.3.2	*By 2008, quantitatively assess the impact of space and ground-based research on fire safety hazard prevention and*

Theme: Physical Sciences Research

Outcomes/Annual Performance Goals (APGs)	
	containment and on energy conversion to demonstrate measurable risk reduction and increased efficiency.
5PSR3	Publish the results of STS-107 investigations based on available data in microgravity combustion research, and maintain a productive ground and flight-based program in fundamental and strategic combustion and reactive flows research.
Outcome 4.2.1	*By 2008, complete the first generation of ISS research in colloidal physics and soft condensed matter and demonstrate the ability to control the colloidal engineering of at least two different model structures.*
5PSR4	Continue flight and ground-based research in colloidal physics and soft-condensed matter, and accomplish the project milestones for the ISS research program in fluid physics.
Outcome 4.2.2	*By 2008, complete the design and fabrication of the first ISS fundamental microgravity physics facility to allow the performance of two capstone investigations in dynamical critical phenomena.*
5PSR5	Continue the development of the ISS fundamental physics facility for low temperature and condensed matter physics, and maintain a productive ground-based research program in condensed matter physics.
Outcome 4.2.3	*By 2008, complete the design for the ISS laser-cooling laboratory and demonstrate the feasibility to deploy the most accurate atomic clock in space.*
5PSR6	Continue the development of the ISS laser cooling and atomic facility by accomplishing the project milestones, and maintain an innovative and outstanding ground research program in atomic and gravitational physics.
Outcome 4.2.4	*By 2008, complete the first phase of the ISS biotechnology facility and demonstrate cellular biotechnology research throughput increase by a factor of two.*
5PSR7	Continue the development of the ISS Biotechnology Facility and maintain a productive and innovative ground and space research program in cellular biotechnology and tissue engineering.
Outcome 9.2.2	*By 2008, develop predictive models for prototype two-phase flow and phase change heat transfer systems for low- and fractional gravity with an efficiency improvement of at least a factor of two over 2003 ISS radiative systems, and prepare ISS experiments for validation.*
5PSR8	Continue Strategic ground-based research in microgravity heat-exchange multi-phase systems and advance existing flight projects toward flight.
Outcome 9.2.3	*By 2008, develop predictive engineering model and prototype systems to demonstrate the feasibility of deploying enhanced space radiation-shielding multi-functional structures with at least a factor of two improvement in shielding efficiency and mass reduction, and prepare a space experiment for validation.*
5PSR9	Continue accumulating data on radiation effects on materials properties and initiate the assessment of the performance of multifunctional materials.
Uniform Measures	
5PSR10	Complete all development projects within 110% of the cost and schedule baseline.
5PSR11	Deliver at least 90% of scheduled operating hours for all operations and research facilities.
5PSR12	At least 80%, by budget, of research projects will be peer-reviewed and competitively awarded.

INDEPENDENT REVIEWS

Review Types	**Performer**	**Last Review Date**	**Next Review Date**	**Purpose**
ReMAP	Independent Committee	9/02	N/A	Set priorities for ISS Research
National Research Council Committees	NAS/NRC	6/02	N/A	NAS research progress/quality
External Advisory Committees-BPRAC	NASA	8/02	2/04	Advisory Committees Research

BUDGET

Budget Authority ($ millions)	**FY 2003**	**FY 2004**	**Change**	**FY 2005**	**Comments**
Physical Sciences Research	**241.4**	**357.2**	**-57.1**	**300.1**	**Pending Exploration Replanning**
Development	48.9	47.5	-13.8	33.7	
Materials Science Research Rack-1 (MSRR-1)	8.8	15.0	-7.5	7.5	
Fluids and Combustion Facility (FCF)	29.7	22.8	-5.8	17.0	
Low Temperature Microgravity Physics Facility (LTM)	10.4	9.7	-0.5	9.2	
Operations	102.3	158.4	-51.4	107.0	
Research	90.1	151.3	+8.1	159.4	

Indicates changes since the previous year's President's Budget Submit

Indicates budget numbers in full cost.

Theme: Physical Sciences Research
Development: Fluids and Combustion Facility (FCF)

PURPOSE

Objectives	Performance Measures
3.2, 3.3, 4.2, 9.2	5PSR1-10

PENDING EXPLORATION REPLANNING. 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. (Note: PSR will be conducting a major review of priorities to ensure alignment of activities with the new Exploration vision. Some of the specific activities described here may change.)

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

The Enterprise Official for the Physical Sciences Research Theme is Mary Kicza, Associate Administrator for Biological & Physical Research. The HQ Division Director for Physical Sciences Research is Dr. Eugene Trinh. The FCF program responsibility is delegated to the Glenn Research Center. Project Manager is Robert Zurawski at the Glenn Research Center. FCF Development is being implemented per ISSRC Program Commitment Agreement (PCA) dated July 9, 2003.

TECHNICAL COMMITMENT

PENDING EXPLORATION REPLANNING. FCF Development is being implemented per ISSRC Program Committement Agreement (PCA) dated July 9, 2003.

Technical Specifications	FY 2005 President's Budget	Change from Baseline
Launch Vehicle:	Shuttle	--
Fluids and Combustion Facility:	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	FY 2005 President's Budget	Change from Baseline
CIR Critical Design Review (CDR)	May-02	+2 months
FIR Critical Design Review (CDR)	Dec-02	+2 month
CIR Flight Hardware Available (FHA)	Oct-04	+3 Months
FIR Flight Hardware Available (FHA)	Dec-04	+4 Months

ACQUISITION STRATEGY AND PERFORMING ORGANIZATIONS

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 FY04 President's Budget: None.

Theme: Physical Sciences Research

Development: Fluids and Combustion Facility (FCF)

Current Acquisition	Actual*	Selection Method	Actual*	Performer	Actual*
Cooperative Agreement	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	58%	Sci Peer Review	0%	Non Profit	0%
* as of FY03 direct procurement	100%	* as of FY03 direct procurement		* as of FY03 direct procurement	100%

Future Acquisition - Major	Selection	Goals
Change to Cost Plus	Fall 03	100% Full & Open Competition, 10% SB, 100% Cost Plus

Agreements

Internal: None. External: None. Changes since the FY04 Presidents Budget: None.

Risk Mitigation

Risk Date: 1/15/2004

Top Risks	G	Overall	G	Cost	Y	Schedule	G	Technical	Probability	Impact	Mitigation Plan
Y	Verification Program								Low	Low	In Place

Independent Reviews

Review Types	Performer	Last Review Date	Next Review Date	Purpose
Critical Design Reviews	Indep. Panel	9/03	N/A	NASA technical and programmatic assessment.
ReMAP	Independent Committee	9/02	N/A	Set priorities for ISS Research.

Budget/Life Cycle Cost

Budget Authority ($ millions)	Prior	FY03	FY04	FY05	FY06	FY07	FY08	FY09	BTC	Total	Comments
FY2005 PRESBUD	136.2	29.7	22.8	17.0	10.8					216.5	
Development	136.2	29.7	22.8	17.0	10.8					216.5	
Changes since 2004 PRESBUD	+6.4	+17.7	-0.1	+4.5	+5.9					+34.4	
Development	+6.4	+17.7	-0.1	+4.5	+5.9					+34.4	
FY2004 PRESBUD	129.8	12.0	22.9	12.5	4.9					182.2	
Development	129.8	12.0	22.9	12.5	4.9					182.2	
Initial Baseline		12.0	22.9	12.5	4.9					52.3	
Fluids and Combustion Facility (FCF)		12.0	22.9	12.5	4.9					52.3	

Indicates changes since the previous year's President's Budget Submit

Indicates budget numbers in full cost.

Theme: Physical Sciences Research
Operations: Low Temperature Microgravity Physics Facility (LTMPF)

PURPOSE

Objectives	Performance Measures
4.2	5PSR4-7,10

PENDING EXPLORATION REPLANNING. 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. (Note: PSR will be conducting a major review of priorities to ensure alignment of activities with the new Exploration vision. Some of the specific activities described here may change.)

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 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

The Enterprise Official for the Physical Sciences Research Theme is Mary Kicza, Associate Administrator for Biological & Physical Research. The HQ Division Director for Physical Sciences Research is Dr. Eugene Trinh. The LTMPF Project program responsibility is delegated to the Jet Propulsion Laboratory. Project Manager is John Pensinger at the Jet Propulsion Laboratory. LTMPF Development is being implemented per ISSRC Program Commitment Agreement (PCA) dated July 9, 2003.

TECHNICAL COMMITMENT

PENDING EXPLORATION REPLANNING. LTMPF Development is being implemented per ISSRC Program Commitment Agreement (PCA) dated July 9, 2003.

Technical Specifications	FY 2005 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:	Critical Dynamics in Microgravity (DYNAMX/CQ) and Superconducting Microwave Oscillator Experiment (SUMO)	--

Schedule	FY 2005 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

ACQUISITION STRATEGY AND 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 the FY04 President's Budget: None.

Theme: Physical Sciences Research

Operations: Low Temperature Microgravity Physics Facility (LTMPF)

Current Acquisition	Actual*	Selection Method	Actual*	Performer	Actual*
Cooperative Agreement	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	100%	Sci Peer Review	0%	Non Profit	0%
* as of FY03 direct procurement	100%	* as of FY03 direct procurement		* as of FY03 direct procurement	100%

Future Acquisition - Major	Selection	Goals
Cost + Award Fee	Fall 01	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 FY04 President's Budget: None.

Risk Mitigation

Risk Date: 1/15/2004

Top Risks	G	Overall	Y	Cost	G	Schedule	Y	Technical	Probability	Impact	Mitigation Plan
Y	Frequency - Synchronization link implementation approach to be agreed to by JAXA.								moderate	moderate	under development

Independent Reviews

Review Types	Performer	Last Review Date	Next Review Date	Purpose
Independent Assessment	MSFC CFO	7/01	N/A	Cost and schedule assessment.
ReMap	Independent Committee	9/02	N/A	Set priorities for ISS research

Budget/Life Cycle Cost

Budget Authority ($ millions)	Prior	FY03	FY04	FY05	FY06	FY07	FY08	FY09	BTC	Total	Comments
FY2005 PRESBUD	40.0	10.4	9.7	9.2	7.3	4.5	2.0	2.1		85.3	
Development	40.0	10.4	9.7	9.2	7.3	4.5	2.0	2.1		85.3	
Changes since 2004 PRESBUD	+11.6	-2.5	-0.1	+2.8	+6.0	+4.5	+2.0	+2.1		+26.4	
Development	+11.6	-2.5	-0.1	+2.8	+6.0	+4.5	+2.0	+2.1		+26.4	
FY2004 PRESBUD	28.4	12.9	9.8	6.4	1.3					58.9	
Development	28.4	12.9	9.8	6.4	1.3					58.9	
Initial Baseline		12.9	9.9	6.4	1.3					30.5	
LowTemp Microgr Physics Facility (LTMPF)		12.9	9.9	6.4	1.3					30.5	

Indicates changes since the previous year's President's Budget Submit

Indicates budget numbers in full cost.

Theme: Physical Sciences Research
Development: Materials Science Research Rack – 1(MSRR-1)

PURPOSE

Objectives	Performance Measures
3.2, 3.3, 4.2, 9.2	5PSR1-10

PENDING EXPLORATION REPLANNING. 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. (Note: PSR will be conducting a major review of priorities to ensure alignment of activities with the new Exploration vision. Some of the specific activities described here may change.)

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

The Enterprise Official for the Physical Sciences Research Theme is Mary Kicza, Associate Administrator for Biological & Physical Research. The HQ Division Director for Physical Sciences Research is Dr. Eugene Trinh. The MSRR Project is delegated to the Marshall Space Flight Center (MSFC). Project Manager is Charles Darby at MSFC. MSRR-1 Development is being implemented per ISSRC Program Commitment Agreement (PCA) dated July 9, 2003.

TECHNICAL COMMITMENT

PENDING EXPLORATION REPLANNING. MSRR-1 Development is being implemented per ISSRC Program Commitment Agreement (PCA) dated July 9, 2003.

Technical Specifications	FY 2005 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.	--
Science Instruments: 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.	--

Theme: Physical Sciences Research
Development: Materials Science Research Rack – 1(MSRR-1)

Schedule	FY 2005 President's Budget	Change from Baseline
Integrated Payload CDR	Complete 5/02	--
Payload Safety Review	Oct-03	--
Growth and processing of glass preforms. Samples are exchanged w/ furnace insert	Jan-05	+6 months
MSRR Flight Hardware Available (FHA)	July-05	+6 Months

Acquisition Strategy and Performing Organizations

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 consist of the 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 acquired through other agreements. Changes since the FY04 President's Budget: None.

Current Acquisition	Actual*	Selection Method	Actual*	Performer	Actual*
Cooperative Agreement	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%
Other	70%	Sci Peer Review	0%	Non Profit	0%
* as of FY03 direct procurement	100%	* as of FY03 direct procurement		* as of FY03 direct procurement	100%

Future Acquisition - Major	Selection	Goals
Change to On-Site Contractors	Fall 03	100% Full & Open Competition

Agreements

Internal: None External: International Bilateral Cooperative Research Agreement (dated August 1999), as authorized by the early Station Utilization Memorandum of Understanding (MOU) between NASA and ESA. Changes since FY04 President's Budget: None.

Risk Mitigation

Risk Date: 1/15/2004

Top Risks	G	Overall	G	Cost	Y	Schedule	G	Technical	Probability	Impact	Mitigation Plan
Y	Physical Integration and end-to-end performance verification								moderate	low	Working with ESA

Independent Reviews

Review Types	Performer	Last Review Date	Next Review Date	Purpose
Independent Annual Review	MSFC/SMO	7/03	N/A	Independent Audit
ReMAP	Independent Committee	9/02	N/A	Set priorities for ISS Research

Theme: Physical Sciences Research
Development: Materials Science Research Rack – 1(MSRR-1)

BUDGET/LIFE CYCLE COST

Budget Authority ($ millions)	Prior	FY03	FY04	FY05	FY06	FY07	FY08	FY09	BTC	Total	Comments
FY2005 PRESBUD	85.0	8.8	15.0	7.5						116.3	--
Development	85.0	8.8	15.0	7.5						116.3	--
Changes since 2004 PRESBUD	+45.3	+3.8	-0.1	+6.0						+55.0	--
Development	+45.3	+3.8	-0.1	+6.0						+55.0	--
FY2004 PRESBUD	39.7	5.0	15.1	1.5						61.3	--
Development	39.7	5.0	15.1	1.5						61.3	--
Initial Baseline		5.0	15.1	1.5						21.6	--
Materials Science Research Rack1 (MSRR1)		5.0	15.1	1.5						21.6	--

Indicates changes since the previous year's President's Budget Submit
Indicates budget numbers in full cost.

Theme: Physical Sciences Research
Operations

PURPOSE

Objectives	Performance Measures
3.2, 3.3, 4.2, 9.2	5PSR1-9,11

PENDING EXPLORATION REPLANNING. 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. (Note: PSR will be conducting a major review of priorities to ensure alignment of activities with the new Exploration vision. Some of the specific activities described here may change.)

OVERVIEW

The Physical Sciences Research Program will continue fabrication of ISS research racks and experiment inserts for the CIR, FIR, LTMPF, 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 62 flight investigations to be implemented between 2004 and 2008. PSR will also collaborate with the International Partners (ESA, DLR, CNES, JAXA) in order to plan the efficient utilization of all available ISS experiment facilities. Starting in FY 2004 OBPR will begin the Human Research Initiative. 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

The Enterprise Official for the Physical Sciences Research Theme is Mary Kicza, Associate Administrator for Biological & Physical Research. The HQ Division Director for Physical Sciences Research is Dr. Eugene Trinh. 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 NPR 7120.5B will be achieved in FY 04 for the relevant portions.

TECHNICAL COMMITMENT

PENDING EXPLORATION REPLANNING. Baseline commitment as of the FY 2004 PBS dated January 2003.

Technical Specifications	FY 2005 President's Budget	Change from Baseline
Multi-use Droplet Combustion Apparatus (MDCA)	Provide laboratory capability for combustion research	--
(Light Microscopy Module) LMM	Implement cross disciplinary research	--
(Quench Module Insert) QMI	Provides materials science research platform	--
Physics of Colliods in Space + (PCS+)	Implements fundamental research in complex systems	--
M1: Critical Dynamics in Microgravity (DYNAMX), Superconducting Microwave Oscillator Experiment (SUMO)	Implements fundamental physics external platform	--
Space Acceleration Measurement System	Implements environmental acceleration measurements	--
Protein Crystal Growth	Implements structural biology research in Express racks	--
Biospecimen Temperature Controller (BSTC)/Biotechnology Refrigerator (BTR)	Implements cell biotechnology research	--
Microgravity Science Glovebox	Provides a cross-disciplinary hands-on research platform	--
Primary Atomic Reference Clock in Space (PARCS)	Implements fundamental physics external platform	--

Schedule	FY 2005 President's Budget	Change from Baseline
Biospecimen Temperature Controller (BSTC)/Biotechnology Refrigerator (BTR)	Operations in US Lab	--
Microgravity Science Glovebox	Operations in US Lab	--
Protein Crystal Growth	Operations in US Lab	--
Space Acceleration Measurement System	Operations in US Lab	--
Multi-user Droplet Combustion Apparatus (MDCA)	FHA 10/2004	+3 Months
Light Microscopy Module (LMM)	FHA 12/2004	+4 Months

Theme: Physical Sciences Research
Operations

Schedule	FY 2005 President's Budget	Change from Baseline
Physics of Colliods in Space + (PCS+)	FHA in '05	+2 years
Quench Module Insert (QMI)	FHA 01/2006	+4 Months
Critical Dynamics in Microgravity (DYNAMX)	FHA 08/2007	--
Superconducting Microwave Oscillator Experiment (SUMO)	FHA 08/2007	--
Primary Atomic Reference Clock in Space (PARCS)	FHA 08/2007	--

ACQUISITION STRATEGY AND PERFORMING ORGANIZATIONS

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 operations, utilization and institutional requirements. Changes since the FY04 President's Budget: None.

Current Acquisition	Actual*	Selection Method	Actual*	Performer	Actual*
Cooperative Agreement	0%	Full & Open Competition	90%	Industry	60%
Cost Reimbursable	0%	Sole Source	10%	Government	0%
Fixed Price	5%			NASA Intramural	35%
Grants	0%		100%	University	5%
Other	95%	Sci Peer Review	%	Non Profit	0%
* as of FY03 direct procurement	100%	* as of FY03 direct procurement		* as of FY03 direct procurement	100%

Future Acquisition	Selection	Goals
Change to Cost Plus	Fall 03	100% Full & Open Competition, 5% SB, 100% Cost Plus

AGREEMENTS

Internal: None. External: None. Changes since the FY04 President's Budget: None.

RISK MITIGATION

Risk Date: 1/15/2004

Top Risks	G Overall	G Cost	G Schedule	G Technical	Probability	Impact	Mitigation Plan
G	Availability of flight opportunities determines ability to execute mission				low	low	N/A

INDEPENDENT REVIEWS

Review Types	Performer	Last Review Date	Next Review Date	Purpose
ReMAP	Independent Committee	9/02	N/A	Set priorities for ISS research
National Academy	NRC/SSB	6/02	N/A	Independent science assessment

BUDGET

Budget Authority ($ millions)	FY 2003	FY 2004	FY 2005	Comments
FY2005 PRESBUD	102.3	158.4	107.0	
ISSRC Physical Sciences Research (Operations)	102.3	158.4	107.0	
Changes since 2004 PRESBUD	+19.2	-1.4		
ISSRC Physical Sciences Research (Operations)	+19.2	-1.4		
FY2004 PRESBUD	83.1	159.8		
ISSRC Physical Sciences Research (Operations)	83.1	159.8		

Indicates changes since the previous year's President's Budget Submit

Indicates budget numbers in full cost.

Theme: Physical Sciences Research

Research

PURPOSE

Objectives	Performance Measures
3.2, 3.3, 4.2, 9.2	5PSR1-9,12

PENDING EXPLORATION REPLANNING. The strategic objective of the Physical Sciences Research 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. (Note: PSR will be conducting a major review of priorities to ensure alignment of activities with the new Exploration vision. Some of the specific activities described here may change.)

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 areas: strategic research and fundamental microgravity research. The key difference between the two areas is the strategic research focus on developing advanced technology for both robotic and human deep space flight. Fundamental microgravity research focuses on tackling both challenging basic scientific issues as well as addressing technical challenges relevant to Earth-based applications. 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 Research Initiative. 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

The Enterprise Official for the Physical Sciences Research Theme is Mary Kicza, Associate Administrator for Biological & Physical Research. The HQ Division Director for Physical Sciences Research is Dr. Eugene Trinh. 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 NPR 7120.5B will be achieved in FY 04 for the relevant portions.

TECHNICAL COMMITMENT

PENDING EXPLORATION REPLANNING. Baseline commitment as of the FY 2004 PBS dated January 2003.

Technical Specifications	FY 2005 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	FY 2005 President's Budget	Change from Baseline
Research Announcements Release	03 NRA - 2/04, 04 NRA - 2/05	--
Research Awards	Award 3/04, Award 3/05	--

Theme: Physical Sciences Research
Research

ACQUISITION STRATEGY AND 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 increments. In FY03, direct NRA Grant procurement represented 75% of budget authority. Changes since the FY04 President's Budget: None.

Current Acquisition	Actual*	Selection Method	Actual*	Performer	Actual*
Cooperative Agreement	0%	Full & Open Competition	100%	Industry	25%
Cost Reimbursible	0%	Sole Source	0%	Government	0%
Fixed Price	0%			NASA Intramural	15%
Grants	75%		100%	University	60%
Other	25%	Sci Peer Review	100%	Non Profit	0%
* as of FY03 direct procurement	100%	* as of FY03 direct procurement		* as of FY03 direct procurement	100%

Future Acquisition - 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 FY04 President's Budget: None.

RISK MITIGATION

Risk Date: 1/15/2004

Top Risks	G	Overall	G	Cost	G	Schedule	G	Technical	Probability	Impact	Mitigation Plan
G	Availability of flight opportunities determines ability to execute mission.								low	low	N/A

INDEPENDENT REVIEWS

Review Types	Performer	Last Review Date	Next Review Date	Purpose
National Research Council Committee	NAS/NRC	6/02	N/A--	NAS research progress & quality evaluation
External Advisory Committees	BPRAC	8/03	2/04	Advisory Committees Research progress reviews
ReMap	Independent Committee	9/02	N/A	Set priorities for ISS research

BUDGET

Budget Authority ($ millions)	FY 2003	FY 2004	FY 2005	Comments
FY2005 PRESBUD	**90.1**	**151.3**	**159.4**	**--**
Physical Science Research (Strategic/Fundamental)	90.1	151.3	159.4	--
Changes since 2004 PRESBUD	-44.0	+13.6		--
Physical Science Research (Strategic/Fundamental)	-44.0	+13.6		Changes due to institutional adjustments.
FY2004 PRESBUD	134.1	137.7		--
Physical Science Research (Strategic/Fundamental)	134.1	137.7		--

Indicates changes since the previous year's President's Budget Submit
Indicates budget numbers in full cost.

The Payload Operations Integration Center (POIC), located at Marshall Space Flight Center (MSFC), provides operational payload flight control, planning, and development systems for the ISS.

Research Partnerships and Flight Support

MAJOR EVENTS IN FY 2005

All Research Partnership and Flight Support (RPFS) major events listed below will be accomplished **pending the Exploration Replanning.**

- As part of its realignment plan, Space product Development (SPD) will develop new research partnerships with other divisions of BPRE, other NASA Enterprises and other federal agencies.
- SPD will initiate a new funding allocation system for the Research Partnership Centers (RPCs), which will incorporate the realignment objectives.
- SPD will start work on four new realignment initiatives that directly address NASA's mission and involve the RPC industrial partners.
- SPD will expand its education and outreach activities to engage the public in NASA's missions, discoveries and technology.
- The ISS Downlink Enhancement Architecture (IDEA) will demonstrate 150 MBS communication for ISS research. (MUSS)
- The ISS will have the capability for -80C cold stowage of research samples upon launch of the Minus Eighty-Degree Laboratory for ISS (MELFI) freezer unit in FY2005. (MUSS)
- Mid-deck locker size units will be developed to provide additional volume for storing research samples at +4C, -20C and -180C. (MUSS)

Theme: Research Partnerships and Flight Support

OVERVIEW

PENDING EXPLORATION REPLANNING. The Research Partnerships and Flight Supports (RPFS) theme is currently composed of several sections that directly contribute to many objectives of 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 Space Product Development and the Research Partnership Centers will further NASA's mission by establishing industry-university-government partnerships making use of NASA assets, academic expertise and industry market knowledge and investment. The SPD and RPC programs are being realigned such that all activities contribute directly to the Agency mission while simultaneously providing industry researchers an access to conduct space-based experimentation they deem necessary to advance applications on earth. The dual-use philosophy allows both industry and NASA to benefit from the activities with industry and NASA sharing the costs. (Note: RPFS will be conducting a major review of priorities to ensure alignment of activities with the new Exploration vision. Some of the specific activities described here may change.)

The RPFS theme also includes the cross-cutting functions of Multi-User Systems & Support (MUSS), which encompasses the multi-use hardware development projects, and the overall ISS Shuttle, Progress, and Soyuz payload integration, ground processing, and operations support.

Finally, the RPFS theme currently includes integration responsibilities for the Alpha Magnetic Spectrometer (AMS), a major high-energy space particle physics experiment planned for the ISS with the U. S. Department of Energy.

Missions	Goals supported by this Theme	Objectives supporting these Goals
To 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.	3.2 Improve the Nation's economic strength and quality of life by facilitating innovative use of NASA technology.
		3.3 Resolve scientific issues in the low gravity environment of space that enrich life on Earth by leading to better design tools in energy, materials, medical, and communication technologies.
To Inspire the Next Generation of Explorers	7. Engage the public in shaping and sharing the experience of exploration and discovery.	7.1 Improve public understanding and appreciation of science and technology, including NASA aerospace technology, research, and exploration missions.

RELEVANCE

The SPD program provides research partners with the capabilities to pursue product lines with dual purpose applications which include improving NASA spacecraft and commercial aircraft safety, improving human health in space and on Earth, creating enabling technologies for exploration and development of space, and supporting the Biological and Physical Research Enterprise (BPRE) strategic and fundamental research goals (see Annual Performance Goal 5RPFS2) 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.

Education and Public Benefits
The SPD program results in research lead to new businesses, products, and services that are of value to NASA, 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, a direct understanding of the benefits of the space environment for research and development, and awareness of the needs of industry.

IMPLEMENTATION

PENDING EXPLORATION REPLANNING. 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 Marshall Space Flight Center (MSFC), and the RPCs, and the Johnson Space Center (JSC) Payloads Office to achieve the aforementioned goals and objectives. POC is Dr. Frank Schowengerdt, Director of the Space Product Development Division, and Peter Ahlf, Acting Director of the Mission Integration Division. Full compliance with NPR 7120.5B will be achieved in FY04 for the relevant portions.

Theme: Research Partnerships and Flight Support

IMPLEMENTATION SCHEDULE

Theme Element	Schedule by Fiscal Year 95 96 97 98 99 00 01 02 03 04 05 06 07 08 09 10	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 dual use research that is directly related to the NASA mission.
MUSS: Payload Operations and Integration Center (POIC)		The POIC provides operational payload flight control, planning, and 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 Research Facility (WORF)		WORF is a payload rack uniquely built to take full advantage of the optical quality window to the U.S. Lab.

Tech & Adv Concept Development Operations Research

STATUS

In FY 2002, SPD transitioned four RPCs from another NASA Enterprise. Some of the major accomplishments included the flight of six commercial research experiments to the ISS, the 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.

PERFORMANCE MEASURES

Outcomes/Annual Performance Goals (APGs)	
Outcome 3.2.2	*By 2008, realign commercial product development to focus on NASA needs, while maintaining industrial partnerships.*
5RPFS1	Implement SPD realignment plan by establishing three partnerships between SPD and other divisions of OBPR.
5RPFS2	Involve RPC industrial partners in at least one new project that directly benefits NASA's mission.
Outcome 3.2.3	*By 2008, develop and test at least two design tools for advanced materials and in-space fabrication, and validate on ISS.*
5RPFS3	Based on present manifest, begin on-orbit containerless processing of new ceramic materials using Space-DRUMS hardware installed on ISS.
Outcome 3.2.4	*By 2008, working with all OBPR research organizations and other NASA enterprises, identify at least three additional users of Research Partnership Center spaceflight hardware.*
5RPFS4	Promote availability of RPC-built spaceflight hardware throughout NASA utilizing the new database.
5RPFS5	Implement hardware sharing system.
5RPFS6	Identify and develop a working relationship with at least one new non-SPD user of RPC-built spaceflight hardware.
Outcome 3.3.3	*By 2008, develop at least three new leveraged research partnerships with industry, academia, and other government agencies that improve NASA spacecraft safety.*
5RPFS7	Develop a prototype system based on one new enabling technology to improve the safety of space transportation systems
Outcome 7.1.4	*Engage the public in NASA missions, discoveries and technology through public programs, community outreach, mass media, and the Internet.*
5RPFS8	Through collaboration with PAO, establish and sustain a series of media briefings highlighting OBPR research.
5RPFS9	Expand outreach activities that reach minority and under-represented sectors of the public, through increased participation in conferences and community events that reflect cultural awareness and outreach. Each fiscal year, increase the previous year baseline by supporting at least one new venue that focuses on these public sectors.
Uniform Measures	
5RPFS10	Deliver at least 90% of scheduled operating hours for all operations and research facilities.

Theme: Research Partnerships and Flight Support

INDEPENDENT REVIEWS

Review Types	Performer	Last Review Date	Next Review Date	Purpose
Types of Reviews	Performer	Last Review Date	Next Review Date	Purpose
Space Station Independent Assessment	NASA	10/01	N/A	Assessment of ISS Program and the MUSS activities.
POCAAS	Independent Committee	1/02	N/A	assessment of payload operations and associated flight/ground architecture
Research Prioritization Independent Rev	Booz Allen Hamilton	2/04	11/05	HQs directed retrospective evals of tasks, progress, & status of RPs every 3 yrs
Space Station Utilization Adv. Committee	Independent Committee	6/03	6/04	Review and advise on overall utilization of the International Space Station.
ReMaP	Independent Committee	9/02	N/A	Set priorities for ISS research.

BUDGET

Budget Authority ($ millions)	FY 2003	FY 2004	Change	FY 2005	Comments
Research Partnerships and Flight Support	**170.0**	**260.0**	**-3.0**	**257.0**	**Pending Exploration Replanning**
Operations	138.5	229.0	+4.4	233.4	
Operations - Space Product Development	15.4	18.6	-10.4	8.2	
Operations - Multi-User System and Support	123.1	210.4	+14.8	225.2	
Research	31.6	31.0	-7.4	23.6	

Indicates changes since the previous year's President's Budget Submit

Indicates budget numbers in full cost.

Theme: Research Partnerships and Flight Support
Operations: Space Product Development

PURPOSE

Objectives	Performance Measures
3.2	5RPFS1-6,10

PENDING EXPORATION REPLANNING. The Space Product Development (SPD) and the Research Partnership Centers (RPC) will further NASA's mission by establishing industry-university-government partnerships, making use of NASA assets, academic expertise, and industry market knowledge and investment. SPD and RPC programs have been realigned such that all activities contribute directly to the Agency mission while assuring that industry researchers have efficient access to space. The dual use philosophy allows both industry and NASA to benefit from the activities with industry and NASA sharing the costs (see 5RPFS1). (Note: RPFS will be conducting a major review of priorities to ensure alignment of activities with the new Exploration vision. Some of the specific activities described here may change.)

OVERVIEW

The SPD and RPC programs provide research partners with the capabilities to pursue product lines with dual-purpose applications which include improving NASA spacecraft and commercial aircraft safety, improving human health in space and on Earth, creating enabling technologies for exploration and development of space, and supporting BPRE strategic and fundamental research goals and Annual Performance Goals.

PROGRAM MANAGEMENT

The SPD program responsibility is delegated to Mary Kicza, the BPRE Associate Administrator, to the Headquarters Division Director and then to Marshall Space Flight Center under the authority of the Space Product Development Office. The Commercial Advisory Subcommittee (CAS) assists in an advisory capacity. Projects of the RPCs are subject to the project requirements of the RPCs. For details, see the SPD Program Plan (a copy can be obtained through the MSFC Space Product Development Office). Full compliance with NPR 7120.5B will be achieved in FY04 for the relevant portions.

TECHNICAL COMMITMENT

PENDING EXPLORATION REPLANNING. The definition of the baseline is contained in the SPD FY04 President's Budget Submit dated January 2003.

Technical Specifications	FY 2005 President's Budget	Change from Baseline
Hydrospectral Sensor for Global Environmental Imaging and Analysis (HYGEIA)	H/W Ready-1/05	--
HDMAX Space Camera System	Preliminary Design Review(PDR)-10/03; Critical Design Review(CDR)-2/04; H/W Ready 1/05	--
Space Dynamically Responding Ultrasonic Matrix System (Space DRUMS)	PDR-10/98; CDR-9/99; H/W Ready-'02	--
Zeolite Crystal Growth High Temperature Furnace (ZCG-HTF)	PDR-03/01; CDR-11/01; H/W-12/02	--
Commercial Biomedical Testing Module (CBTM)	PDR-02/03; CDR-09/03; H/W Ready-04	--
Commercial Generic Bioprocessing Apparatus (CGBA)	PDR-Completed; CDR-Completed; H/W Ready-02	--
Plant Generic Bioprocessing Apparatus (PGBA)	PDR-Completed; CDR-Completed; H/W Ready-03	--
Commercial Protein Crystal Growth-High Density (CPCG-H)	PDR-Completed; CDR-Completed; H/W Ready-04	--
Commercial Protein Crystal Growth-Video (CPCG-V)	PDR-9/97; CDR-8/99; H/W Ready-03	--
Development of Organic Materials for Electronics (DOME)	PDR-8/01; CDR-12/01; H/W-TBD-03	--

Schedule	FY 2005 President's Budget	Change from Baseline
2002-2004, 2005-2007	Independent review of Research Partnership Centers, 3 year cycle.	--
April 2002-2007	6-month review of RPC milestone accomplishments.	--
Nov 2002-2007	Annual renewal of Research Partnership Center Cooperative Agreements.	--

Theme: Research Partnerships and Flight Support
Operations: Space Product Development

Acquisition Strategy and Performing Organizations

The SPD/ISSRC program is in place through five-year Cooperative Agreements with competitively-procured university-based Research Partnership Centers. These agreements are renewable each year after receipt of the annual report and other indicators that the agreed milestones/deliverables have been met.

Current Acquisition	Actual*	Selection Method	Actual*	Performer	Actual*
Cooperative Agreement	83%	Full & Open Competition	100%	Industry	13%
Cost Reimbursable	0%	Sole Source	0%	Government	0%
Fixed Price	13%			NASA Intramural	4%
Grants	0%		100%	University	78%
Other	4%	Sci Peer Review	%	Non Profit	5%
*As of FY 2003 direct procurement	100%	*As of FY 2003 direct procurement	100%	*As of FY 2003 direct procurement	100%

Future Acquisition	Selection	Goals
H/W Testing Contract	----	Renew as contract expires to maintain continuous support.
ISS Manifest Contract	Fall '05	New contract needed starting in FY05

Agreements

Internal: None. External: Space Act Agreements with private companies/individuals. Cooperative Agreements are in existence with each RPC and host university. Changes since FY04 President's Budget: None.

Risk Mitigation

Risk Date: 1/15/2004

Top Risks	Y	Overall	G	Cost	Y	Schedule	G	Technical	Probability	Impact	Mitigation Plan
R	5RPFS2-Loss of Consortia-based infrastructure								High	High	Strategic Realignment underway
R	5RPFS1-Loss of industry participation/resources as a result of NASA Mission focus								High	High	Strategic Realignment underway

Independent Reviews

Review Types	Performer	Last Review Date	Next Review Date	Purpose
RPC Independent Review	Booze Allen Hamilton	2/04	11/05	HQ directed retrospective evals of tasks, status & progress of RPCs every 3 yrs
ReMAP	Independent Committee	9/03	N/A	Set Priorities for ISS research

Budget

Budget Authority ($ millions)	FY 2003	FY 2004	FY 2005	Comments
FY2005 PRESBUD	15.4	18.6	8.2	
Operations	15.4	18.6	8.2	
Changes since 2004 PRESBUD	-0.4	-0.2		
Operations	-0.4	-0.2		Realignment of SPD Program elements to better serve NASA Mission.
FY2004 PRESBUD	15.8	18.8		
Operations	15.8	18.8		

Indicates changes since the previous year's President's Budget Submit
Indicates budget numbers in full cost.

Theme: Research Partnerships and Flight Support
Operations: Multi-User System and Support

PURPOSE

Objectives	Performance Measures
4.1, 4.2	5RPFS10

PENDING EXPLORATION REPLANNING. MUSS's objective is to provide end-to-end payload integration processing. MUSS provides the following services to enable ISS research; Initial manifesting, engineering integration, crew training, mission integration, ground testing, on-orbit operations, and experiment return. MUSS also develops and sustains multi-use hardware for the Principal Investigators. (Note: RPFS will be conducting a major review of priorities to ensure alignment of activities with the new Exploration vision. Some of the specific activities described here may change.)

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 EXpedite the PRocessing of Experiments to Space Station (EXPRESS) 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 (HHRs). 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 Integration Function (POIF).

PROGRAM MANAGEMENT

Enterprise Official is Mary Kicza, Associate Administrator, with Peter Ahlf as the Acting Mission Integration Division Director and Naseem Saiyed as the Program Executive. MUSS program management is implemented by the Johnson Space Center Payloads Office (JSC/OZ) by Dan Hartman, Acting Director. Full compliance with NPR 7120.5B will be achieved in FY04 for the relevant portions.

TECHNICAL COMMITMENT

PENDING EXPLORATION REPLANNING. The definition of the baseline is as of the FY 2004 President's Budget Submit January 2003.

Technical Specifications	FY 2005 President's Budget	Change from Baseline
ISS Downlink Enhancement Architecture (IDEA)	Enable 150 mbs communications for ISS research	--
MERLIN-2	7 Flight Units, 1 Qualification Unit all with the capability of +4/-26 degrees C	--
Passive Rack Isolation System (PaRIS)	Deliver 3 units	--
General Laboratory Active Cryogenic ISS Experiment Refrigerator (GLACIER)	2 Flight Units, 1 Qualification Unit all with the capability of -180 degrees C	--
Minus Eighty-degree Laboratory for ISS (MELFI)	Integrate for launch	--

Schedule	FY 2005 President's Budget	Change from Baseline
PaRIS for HHR-2	March 2004	--
MERLIN-2	April/May 2004	--
MELFI	October 2004	--
IDEA	December 2004	--
GLACIER	September 2006	--

Theme: Research Partnerships and Flight Support
Operations: Multi-User System and Support

ACQUISITION STRATEGY AND PERFORMING ORGANIZATIONS

The prime contractor for the POIC is Lockheed Martin. Present work includes sustaining engineering and maintenance of the facility. This contract runs through the end of FY04 and subsequently recompeted. The prime contractor for the ISS Payload Integration Contract is Boeing. This contract runs through FY04 with an option for FY05. In FY02, direct procurement represented 100% of budget authority. Changes since FY03 President's Budget: None.

Current Acquisition	Actual*	Selection Method	Actual*	Performer	Actual*
Cooperative Agreement	0%	Full & Open Competition	50%	Industry	75%
Cost Reimbursable	100%	Sole Source	50%	Government	0%
Fixed Price	0%			NASA Intramural	25%
Grants	0%		100%	University	0%
Other	0%	Sci Peer Review	%	Non Profit	0%
*As of FY 2003 direct procurement	100%	*As of FY 2003 direct procurement		*As of FY 2003 direct procurement	100%

AGREEMENTS

Internal: None. External: None. Changes since the FY04 President's Budget: None.

RISK MITIGATION

Risk Date: 1/15/2004

Top Risks	G Overall G Cost G Schedule G Technical	Probability	Impact	Mitigation Plan
G	MERLIN - 2 (new development item)	Low	Medium	In place
Y	GLACIER (new development item)	Medium	Medium	In place
G	MELFI (on-orbit performance)	Low	Medium	In Place

INDEPENDENT REVIEWS

Review Types	Performer	Last Review Date	Next Review Date	Purpose
POCAAS	Independent Assessment	1/02	N/A	Assess payload ops and associated flight/ground architecture.
ReMAP	Independent Committee	9/02	N/A	Set Priorities for ISS research
Space Station Utilization Adv. Committee	Independent Committee	6/03	6/04	Review and advise on overall utilization of International Space Station

BUDGET

Budget Authority ($ millions)	FY 2003	FY 2004	FY 2005	Comments
FY2005 PRESBUD	123.1	210.4	225.2	
Operations	123.1	210.4	225.2	
Changes since 2004 PRESBUD	-15.8	-1.8		
Operations	-15.8	-1.8		
FY2004 PRESBUD	138.9	212.2		
Operations	138.9	212.2		

Indicates changes since the previous year's President's Budget Submit
Indicates budget numbers in full cost.

Theme: Research Partnerships and Flight Support
Research: Research Partnership Centers

PURPOSE

Objectives	Performance Measures
3.2, 3.3	5RPFS1-7

PENDING EXPLORATION REPLANNING. The Space Product Development (SPD) and the Research Partnership Centers (RPC) will further NASA's mission by establishing industry-university-government partnerships making use of NASA assets, academic expertise, and industry market knowledge and investment. The RPC program is being realigned to provide dual use for its programs benefiting industry and supporting NASA's vision and mission while sharing costs. (Note: PSR will be conducting a major review of priorities to ensure alignment of activities with the new Exploration vision. Some of the specific activities described here may change.)

OVERVIEW

The Research Partnership Centers are in the process of being realigned to provide industry, academia, and other government agencies the opportunity to pursue dual purpose products that can eventually be brought to market and that support NASA's mission. These partnerships provide financial support to product lines that improve NASA spacecraft and commercial aircraft safety, improve human health in space and on Earth, create enabling technologies for exploration and development of space, and support BPRE strategic and fundamental research goals.

PROGRAM MANAGEMENT

The RPCs program responsibility is delegated to Mary Kicza, the BPRE Associate Administrator, to the Headquarters Division Director then to Marshall Space Flight Center under the authority of the Space Product Development Office. The Commercial Advisory Subcommittee (CAS) assists in an advisory capacity. All projects of the RPCs are subject to the project requirements of the RPCs. For details, see the SPD Program Plan (a copy can be obtained through the MSFC Space Product Development Office). Full compliance with NPR 7120.5B will be achieved in FY04 for the relevant portions.

TECHNICAL COMMITMENT

PENDING EXPLORATION REPLANNING. The definition of the baseline is described in the FY04 President's Budget dated January 2003.

Technical Specifications	FY 2005 President's Budget	Change from Baseline
Bioserve Space Technologies Center	Antibiotic production, lignification studies	In Transition (Biotech)
Center for Advanced Microgravity Materials Processing	Zeolites/Nucleation and Control Methods	In Transition (materials)
Center for Commercial Applications of Combustion in Space	SpaceDRUMS, Water Mist	In Transition (materials)
Center for Biophysical Sciences and Engineering	Organ Rejection, Auto Immune, Protein Crystal Growth, Drug Design	In Transition (Biotech)
Center for Space Power	Miniaturization technology, etc.	In Transition (Infrastructure)
Commercial Space Center for Engineering	Engineering Center	In Transition (Infrastructure)
Consortium for Materials Development in Space	Organic Luminescence	In Transition (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	FY 2005 President's Budget	Change from Baseline
6-month reviews	April and October	None
Annual Renewals	November	None
Independent Reviews	2003, 2006, 2009	None

ACQUISITION STRATEGY AND PERFORMING ORGANIZATIONS

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 Acquisition	Actual*	Selection Method	Actual*	Performer	Actual*
Cooperative Agreement	60%	Full & Open Competition	100%	Industry	26%
Cost Reimbursable	0%	Sole Source	0%	Government	0%

Theme: Research Partnerships and Flight Support

Research: Research Partnership Centers

Current Acquisition	Actual*	Selection Method	Actual*	Performer	Actual*
Fixed Price	26%			NASA Intramural	14%
Grants	0%		100%	University	56%
Other	14%	Sci Peer Review	%	Non Profit	4%
*As of FY 2003 direct procurement	100%	*As of FY 2003 direct procurement		*As of FY 2003 direct procurement	100%

Future Acquisition	Selection	Goals
Outreach Contract	Fall '05	New contract needed starting in FY06.
Media Relations Contract	---	Renew as contract expires to maintain continuous support.
Graphics Contract	---	Renew as contract expires to maintain continuous support.
Renewal of Cooperative Agreements (CA)	Fall '05	CA renewal based on recipient meeting agreed to milestones in current year CA.
Independent Review Contract	Fall '05	Contract for Independent review every 3 years

AGREEMENTS

Internal: None. External: Space Act Agreements are in existence with private companies. Cooperative Agreements are in existence with each RPC and host university.

RISK MITIGATION

Risk Date: 1/15/2004

Top Risks	Y	Overall	G	Cost	Y	Schedule	G	Technical	Probability	Impact	Mitigation Plan
Y	Loss of industry participation/resources as a result of NASA mission focus								High	High	Realignment

INDEPENDENT REVIEWS

Review Types	Performer	Last Review Date	Next Review Date	Purpose
RPC Independent Review	Booz Allen H.	2/04	11/05	HQ directed retrospective eval of tasks, status, & progress of RPCs every 3 yrs
ReMAP	Independent Committee	9/03	N/A	Set Priorities for ISS research

BUDGET

Budget Authority ($ millions)	FY 2003	FY 2004	FY 2005	Comments
FY2005 PRESBUD	31.6	31.0	23.6	
Research Partnership Centers (RPC)	18.0	14.1	8.7	
Alpha Magnetic Spectrometer/ Mission Integration	0.2	3.4	3.5	
Program Support Funds Consolidation	13.4	13.5	11.4	
Changes since 2004 PRESBUD	+16.8	+1.2		
Research Partnership Centers (RPC)	+3.4	+1.2		Realignment of SPD program elements to better serve the NASA Mission
Alpha Magnetic Spectrometer/ Mission Integration	+0.2	-		
Program Support Funds Consolidation	+13.2	-		
FY2004 PRESBUD	14.8	29.9		
Research Partnership Centers (RPC)	14.6	13.0		
Alpha Magnetic Spectrometer/ Mission Integration		3.4		
Program support funds consolidation	0.2	13.5		

Indicates changes since the previous year's President's Budget Submit

Indicates budget numbers in full cost.

In this ISS onboard photo, Expedition Six Science Officer Donald R. Petit works to set up the Pulmonary Function in Flight (PuFF) experiment hardware in the Destiny Laboratory. The PuFF experiment was developed to better understand what effects long-term exposure to microgravity may have on the lungs.

Biological Sciences Research

Major Events in FY 2005

Biological Sciences Research (BSR) major events listed below will be accomplished **pending the Exploration Replanning**. Bioastronautics events will occur in conjunction with priorities developed with the Bioastronautics Critical Path Roadmap.

- BSR-Bioastronautics will systematically explore the utility of Artificial Gravity as a multi-system countermeasure in ground based venues using test subjects deconditioned by bed rest.
- BSR-Bioastronautics will improve ability to predict risks associated with exposure to radiation by funding additional high quality research using the National Space Radiation Laboratory.
- BSR-Bioastronautics will complete preliminary study of Advanced Integration Matrix.
- BSR-Bioastronautics will continue to development of Sabatier technology to help close the water loop on the International Space Station (ISS).
- BSR-Fundamental Space Biology (FSB) will reach its anticipated Flight Hardware Availability status for the Habitat Holding Rack No. 2.
- BSR-FSB will reach its anticipated Flight Hardware Availability status for the Life Sciences Glovebox from the Japanese Aerospace Exploration Agency (JAXA).
- BSR-FSB will initiate development of flight experiments solicited in the FY 2004 International Research Announcement.

Theme: Biological Sciences Research

Overview

PENDING EXPLORATION REPLANNING. Biological Sciences Research (BSR) includes: (1) strategic research that is required to support development of tools, procedures, and technologies to ensure the health, safety, and efficient support of human crews engaging in space exploration; (2) research to enable understanding of how cells, organisms, animals and plants respond to gravity and its absence in space exploration; and (3) projects to develop and demonstrate concepts for new technologies that will improve life support and environmental systems used in human space flight. The Biological Sciences Research theme addresses the understanding of how gravity interacts with life processes at the molecular, cellular, systems, or behavioral levels on human crews in space. The research findings also have application on Earth. Just as studying life's interaction with other environmental factors, such as light and oxygen, provides fundamental insight into life's inner workings, the ability to manipulate gravity levels also provides a new and powerful means of studying the fundamental mechanisms of living processes. (Note: BSR will be conducting a major review of priorities to ensure alignment of activities with the new Exploration vision. Some of the specific activities described here may change.)

Missions	Goals supported by this Theme	Objectives supporting these Goals
To 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 Determine how fundamental biological processes of life respond to gravity and space environments.
Exploration Capabilities	9. Extend the duration and boundaries of human space flight to create new opportunities for exploration and discovery.	9.1 Understand human physiological reactions to reduced gravity and develop countermeasures to assure survival of humans traveling far from Earth.
		9.2 Develop new human support systems and solutions to low gravity technological challenges to allow the next generation of explorers to go beyond low earth orbit.

Relevance

Human space flight is inherently risky. The maintenance of crew health is required to operate the International Space Station (ISS) and its associated research, as well as to expand human presence beyond where we have been. A key element of our strategic research is specifically established to focus on methods to reduce risk, improve safety and maintain health, through attaining new knowledge and developing countermeasures 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.

Studies of the response and adaptation of cells and organisms to space will result in new insights into the effects of gravity and other space environment characteristics on biological processes, providing critical knowledge about the mechanisms underlying the human health risks associated with space flight. In addition, novel information about general principles that regulate biological systems in space provides fundamental knowledge regarding general biological processes on Earth. Long duration exposures to space provide the first opportunity to study how organisms respond to this new environment through complete life cycles and through multiple generations.

This research seeks to unravel the underlying mechanisms to answer 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?

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. 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.

Implementation

The Enterprise Official for the Biological Sciences Research Theme is Mary Kicza, Associate Administrator for the Biological and Physical Research Enterprise (BPRE). The Headquarters Division Director for Fundamental Space Biology (FSB) is Dr. Terri Lomax. The Fundamental Space Biology Program is managed and implemented by the Ames Research Center (ARC) under the authority of the ARC Fundamental Space Biology Research Integration Office. The Center Responsible Official at ARC is Dr. Gary Jahns. The HQ Division Director for Bioastronautics Research is Dr. Guy Fogleman. The Bioastronautics Research (BR) Program coordination responsibility is assigned to the Johnson Space

Center (JSC), under the supervision of John Rummel, Chief, Office of Bioastronautics. The Center Responsible Officials at JSC are Cindy Haven, Bill Paloski, and Mark Jernigan.

IMPLEMENTATION SCHEDULE

Theme Element	Schedule by Fiscal Year 95 96 97 98 99 00 01 02 03 04 05 06 07 08 09 10	Purpose
Biomass Production System (BPS)		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-1 (HHR-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; provided by an International Cooperative Agreement with the Canadian Space Agency.
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 Japanese Aerospace Exploration Agency.
Centrifuge (CR)		Supports a variety of habitat types and provides a selectable, simulated gravity environment for biological specimens on the ISS; provided by an ISS Barter Offset Agreement with the Japanese Aerospace Exploration Agency (JAXA).
Fundamental Space Biology Research		Provides research grants for the study of life sciences research concerning the space environment.
Human Research Facility-1 (HRF-1)		Enables a systematic study of human physiological, behavioral and chemical changes induced by space flight.
Human Research Facility-2 (HRF-2)		Builds on the HRF-1, by adding new hardware that allows additional science capability.
Bioastronautics Research		Provides research grants for the systematic study of human physiological and behavioral changes induced by space flight, and for the development of technologies to support humans in space.
Habitat Holding Rack-2 (HHR-2)		Provides functional support services required by each subrack payload. Also provides a passive vibration control system to protect the payloads from ISS vibration.
Cell Culture Unit (CCU)		Provides highly automated cell culture experiments.
Advanced Animal Habitat (AAH)		Designed to support experiments utilizing rodents; interfaces with LSG and CR.
Plant Research Unit (PAU)		Designed to support experiments for large plant species; interfaces with LSG and CR.
Passive Dosimeter System		Measures biologically active space radiation at specific experiment locations; provided by an International Cooperative Agreement with the Hungarian Space Agency.

Tech & Adv Concept Development Operations Research

Full compliance with NPR 7120.5B will be achieved in FY04 for the relevant portions.

STATUS

During FY03, the FSB program supported 154 investigations (128 ground-based/26 flight); released 2 solicitations for ground-based research resulting in the receipt of 117 proposals (Radiation investigations and 2 Radiation NSCORS were selected in FY03, additional ground-based research selections will be made in FY04); proceeded with planning for early ISS utilization including payloads developed for delivery to ISS by Progress missions; selected & developed for flight studies that will investigate changes in microbial virulence in space, muscle atrophy & potential countermeasures, and genomic changes associated with space flight. FSB investigators published over 200 articles in peer-reviewed journals in FY03 and publications have been submitted, reporting results from the BPS on Increment 4.

The BR program maintained a peer-reviewed research program in Biomedical Research & Countermeasures and in Advanced Human Support Technology to support health, safety, and performance of humans in space. BR sponsored a total of 272 investigations in FY03 and issued 5 Research Announcements. BR investigators published over 300 articles in peer-reviewed journals during 2003, and are also beginning to publish results of experiments conducted during ISS Increments 1-8. There are currently 3 published peer-reviewed papers from early ISS Increments; 4th paper awaits publication. BR completed the NASA Space Radiation Laboratory (NSRL) in Jun03 to enable investigators to perform research using heavy ion radiation. Commissioning experiments began in Jul03. NASA selected 29 individual investigators as the first group of NSRL researchers for the first operational runs set for Oct03.

BR investigators gathered data using the HRF on ISS. During FY03, there were 11 biomedical experiments on ISS. There are currently 23 experiments in the ISS flight program in various stages of preparation, operation, or data analysis. Three examples are: Foot Reaction Forces During Space Flight (studies leg loads on Earth & during treadmill running on ISS to better understand effectiveness of ISS exercises to develop/maintain bone strength), Crew-Member & Crew-Ground Interactions during International Space Missions (studies important interpersonal factors that impact crew and ground support personnel performance during ISS missions), and Pulmonary Function in Flight (measures the effects of long-duration exposure to microgravity and EVA on lung function). HRF Rack 2 has been delivered to KSC & is awaiting a new launch date. In FY03, risk mitigation accomplishments included a Sabatier reactor for ISS, including design of a long life compressor & a gas-water separator to be manufactured in FY04, along with substantial progress on the Vapor Phase Catalytic Ammonia Removal (VPCAR) system which contributed to a reduction of the calculated system mass by 40% compared to the ISS baselined system.

The Program Assessment Tool (PART) evaluation concluded that BSR had not demonstrated results. Although the selection and prioritization of scientific research has improved, additional work is needed to develop suitable performance goals and demonstrate results. To improve the next PART evaluation, the program must refocus to support the new exploration vision.

Go to http://spaceresearch.nasa.gov/research_projects/programs.html for more information.

PERFORMANCE MEASURES

Outcomes/Annual Performance Goals (APGs)	
Outcome 4.1.1	*Use ground-based simulators and ISS to determine gravity responses for at least five model organisms by 2008.*
5BSR1	Solicit ground-based research on three widely studied model organisms.
5BSR2	Implement a tactical plan for plant research and solicit studies appropriate to that plan on at least two model plant species.
Outcome 4.1.2	*Develop predictive models of cellular, pathogenic, and ecological responses to space for at least two organisms by 2008.*
5BSR3	Solicit ground-based research on responses of cells and pathogens to space environments.
5BSR4	Initiate intra- and interagency programs to study microbial ecology and evolution
Outcome 4.1.3	*By 2008, structure the Fundamental Space Biology flight research program to emphasize at least five model organisms and teams of Principal Investigators.*
5BSR5	Develop selected flight research experiments on two model organisms in coordination with research teams for identified flight opportunities.
5BSR6	Align reprioritized fundamental biology flight experiments with available hardware and hardware development.
Outcome 9.1.1	*By 2008, develop and test candidate countermeasures using ground-based analysis and space flight.*
5BSR7	Increase the use of space flight analogs on the ground to better define hypotheses for flight experiments
5BSR8	Publish final results of Bioastronautics experiments conducted during ISS increment 8 and preliminary results from Increments 9 and 10.
5BSR9	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.
5BSR10	Under the Human Research Initiative (HRI) increase the number of investigations addressing biomedical issues associated with human space exploration.
5BSR11	Conduct scientific workshops to fully engage the scientific community in defining research strategies for addressing and solving NASA's biomedical risks.
Outcome 9.1.2	*By 2008, reduce uncertainties in estimating radiation risks by one-half.*
5BSR12	Expand the space radiation research science community to involve cutting edge researchers in related disciplines by soliciting, selecting, and funding high quality research.
5BSR13	Use 1000 hours/yr of beam time at the National Space Radiation Laboratory (NSRL) 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.
5BSR14	Integrate research data collected over the past two years at NSRL, with existing database to develop more accurate predictions resulting in improved biological strategies for radiation risk reduction.
Outcome 9.1.3	*Advance understanding of the role of gravity in biological processes to support biomedical research.*
5BSR15	Maintain a completed, productive, peer-reviewed ground-based research program in appropriate fundamental biology disciplines to lay the groundwork for advanced understanding of the role of gravity in biological processes associated with the human health risk of space flight.
5BSR16	Initiate a nanosatellite program for in-situ analytical technology for producing the fundamental biological understanding necessary for countermeasure development.

Theme: Biological Sciences Research

Outcomes/Annual Performance Goals (APGs)	
Outcome 9.2.1	*Identify & test technologies by 2010 to reduce total mass requirements by a factor of three for Life Support using current ISS mass requirement baseline.*
5BSR17	Demonstrate, through vigorous research and technology development, a 55% reduction in the projected mass of a life support flight system compared to the system base-lined for ISS.
Uniform Measures	
5BSR18	Complete all development projects within 110% of the cost and schedule baseline.
5BSR19	Deliver at least 90% of scheduled operating hours for all operations and research facilities.
5BSR20	At least 80%, by budget, of research projects will be peer-reviewed and competitively awarded.

INDEPENDENT REVIEWS

Review Types	Performer	Last Review Date	Next Review Date	Purpose
Independent Cost Assessment	MSFC CFO	1/02	N/A	Assess non-recurring SSBRP hardware
COLSA Independent Assessment	COLSA Corp.	11/01	N/A	Basis for Habitat Holding Rack cost growth and solutions
ReMAP	Independent Committee	9/02	N/A	Set priorities for ISS research
NASA Advisory Committee	BPRAC	10/03	2/04	Program Review (usually three times a year) including performance measures
Enterprise Strategy Review	BPRAC members/PIs/NASA Centers	6/03	6/06	Review BPRE's Enterprise Strategy with Research Community.

BUDGET

Budget Authority ($ millions)	FY 2003	FY 2004	Change	FY 2005	Comments
Biological Sciences Research	**268.6**	**368.0**	**+123.5**	**491.5**	Pending Exploration Replanning
Development	12.7	10.4	-6.9	3.5	
Human Research Facility (HRF) - 2	3.5	2.1	-2.1		
Habitat Holding Rack (HHR)	9.2	8.3	-4.8	3.5	
Operations	79.3	128.3	-9.3	119.0	
Operations - Bioastronautics Research (BR)	29.0	47.3	-13.6	33.7	
Operations - Fundamental Space Biology (FSB)	50.3	81.0	+4.3	85.3	
Research	176.6	229.3	+139.7	369.0	
Research - Bioastronautics Research (BR)	126.5	163.9	+144.9	308.8	Increase reflects new priority based on Exploration vision
Research - Fundamental Space Biology (FSB)	50.1	65.4	-5.2	60.2	

Indicates changes since the previous year's President's Budget Submit

Indicates budget numbers in full cost.

Theme: Biological Sciences Research
Development: Habitat Holding Rack (HHR)

PURPOSE

Objectives	Performance Measures
4.1	5BSR5-6,18

PENDING EXPLORATION REPLANNING. The Habitat Holding Rack (HHR) provides living quarters for various organisms and cells 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 biological processes using gravity as a tool. In addition, researchers will be able to investigate the effects of weightlessness and variable gravitational forces (e.g., 1/6 or 3/8 of Earth's gravity corresponding to the Moon and Mars, respectively) on living specimens and how to control and mitigate those effects. (Note: BSR will be conducting a major review of priorities to ensure alignment of activities with the new Exploration vision. Some of the specific activities described here may change.)

OVERVIEW

The HHR is a core element of the SSBRP and 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), and with those resources, will enable the determination of gravity thresholds for important physiological and developmental responses, providing the knowledge necessary to develop countermeasures and risk assessment for long duration human presence in space. The HHR provides unique resources necessary for life science research such as cold water cooling, video recording, backup resources for specimens, and crew time saving features. Two HHRs will be located on the International Space Station (ISS). The first is planned to be positioned in the US Lab. Once the CAM is integrated into the Station, both HHRs 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 and Physical Research. The HQ Division Director for Fundamental Space Biology is Dr. Terri Lomax. The SSBRP, of 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 Space Biology Research Integration Office. The Center Responsible Official at ARC is Dr. 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 Window Observational Research Facility (WORF) racks. HHR development is being implemented per ISSRC Program Commitment Agreement (PCA) dated July 9, 2003.

TECHNICAL COMMITMENT

PENDING EXPLORATION REPLANNING. HHR Development is being implemented per ISSRC Program Committement Agreement (PCA) dated July 9, 2003.

Technical Specifications	FY 2005 President's Budget	Change from Baseline
HHR-1 & HHR-2 operational lifetime	10 years	--
HHR-1 & HHR-2	Two units on orbit	--
	Accommodates 4 habitats (subrack 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	--

Theme: Biological Sciences Research
Development: Habitat Holding Rack (HHR)

Schedule	FY 2005 President's Budget	Change from Baseline
HHR-1 Flight Hardware Availability	July-04	--
HHR-2 Flight Hardware Availability	Dec-04	--

Acquisition Strategy and Performing Organizations

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 the FY04 President's Budget: None.

Current Acquisition	Actual*	Selection Method	Actual*	Performer	Actual*
Cooperative Agreement	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%
*As of FY03 direct procurement	100%	*As of FY03 direct procurement		*As of FY03 direct procurement	100%

Future Acquisition - Major	Selection	Goals
None (HHR complete, Boeing contract ends)	N/A	N/A

Agreements

Internal: None. External: The HHR development supports the Japanese Aerospace Exploration Agency (JAXA) development of the 2.5m diameter Centrifuge and the 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 JAXA for NASA via barter agreement. Changes since the FY04 President's Budget: None

Risk Mitigation

Risk Date: 1/15/2004

Top Risks	G	Overall	G	Cost	G	Schedule	G	Technical	Probability	Impact	Mitigation Plan
G	Software related issues								high	low	Reserves applied

Independent Reviews

Review Types	Performer	Last Review Date	Next Review Date	Purpose
COLSA Independent Assessment	COLSA Corp.	11/01	N/A	Determine basis for HHR cost growth and recommend cost reductions.
Independent Cost Assessment	MSFC CFO	1/02	N/A	Assess non-recurring SSBRP hardware development
ReMAP	Independent committee	9/02	N/A	Set priorities for ISS research

Theme: Biological Sciences Research
Development: Habitat Holding Rack (HHR)

BUDGET/LIFE CYCLE COST

Budget Authority ($ millions)	Prior	FY03	FY04	FY05	FY06	FY07	FY08	FY09	BTC	Total	Comments
FY2005 PRESBUD	75.8	9.2	8.3	3.5	0.8					97.6	
Development	75.8	9.2	8.3	3.5	0.8					97.6	
Changes since 2004 PRESBUD	+65.8	+5.7		-0.1	+0.8					+72.2	
Development	+65.8	+5.7		-0.1	+0.8					+72.2	FY03 changes due to full cost adjustments and design changes. FY04-05 changes due to design changes and institutional adjustments. "Prior" data column corrected.
FY2004 PRESBUD	10.0	3.5	8.3	3.6						25.4	
Development	10.0	3.5	8.3	3.6						25.4	
Initial Baseline		3.5	8.3	3.6						15.4	
Habitat Holding Rack (HHR)		3.5	8.3	3.6						15.4	

Indicates changes since the previous year's President's Budget Submit
Indicates budget numbers in full cost.

Theme: Biological Sciences Research

Development: Human Research Facility (HRF) - 2

PURPOSE

Objectives	Performance Measures
9.1	5BSR18

PENDING EXPLORATION REPLANNING. The Human Research Facility (HRF) enables a systematic study of physiological and behavioral 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. NASA studies areas of concern to human well-being and performance, such as renal stone risk, bone deterioration and the effects of ionizing radiation. (Note: BSR will be conducting a major review of priorities to ensure alignment of activities with the new Exploration vision. Some of the specific activities described here may change.)

OVERVIEW

The HRF is a modular International Standard Payload Rack (ISPR) that 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 which will provide an accurate means of determining the on-orbit mass of human subjects; c) the Pulmonary Function System which 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 crewmembers 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 Division Director for Bioastronautics Research is Dr. Guy Fogleman. HRF program management responsibility is delegated to the Johnson Space Center (JSC). The Center Responsible Official at JSC is Ms. Cindy Haven. HRF Development is being implemented per ISSRC Program Commitment Agreement (PCA) dated July 9, 2003.

TECHNICAL COMMITMENT

PENDING EXPLORATION REPLANNING. HRF Development is being implemented per ISSRC Program Commitment Agreement (PCA) dated July 9, 2003.

Technical Specifications	FY 2005 President's Budget	Change from Baseline
Support Biomedical	2 Racks	--
Power to Payload	3 kW per rack	--
Research and Countermeasure	HRF-2 on schedule for launch on ULF-1 (March 2004)	--
Validation - 1	Science Verification Testing HRF-1; August 2000	--
Validation - 2	Science Verification Testing HRF-2; June 2002	--
Science Instruments	Space Linear Acceleration Mass Measuring Device, Pulmonary Function System, Refrigerated Centrifuge, computer workstation	--
Facility operational lifetime	10 years	--

Schedule	FY 2005 President's Budget	Change from Baseline
HRF-1 on-orbit	March 2001	--
HRF-2 on dock at KSC	August 2002	--

ACQUISITION STRATEGY AND PERFORMING ORGANIZATIONS

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.

Theme: Biological Sciences Research
Development: Human Research Facility (HRF) - 2

Current Acquisition	Actual*	Selection Method	Actual*	Performer	Actual*
Cooperative Agreement	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%
*As of FY 2003 direct procurement	100%	*As of FY 2003 direct procurement		*As of FY 2003 direct procurement	100%

Future Acquisition - Major	Selection	Goals
Major acquisitions complete. No new acquisitions scheduled.	N/A	N/A

AGREEMENTS

Internal: None. External: Provision of the Pulmonary Function Module is dependent on the European Space Agency (ESA), according to NASA/ESA Letter of Agreement signed December 1999. Changes since the FY04 President's Budget: None.

RISK MITIGATION

Risk Date: 1/15/2004

Top Risks	G	Overall	G	Cost	G	Schedule	G	Technical	Probability	Impact	Mitigation Plan
G	Risk is minimal as hardware is on dock at KSC.								Low	Low	N/A

INDEPENDENT REVIEWS

Review Types	Performer	Last Review Date	Next Review Date	Purpose
Independent Annual Review	HQ, Space Flight Enterprise	10/01	N/A	No further reviews planned - HRF on-dock at KSC.
ReMAP	Independent Committee	9/02	N/A	Set priorities for ISS research

BUDGET/LIFE CYCLE COST

Budget Authority ($ millions)	Prior	FY03	FY04	FY05	FY06	FY07	FY08	FY09	BTC	Total	Comments
FY2005 PRESBUD	121.4	3.5	2.1							127.0	
Development	121.4	3.5	2.1							127.0	
Changes since 2004 PRESBUD	+114.8	-2.0								+112.8	
Development	+114.8	-2.0								+112.8	No significant changes to FY03-05. "Prior" data column corrected.
FY2004 PRESBUD	6.6	5.5	2.1							14.2	
Development	6.6	5.5	2.1							14.2	
Initial Baseline		5.5	2.1							7.6	
Human Research Facility (HRF)		5.5	2.1							7.6	

Indicates changes since the previous year's President's Budget Submit
Indicates budget numbers in full cost.

Theme: Biological Sciences Research
Operations: Fundamental Space Biology (FSB)

Purpose

Objectives	Performance Measures
4.1, 9.1	5BSR5-6,12,19

PENDING EXPLORATION REPLANNING. The Space Station Biological Research Project (SSBRP) extends the capability to conduct life sciences research in weightlessness with greatly improved on-orbit facilities. SSBRP research equipment provides the research community the capability to perform research using a wide range of specimen types in controlled environments. Investigations address biological processes using gravity as a tool to elucidate the effects of weightlessness on living specimens, and learn how to control and mitigate those effects. Knowledge gained through the SSBRP is used to enhance human exploration of space. Such knowledge will be used initially to establish the underlying biological mechanisms in responding and adapting to space. From this knowledge, it is expected that countermeasures to the deleterious effects of space on human health will be devised or enhanced. In addition, the knowledge gained often has wide-ranging application on Earth. (Note: BSR will be conducting a major review of priorities to ensure alignment of activities with the new Exploration vision. Some of the specific activities described here may change.)

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. As part of a barter offset agreement, the Japanese Aerospace Exploration Agency (JAXA) is providing the Life Sciences Glovebox (LSG), which provides a contained environment for crew performance of science protocols on science specimens, and the Centrifuge, which provides an environment for physiological experiments at variable g forces. The variable g capability allows the investigation and potential establishment of gravity thresholds, i.e. gravity levels at which specific biological effects are observed. The Operations budget supports classes of experiments that examine a wide range of life from the cellular level to animals. 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 Division Director for Fundamental Space Biology (FSB) is Dr. Terri Lomax. The FSB Program is managed and implemented by the Ames Research Center (ARC) under the authority of the ARC Fundamental Space Biology Research Integration Office. The Center Responsible Official at ARC is Dr. Gary Jahns. Full compliance with NPR 7120.5B will be achieved in FY04.

Technical Commitment

PENDING EXPLORATION REPLANNING. Baseline commitment as of FY 2004 President's Budget Submit dated January 2003.

Technical Specifications	FY 2005 President's Budget	Change from Baseline
Centrifuge (provided by an International Partner)	2.5 meter diameter, 4 habitats, vibration isolation, 0.01g-2.0g, cold water cooling, International Subrack Standard Interfaces	--
Life Sciences Glovebox (provided by an International Partner)	2 operators, 2 habitats, airlock, lab support equipment capability, bioisolation, cleanability, cold water cooling	--
Passive Dosimeter System (PDS)	Nuclear track detectors	--
Incubator (2 units on orbit)	4°C to 45°C internal temp, data & video capability, 90 day cap	--
Insect Habitat (1 on orbit) Provided by an International Partner	Multiple generation insect 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 (or 12 mice), environ control, video, 90 day capability	--
PRU (8 on orbit)	38cm high plants, environ control, video, 90 day capability	--
Aquatic Habitat (Provided by an International Partner)	14°C-30°C water temp., video recording, 90 day capability	--

Theme: Biological Sciences Research
Operations: Fundamental Space Biology (FSB)

Schedule	FY 2005 President's Budget	Change from Baseline
CCU Critical Design Review	Aug-03	--
PRU Delta Preliminary Design Review	Jan-04	--
AAH Delta Preliminary Design Review	Mar-04	--
Incubator Habitat Flight Hardware Availability	Jul-04	--
AAH Critical Design Review	Feb-05	--
PRU Critical Design Review	May-05	--
LSG Flight Hardware Availability	Jul-05	--
CCU Flight Hardware Availability	Mar-06	--
Centrifuge Rotor Flight Hardware Availability	Nov-06	--
AAH Flight Hardware Availability	Jun-07	--
PRU Flight Hardware Availability	Jan-08	--

Acquisition Strategy and Performing Organizations

FSB Operations has 2 primary components: Biological Research Projects (BRP) and Utilization. BRP consists of the following equipment building contracts: Lockheed Martin (Facility Integration & Incubator), ORBITEC (BPS/PRU), PSI (CCU), STAR (AAH); a co-op agreement with the Canadian Space Agency (Insect Habitat), and barter agreements for equipment w/other intern'l partners. Utilization covers all expenses associated with integrating experiments into the flight platform, performing experiments on-orbit (and related ground control experiments), and post-flight processing of specimens/data, including development of experiment unique HW, ground ops, flight ops, safety, and qual control. Changes since the FY04 Pres Budget: None

Current Acquisition	Actual*	Selection Method	Actual*	Performer	Actual*
Cooperative Agreement	0%	Full & Open Competition	85%	Industry	100%
Cost Reimbursible	95%	Sole Source	15%	Government	0%
Fixed Price	5%			NASA Intramural	0%
Grants	0%		100%	University	0%
Other	0%	Sci Peer Review	0%	Non Profit	0%
*As of FY 2003 direct procurement	100%	*As of FY 2003 direct procurement		*As of FY 2003 direct procurement	100%

Future Acquisition	Selection	Goals
Support Services Contract (Lockheed/Martin)	Summer 06	100% Full & Open Competition, 100% Cost Reimbursable
Advanced Animal Habitat	Winter 04	100% SBIR, 100% Cost Reimbursable
Plant Research Unit	Winter 04	100% SBIR, 100% Cost Reimbursable

Agreements

Internal: None. External: cooperative agreement with the Hungarian Space Agency (PDS); cooperative agreement with the Canadian Space Agency (Insect Habitat); agreement with Japanese Aerospace Exploration Agency (JAXA) for (Aquatic Habitat)is TBD; and ISS barter offset agreement with JAXA for the CAM, Centrifuge, and the LSG. Changes since FY04PresBud: None

Risk Mitigation

Risk Date: 1/15/2004

Top Risks	G Overall	G Cost	Y Schedule	G Technical	Probability	Impact	Mitigation Plan
Y	Incubator redesign (acoustics issue) impact on schedule				Moderate	Moderate	Under review
Y	Limited avail. flight opportunities impact on mission				Moderate	Moderate	Use other spacecraft
Y	CCU, S/W CDR slip; schedule impact				Moderate	Moderate	Under development

Theme: Biological Sciences Research
Operations: Fundamental Space Biology (FSB)

INDEPENDENT REVIEWS

Review Types	Performer	Last Review Date	Next Review Date	Purpose
Independent Cost Assessment	MSFC CFO	1/02	N/A	Assess non-recurring SSBRP hardware development costs & perform parametric est
ReMaP	Indep Comm	9/02	N/A	Set priorities for ISS research.

BUDGET

Budget Authority ($ millions)	FY 2003	FY 2004	FY 2005	Comments
FY2005 PRESBUD	50.3	81.0	85.3	
ISSRC Fundamental Space Biology (Operations)	50.3	81.0	85.3	
Changes since 2004 PRESBUD	-5.7	+22.2		
ISSRC Fundamental Space Biology (Operations)	-5.7	+22.2		FY03delta:HW/util incr., add'l mandated content, FC. FY04-05delta: institutional adjustments
FY2004 PRESBUD	56.0	58.8		
ISSRC Fundamental Space Biology (Operations)	56.0	58.8		

Indicates changes since the previous year's President's Budget Submit
Indicates budget numbers in full cost.

Theme: Biological Sciences Research
Operations: Bioastronautics Research (BR)

PURPOSE

Objectives	Performance Measures
9.1	5BSR9,19

PENDING EXPLORATION REPLANNING. 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 human organs. NASA studies areas of concern to human well-being and performance, such as renal stone risk, bone deterioration, and the effects of ionizing radiation. (Note: BSR will be conducting a major review of priorities to ensure alignment of activities with the new Exploration vision. Some of the specific activities described here may change.)

OVERVIEW

Bioastronautics Research operations include activities required for Human Research Facility (HRF) science development and operations, such as developing experiments and associated flight products. Some examples are devising operations concepts, defining flight resource and integration requirements and data management plans, developing crew procedures and displays, and creating products used to train the crew and ground support personnel. HRF operations include Principal Investigator (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 on-orbit hardware and software. It also includes equipment upgrades and improvements. HRF operations also include experiment integration support for Advanced Human Support Technology flight experiments. 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. The Human Research Initiative started in FY 2004. This Initiative 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 Division Director for Bioastronautics Research is Dr. 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 NPR 7120.5B will be achieved in FY04 for the relevant portions.

TECHNICAL COMMITMENT

PENDING EXPLORATION REPLANNING. Baseline commitment is as of the FY 2004 President's Budget dated January 2003.

Technical Specifications	FY 2005 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 1	Science Verification Testing HRF Rack 1 Aug 2000	Not included
Validation 2	Science Verification Testing HRF Rack 2 June, 2002	Not included
Science Instruments:	Gas Analyzer System for Metabolic Analysis Physiology (GASMAP), Ultrasound Imaging System, computer workstation	--

Theme: Biological Sciences Research
Operations: Bioastronautics Research (BR)

Schedule	FY 2005 President's Budget	Change from Baseline
SMO-006/Meck/test Midodrine as ctrmeasure agnst postflight orthostatic hypertens	--	--
E049/Pierson/comp. chararacterization of microorg./allergens in spacecraft env.	--	--
E104/Stuster/behav. issues assoc. w/long-duration space msn; review of journals	--	--
E083/Dulchavsky/advanced ultrasonic diagnosis in microgravity	--	--
E060/Bingham/optimizing root zone substrates for reduced gravity experiments	--	--
E010/Obe/chromosomal aberrations in blood lymphocytes of astronauts	--	--
E036/Levine/water offset nutrient delivery experiment	--	--
E057L/Whitson/ Renal Stone Risk During Spaceflight: Assessment and Countermeasure Validation,	--	--
E096/Kanas/crewmember and crew-ground interactions during ISS missions	--	--
E120/Bloomberg/Mobility Promoting Sensorimotor Response Generalizability: A Countermeasure to Mitigate LocomotorDysfunction after Long-Duration Space Flight,	--	--
E129/Barrett/space flight-induced reactivation of latent Epstein-Barr Virus	--	--
E318/Cavanagh/foot/ground reaction forces during space flight	--	--
E400/Fitts/effect of prolonged spaceflight on human skeletal muscle	--	--

Acquisition Strategy and Performing Organizations

The prime contractor for the HRF Operations mission is Lockheed Martin under the Wyle-led Bioastronautics contract, transferred from the "SEAT" contract on October 1, 2003. The contract covers 5 years of operations, renewable in May 2008. In FY 2003, direct procurement represented about 50% of budget authority. Changes since the FY 2004 President's Budget: new contractor, but no changes to program organization or execution.

Current Acquisition	Actual*	Selection Method	Actual*	Performer	Actual*
Cooperative Agreement	0%	Full & Open Competition	100%	Industry	100%
Cost Reimbursible	100%	Sole Source	0%	Government	0%
Fixed Price	0%			NASA Intramural	0%
Grants	0%		100%	University	0%
Other	0%	Sci Peer Review	%	Non Profit	0%
*As of FY 2003 direct procurement	100%	*As of FY 2003 direct procurement		*As of FY 2003 direct procurement	100%

Agreements

Internal: None. External: None. Changes since the FY04 President's Budget: None.

Risk Mitigation

Risk Date: 1/15/2004

Top Risks	G	Overall	G	Cost	G	Schedule	G	Technical	Probability	Impact	Mitigation Plan
G	Availability of flight opportunities determines ability to execute mission								Low	Moderate	Investigate way to min. impact

Independent Reviews

Review Types	Performer	Last Review Date	Next Review Date	Purpose
ReMaP	Independent committee	9/02	9/02	Set priorities for ISS Research.

Theme: Biological Sciences Research
Operations: Bioastronautics Research (BR)

BUDGET

Budget Authority ($ millions)	FY 2003	FY 2004	FY 2005	Comments
FY2005 PRESBUD	29.0	47.3	33.7	
Operations	29.0	47.3	33.7	
Changes since 2004 PRESBUD	+0.6	-0.4		
Operations	+0.6	-0.4		Correction to Human Research Initiative (HRI) funding from BR-Operations to BR-Research; and transfer of program reserves to other OBPR themes.
FY2004 PRESBUD	28.4	47.7		
Operations	28.4	47.7		

Indicates changes since the previous year's President's Budget Submit.
Indicates budget numbers in full cost.

Theme: Biological Sciences Research
Research: Fundamental Space Biology (FSB)

PURPOSE

Objectives	Performance Measures
4.1, 9.1	5BSR1-6,12,15-16,20

PENDING EXPLORATION REPLANNING. The Fundamental Space Biology 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 supports long-term human space flight. Such knowledge will be used initially to establish the underlying biological mechanisms in responding and adapting to space. From this knowledge, it is expected that countermeasures to the deleterious effects of space on human health will be devised or enhanced. Additionally, information from this research provides new knowledge about biological processes and their applications on Earth. (Note: BSR will be conducting a major review of priorities to ensure alignment of activities with the new Exploration vision. Some of the specific activities described here may change.)

OVERVIEW

The Fundamental Space Biology Program will focus on research in Cell and Molecular Biology, Microbial Ecology, and Organismal and Comparative Biology. It 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 associated with human space flight; (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 Division Director for Fundamental Space Biology is Dr. Terri Lomax. The Fundamental Space Biology Program is managed and implemented by the Ames Research Center (ARC) under the authority of the ARC Fundamental Space Biology Research Integration Office. The Center Responsible Official at ARC is Dr. Gary Jahns. Full compliance with NPG 7120.5B will be achieved in FY 04.

TECHNICAL COMMITMENT

PENDING EXPLORATION REPLANNING. Baseline commitment as of FY 2004 President's Budget Submit dated January 2003.

Technical Specifications	FY 2005 President's Budget	Change from Baseline
The Fundamental Space Biology Program	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.	--

Schedule	FY 2005 President's Budget	Change from Baseline
Research Announcements	Mar-04, Mar-05, Mar-06	--
Research Awards	Dec-04, Dec-05, Dec-06	--

ACQUISITION STRATEGY AND PERFORMING ORGANIZATIONS

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 Research Integration Office.

Theme: Biological Sciences Research
Research: Fundamental Space Biology (FSB)

Current Acquisition	Actual*	Selection Method	Actual*	Performer	Actual*
Cooperative Agreement	7%	Full & Open Competition	88%	Industry	20%
Cost Reimbursable	18%	Sole Source	12%	Government	0%
Fixed Price	2%			NASA Intramural	2%
Grants	73%		100%	University	70%
Other	0%	Sci Peer Review	55%	Non Profit	8%
*As of FY 2003 direct procurement	100%	*As of FY 2003 direct procurement		*As of FY 2003 direct procurement	100%

Future Acquisition	Selection	Goals
Cooperative Agreements	Spring 04	100% Cooperative Agreements- 100% Sole Source
Support Services Contract (Lockheed/Martin)	Summer 06	100% Full and Open, Cost Reimbursable
Annual Research Announcement (NRA)	Fall 04	100% Science Peer Review, 100% Grants

AGREEMENTS

Internal: None. External: None Changes since FY04 President's Budget: None

RISK MITIGATION

Risk Date: 1/15/2004

Top Risks	G	Overall	G	Cost	G	Schedule	G	Technical	Probability	Impact	Mitigation Plan
Y	Limited Availability of flight opportunities determines ability to execute mission.								Moderate	Moderate	Progress Experiments

INDEPENDENT REVIEWS

Review Types	Performer	Last Review Date	Next Review Date	Purpose
Independent committee	ReMaP	9/02	N/A	Establish research priorities for OBPR.
NASA Advisory Committee	BPRAC	2/03	2/04	Program Review (usually three times a year).

BUDGET

Budget Authority ($ millions)	FY 2003	FY 2004	FY 2005	Comments
FY2005 PRESBUD	50.1	65.4	60.2	
Research	50.1	65.4	60.2	
Changes since 2004 PRESBUD	-5.9	+6.6		
Research	-5.9	+6.6		FY 03 changes due to full cost adjustments and addition of Congressionally mandated content. FY 04-05 changes due to center repricing of full cost elements to more accurately reflect requirements, and procurement increases.
FY2004 PRESBUD	56.0	58.8		
Research	56.0	58.8		

Indicates changes since the previous year's President's Budget Submit.
Indicates budget numbers in full cost.

Theme: Biological Sciences Research
Research: Bioastronautics Research (BR)

PURPOSE

Objectives	Performance Measures
9.1, 9.2	5BSR7-14,17,20

PENDING EXPLORATION REPLANNING. 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 and manage risks to the crew. The theme also develops technologies that increase efficiency by improving spacecraft habitability, environmental controls, planetary habitability, and space systems. The Bioastronautics critical path roadmap is a systematic approach for preventing or reducing the known risks to crew health, safety and performance. Risks have been identified and Bioastronautics Research is aligned and focused toward reducing these critical risks. This research also has the potential to make significant contributions to medical care on Earth. (Note: BSR will be conducting a major review of priorities to ensure alignment of activities with the new Exploration vision. Some of the specific activities described here may change.)

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 Headquarters Division Director for Bioastronautics Research is Dr. Guy Fogleman. The Bioastronautics Research Program coordination responsibility has been delegated 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 Mark Jernigan for Advanced Human Support Technology.

TECHNICAL COMMITMENT

PENDING EXPLORATION REPLANNING. Baseline commitment is as of the FY 2004 President's Budget dated January 2003.

Technical Specifications	FY 2005 President's Budget	Change from Baseline
Bioastronautics Research	Biomedical Research and Countermeasures (BR&C) and Advanced Human Support Technology (AHST). These programs are further divided into a variety of research subdisciplines.	--

Schedule	FY 2005 President's Budget	Change from Baseline
Grant Awards	Dec 04, Dec 05, Dec 06	--
Research Announcements	Mar 04, Mar 05, Mar 06	--

ACQUISITION STRATEGY AND PERFORMING ORGANIZATIONS

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.

Theme: Biological Sciences Research
Research: Bioastronautics Research (BR)

Current Acquisition	Actual*	Selection Method	Actual*	Performer	Actual*
Cooperative Agreement	32%	Full & Open Competition	100%	Industry	23%
Cost Reimbursable	23%	Sole Source	0%	Government	6%
Fixed Price	0%			NASA Intramural	2%
Grants	45%		100%	University	69%
Other	0%	Sci Peer Review	77%	Non Profit	0%
*As of FY 2003 direct procurement	100%	*As of FY 2003 direct procurement		*As of FY 2003 direct procurement	100%

Future Acquisition	Selection	Goals
Annual Research Announcement	N/A	Issue announcement each March; awards in December.
Renew or re-compete 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 FY04 Pres. Budget: None.

RISK MITIGATION

Risk Date: 1/15/2004

Top Risks	G	Overall	G	Cost	G	Schedule	G	Technical	Probability	Impact	Mitigation Plan
G	Limited availability of flight opportunities.								Low	low	N/A

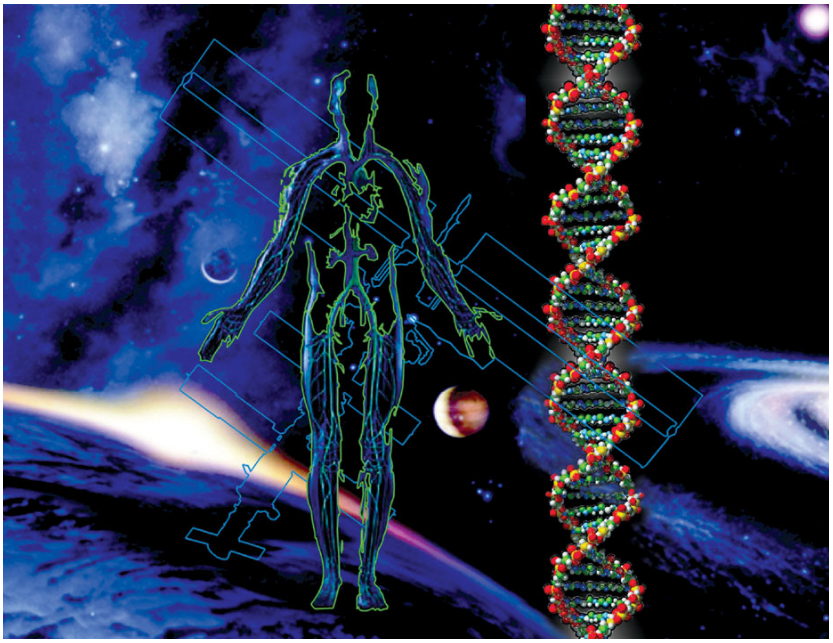
INDEPENDENT REVIEWS

Review Types	Performer	Last Review Date	Next Review Date	Purpose
NASA Advisory Committee	BPRAC	8/03	2/04	Program Review (three times a year).
ReMaP	Independent committee	9/02	N/A	Set priorities for ISS Research.
National Research Council (NRC)	Institute of Medicine		3/04	Evaluate critical path roadmap

BUDGET

Budget Authority ($ millions)	FY 2003	FY 2004	FY 2005	Comments
FY2005 PRESBUD	126.5	163.9	308.8	
Research	126.5	163.9	308.8	
Changes since 2004 PRESBUD	+13.4	+3.9		
Research	+13.4	+3.9		FY 2003 increase due to Congressionally directed funding; FY04 includes correction to HRI funding from BR-Operations to BR-Research.
FY2004 PRESBUD	113.1	160.0		
Research	113.1	160.0		

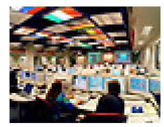
Indicates changes since the previous year's President's Budget Submit
Indicates budget numbers in full cost.



THEMES

Biological Sciences Research

Physical Sciences Research



Research Partnerships and Flight Support

NASA's Biological and Physical Research (BPR) Enterprise conducts interdisciplinary, peer reviewed, fundamental and applied research to address the opportunities and challenges to NASA that are provided by the space environment and the human exploration of space.

BIOLOGICAL AND PHYSICAL RESEARCH

PURPOSE

The Biological and Physical Research (BPRE) Enterprise has a unique role in support of NASA's Vision and Mission. In concert with the new exploration vision, BPRE will refocus research on activities that prepare human explorers to travel beyond low Earth orbit, such as the development of countermeasures against space radiation and the long-term effects of reduced gravity. During FY2004, BPRE will concentrate its efforts on studying, reviewing, and replanning current efforts, goals, and funding to best support the exploration initiatives as it matures. We expect to have an updated research plan and funding justification available Spring 2004. BPRE research seeks innovations and solutions to enable the extension of life into deep space safely and productively. Our fundamental and strategic research, as well as our research partnerships with industry and other agencies, allow new knowledge and technologies to bring improvements to life on Earth while we pursue our mission in space. Our interdisciplinary research in the unique laboratory of microgravity addresses opportunities and challenges on our home planet as well as in space environments. The Enterprise plays a key role in encouraging and engaging the next generation of explorers from primary school through the graduate level via our direct student participation in space research and our other outreach efforts.

Coordinated strategic research thrusts address topics such as radiation health and protection, biomedical countermeasures, bioregenerative life support, and engineering research supporting the technologies required for sustained human exploration of space. For humans to venture into space - beyond where we have been - NASA must be able to provide the same kind of safe cocoon for space explorers that Earth provides for its inhabitants. Understanding the process of adaptation of humans and other life forms to the environment of space is a critical role for BPRE.

The Enterprise's contributions to realizing NASA's vision are structured around five organizing questions. These questions provide a framework for all Enterprise activities:

(1) How can we assure the survival of humans traveling far from Earth?

(2) How does life respond to gravity and space environments?

(3) What new opportunities can research bring to expand understanding of the laws of nature and enrich lives on Earth?

(4) What technology must we create to enable the next explorers to go beyond where we have been?

(5) How can we educate and inspire the next generation to take the journey?

Working together across research disciplines, BPRE is performing vital research and technology development to extend the reach of human space flight. The many investigations supported by this Enterprise in the pursuit of answering our organizing questions are unique to the NASA Mission and distinguish NASA's research in these areas from that of other agencies, as well as BPRE's research from that of the rest of NASA.

FY 2003 Accomplishments

FY 2003 was a challenging time for Biological and Physical Research Enterprise. Sadly, we remember the loss of the Columbia, and mourn the deaths of seven brave and dedicated astronauts. Perhaps the greatest legacy to STS – 107 is some of the outstanding experiments performed on this mission such as:

- Learning how bone and cancer cells interact when cancer begins to spread. The astronauts used a device invented by NASA called a bioreactor that allowed these cells to grow and form assemblies much larger than anything researchers have seen before. This bioreactor will enable researchers to turn cell cultures into functional tissue, which can be used for experiments, transplants, and drug development.
- Demonstrating an improved way of burning hydrogen that could result in cleaner-burning cars in the future and other fuels in engines and furnaces.
- Collecting data on how granular materials respond to physical stressors, yielding new knowledge that can be applied to better predict how soils react in an earthquake.
- Studying how the formation of flames and the use of water droplets to quench them will provide data to replace chemical fire suppressants that are currently banned for use internationally.

Despite the stand down of the shuttle fleet, 23 BPRE research experiments were conducted on the International Space Station in FY 2003 including 12 in Bioastronautics Research, 10 in Physical Sciences, and 3 in Space Product Development research.

Theme Distribution

Budget Authority ($ in millions)	FY 2003	FY 2004	FY 2005
Biological Sciences Research	268.6	368.0	491.5
Physical Sciences Research	241.4	357.2	300.1
Research Partnerships and Flight Support	170.0	260.0	257.0
Total	680.0	985.2	1048.6

Note: For all formats, the FY 2003 column reflects the FY 2003 Congressional Operating Plan, dated 9/04/03. The FY 2004 column reflects the FY 2004 Conference committee report. The FY 2005 column represents the FY 2005 President's Budget Submit.

Indicates budget numbers in full cost

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 carrying out research to define and control these risks and to improve the performance of life support systems. The Biological Sciences Research theme also pursues fundamental biological questions from cell to tissues to whole organisms to ecosystems, which produce results that support advanced methods for enabling human exploration of space as well as enhancing understanding of biological systems and improving human health on Earth.

OVERALL BUDGET

The FY 2005 request is $491.5 million, a $123.5 million or 34 percent increase over FY 2004 President's Request in support of the new exploration vision.

- $342.5 million for Bioastronautics Research to perform research and develop technology for systems that will enable humans to live and work safely and effectively in space. These research activities are aligned with the Bioastronautics Critical Path Roadmap that identifies the critical risks associated with long-term human space travel.
- $149 million for Fundamental Space Biology to focus on research on life's responses to space environments at all levels including cell sciences and genomics, physiological adaptation and developmental biology, ecosystem interactions and multigenerational studies and the development of hardware for the Centrifuge Accommodation Module.

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 and to impact industrial and technological applications on Earth, as illustrated by the bioreactor, combustion, and materials science work mentioned earlier. This theme also supports applied physical science and engineering research to develop reduced gravity technologies critical to human space exploration, such as radiation shielding, microgravity fire safety, and those elements of spacecraft power and propulsion systems that are gravity dependent. The Physical Sciences Research program develops advanced technologies in support to NASA space crew health programs and novel engineering processes for life-sustaining resource production in a reduced-gravity and remote environment.

OVERALL BUDGET

The FY 2005 request is $300.1 million, a $57.1 million or 16 percent decrease of the FY 2004 President's Request in support of the new exploration vision:

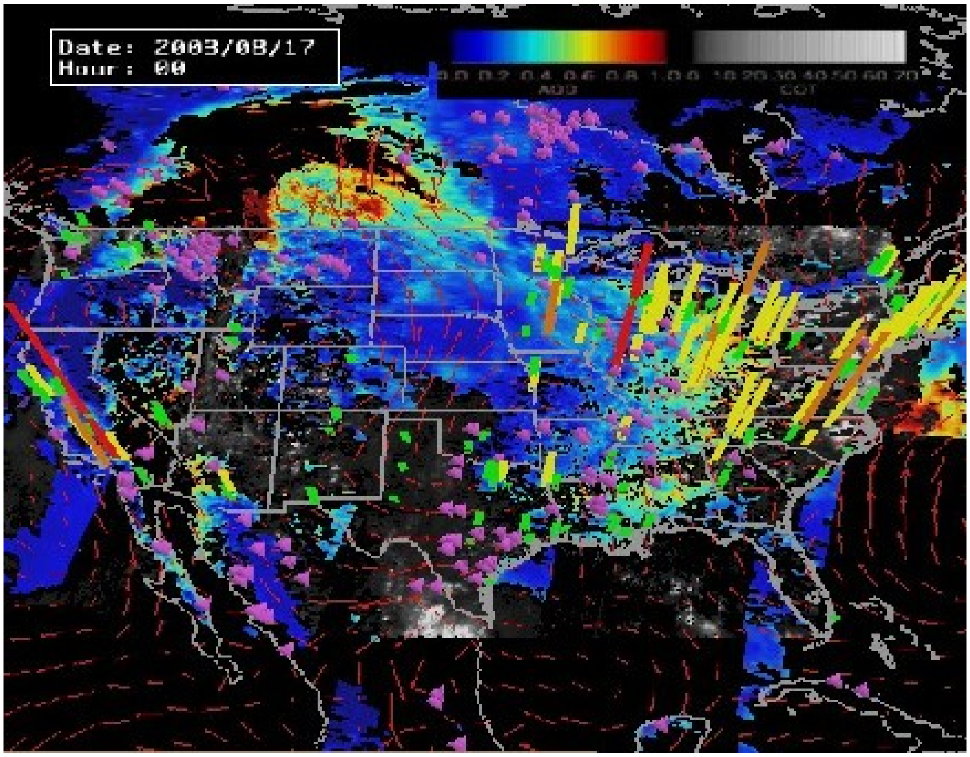
- The request covers the development of hardware for inserts, such as the Sample Cartridge Development, the Lab-on-a-Chip Application Development, the Multi-user Gaseous Fuel Apparatus, the Granular Flow Module, the Space Acceleration Measurement System, the Microgravity Acceleration Measurement System, and the Primary Atomic Reference Clock in Space, to enable experiments to be performed within the ISS Research Facilities. In addition, the request includes research that in prior years was reduced to cover the shortfall in the ISSRC budget for the development of the major ISS Research Facilities.

Research Partnerships and Flight Support

This theme establishes policies and allocates space resources to support space flight research and also encourage development of research partnerships in the pursuit of NASA missions and Enterprise scientific objectives, while leveraging NASA support by factors of greater than two with contributions from industrial and other partners in the Space Product Development (SPD) program. This research supports product development on Earth and accelerates progress in our strategic research areas. Ultimately, research partnerships may support development of an infrastructure that can be applied to human exploration. This theme also funds ISS research planning, integration and operations, as well as development and maintenance of research hardware that is used across multiple research disciplines such as the Express Rack and refrigerator/freezers.

OVERALL BUDGET

FY 2005 request is $257 million, a $3 million or 1 percent decrease of the FY 2004 President's Request in support of the new exploration vision.



This image illustrates a fusion of Earth science observations and model products to support air quality forecasting. The image above shows the relationship between aerosols, clouds, winds, fire locations, and ground aerosol measurements to provide a wide area view of aerosol events across North America. Researchers at NASA and US Environmental Protection Agency (EPA) developed this data fusion tool to assist air quality forecasters assess particle pollution and aerosol transport. EPA manages the Air Quality Index (AQI) to report daily air quality levels, and this data fusion assists in improving the accuracy of EPA's AQI. Forecasters use a 3-day visualization of this data fusion to assess transport of aerosols into their region and develop the air quality forecasts they issue.

Earth Science Applications

Major Events in FY 2005

- ESA will deliver benchmarks of integrated solutions to the Committee on Environment and Natural Hazards (CENR), Climate Change Science Program (CCSP), Climate Change Technology Program, and Interagency Working Group on Earth Observations (IWGEO).
- The Earth Science Applications (ESA) program will continue to extend the use of new technology and knowledge about the Earth system to serve society through partnerships with other Federal agencies and industry partners. ESA can contribute to saving lives and property by working with partners to extend the benefits of the results of NASA's Earth Science research and development activities into areas such as Air Quality, Public Health, and Disaster Management.
- ESA will contribute verification and validation results to support the objectives of Geospatial One Stop (GOS) and Commercial Remote Sensing Space Policy (CRSSP).
- ESA will continue participation in Joint Agency Commercial Imagery Evaluation (JACIE) to provide Earth scientists with verification of the performance of commercial data, thereby optimizing the value to the government of private sector investments.
- ESA will expand the Digital Earth Virtual Environment and Learning Outreach Project (DEVELOP) program in an effort to develop human capital that will meet the future needs of the Earth Science Enterprise and the Applications program. This will be accomplished through student-centered programs that serve communities in at least 26 states.

- ESA will collaborate to develop and deploy national and international standards and interoperability protocols and processes in support of e-government, Geospatial One Stop, NASA, and science-based solutions in partnership with other Federal agencies.
- ESA will continue to inspire the next generation of Earth explorers by providing opportunities for learners of all ages to investigate the Earth system using unique NASA resources. Solicitations supporting the Earth Science Fellowship Program, GLOBE, New Investigator Program, and K-16/Informal Education Program will be ongoing in FY05.

OVERVIEW

The Earth Science Applications program bridges the gap between scientific discoveries and practical applications that 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 predictions of hurricane landfall, monitoring wildfires, and increasing aviation safety. As we move forward to 2005, the NASA Earth Science Applications program continues to benchmark contributions to relevant decision support tools that are vital for the nation's safety and security.

Missions	Goals supported by this Theme	Objectives supporting these Goals
To 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 through partnerships with DOD, DHS and other U.S. or international government agencies.
To Inspire the Next Generation of Explorers	7. Engage the public in shaping and sharing the experience of exploration and discovery.	7.1 Improve public understanding and appreciation of science and technology, including NASA aerospace technology, research, and exploration missions.

RELEVANCE

The Applications program enhances the availability, interoperability, and utility of Earth Science Enterprise and private sector data sets, communications, computing, and modeling capabilities to serve national applications as only NASA can. Applications program outputs include prototypes, assessments, procedures, and verification reports resulting from projects that benchmark system solutions. The Enterprise works through partnerships with public, academic, and private organizations to develop innovative approaches for using Earth science information that enhance products and services delivered through decision support tools to serve citizens. In essence, ESE pursues "government-to-government-to-citizen" relationships to extend the Earth science results to society. Key components of the 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 17 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 to model the Earth system and improve predictions.

Education and Public Benefits
Education: 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." Public Benefit: NASA's technology, observations and knowledge of the Earth System are harnessed to deliver an improved 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.

IMPLEMENTATION

The ESA Theme is composed of National Applications, Cross-Cutting Solutions, and Education activities. 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 Headquarters (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.

IMPLEMENTATION SCHEDULE

Theme Element	Purpose
Agricultural Efficiency	Benchmark the process of assimilating NASA enabled predictions of weather, climate and natural hazards via the Crop Assessment Data Retrieval & Evaluation (CADRE) system to improve environmental stewardship, and increase production efficiency and farm income through partnerships with USDA and EPA.
Aviation	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 through partnerships with DOT/FAA and the aviation community.
Energy Management	Work in partnership with DOE & EPA 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 via the RETScreen & Natural Resources Canada systems.
Carbon Management	Provide monitoring and modeling capability to serve the USDA, EPA, DOE, USGS & USAID 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 DHS, NIMA, USDA, USGS, NOAA & DoD to benchmark processes of monitoring air & water quality, tracking the spread of dangerous plumes and particulates, and planning for evacuation scenarios for integration into the DHS Situation Control System.
Public Health	Benchmark the process of assimilating NASA enabled predictions of weather, climate & natural hazards via partnerships with CDC, DoD, NIH, EPA, USGS & NOAA to more accurately predict conditions associated with global environmental indicators of public health risks.
Water Management	Benchmark the process of assimilating NASA enabled predictions of weather, climate and natural hazards to contribute to partnerships w/ USBoR,USGS,USDA & EPA developing tools to quantify, monitor and predict water quantity parameters for resource mgmt via RiverWare, BASINS & AWARDS systems.
Air Quality	Benchmark the process of assimilating NASA enabled predictions of weather, climate and natural hazards through partnerships with EPA, NOAA, USDA & FAA to improve analytical capabilities for emission estimates, & multiple-day air quality forcasting.
Disaster Management	Benchmark the process of assimilating NASA enabled predictions of weather, climate & natural hazards through partnerships with FEMA, USGS, NOAA & USDA to provide improved detection, response & mitigation by monitoring earthquakes, hurricanes, floods, & tornados.
Coastal Management	Benchmark the process of assimilating NASA enabled predictions of weather, climate and natural hazards through partnerships with NOAA & EPA to facilitate the modeling and prediction of harmful algal bloom development and landfall.
Invasive Species	Benchmark the process of assimilating NASA enabled predictions of weather, climate and natural hazards through partnerships with USGS & USDA to enhance current tools and methodologies for detecting, monitoring and mitigating invasive species.

Ecological Forecasting	Benchmark the process of assimilating NASA enabled observations of vegetation structure, topography, rainfall & coastal circulation/suspended sediments through partnerships with USAID & the World Bank to support models of habitat change, the impacts of El Nino and other climate phenomena.
Crosscutting Solutions	Support the national applications core areas through 1) Integrated Benchmark systems, 2) Solutions Networks, 3) Geospatial Interoperability engineering, and 4) Human Capital capacity development.
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 Departments of Education and Labor, the National Science Foundation, and others.

No exceptions to NPG 7120.5B have been taken.

STATUS

This Theme accomplished the following in FY03: Worked with partners at USDA, USGS, CDC, EPA, FEMA, FAA, and NOAA to achieve citizen benefits from improved predictions of hurricanes, wildfires, and volcanic ash effects; Established agreements with the DOE's National Renewable Energy Laboratory and with the USDA for future benchmarking activities; Provided leadership to the Research, Education, and Applications Solutions Network (REASoN) competitive opportunity, resulting in 41 projects started in FY03/04 that serve as the foundation to benchmark solutions for at least six decision support systems in FY05; Competitively selected University Corporation for Atmospheric Research (UCAR) in FY03 to implement the Global Learning and Observation to Benefit the Environment (GLOBE) education program to connect NASA Earth science with over 1200 U.S. schools and over 100 countries worldwide into and beyond FY05; Provided leadership to the DEVELOP program enabling over 120 students in over 30 states to conduct prototype projects using Earth science results to serve their state, local and tribal governments; Performed assigned roles to support the Agency in six significant programs designated as priorities for the Administration, including the Climate Change Science Program, Climate Change Technology Program, Commercial Remote Sensing Policy, Geospatial One Stop, and the Earth Observation Summit; Was rated using OMB's Performance Assessment Rating Tool (PART) and received a rating of "results not demonstrated." In response to this evaluation, ESA Theme management will improve performance measures to reflect the value added of incorporating NASA data into existing systems, and finalize roadmaps for each of the twelve priority areas that specify how and where NASA content can best be utilized.

Link to theme homepage for more information: http://www.earth.nasa.gov/eseapps/.

PERFORMANCE MEASURES

Outcomes/Annual Performance Goals (APGs)	
Outcome 1.2.1	*By 2012, benchmark the assimilation of observations (geophysical parameters, climate data records) provided from 20 of the 80 remote sensing systems deployed on the flotilla of 18-22 NASA Earth observation research satellites.*
5ESA1	Crosscutting Solutions: Work within the Joint Agency Committee on Imagery Evaluation and the Commercial Remote Sensing Policy Working Group through partnerships with NIMA, USGS, NOAA, and USDA to verify/validate at least two commercial remote sensing sources/products for Earth science research, specifically with respect to land use/land cover observations for carbon cycle and water cycle research.
5ESA2	National Apps: Benchmark measurable enhancements to at least 2 national decision support systems using NASA results, specifically in the Disaster Management and Air Quality communities. These projects will benchmark the use of observations from 5 sensors from NASA research satellites.
5ESA3	Crosscutting Solutions: Expand DEVELOP (Digital Earth Virtual Environment and Learning Outreach Project) human capital development program to increase the capacity for the Earth science community at a level of 100 program graduates per year and perform significant student-led activities using NASA research results for decision support with representation in 30 states during the fiscal year.
5ESA4	Crosscutting Solutions: Benchmark solutions from at least 5 projects that were selected in FY03 REASoN program to serve national applications through projects that support decision support in areas such as agriculture, public health and water quality. These projects will benchmark use of observations from at least 5 sensors from NASA research satellites.
Outcome 1.2.2	*By 2012, benchmark the assimilation of 5 specific types of predictions resulting from Earth Science Model Framework (ESMF) of 22 NASA Earth system science models.*
5ESA5	The DEVELOP (Digital Earth Virtual Environment and Learning Outreach Project) program will advance the capacity of our future workforce with students from at least 20 states working to develop and deliver benchmark results of at least 4 rapid prototype projects using NASA Earth science research results in decision support tools for state, local and tribal government applications.
5ESA6	Crosscutting Solutions: Benchmark solutions associated with at least 5 decision support systems that assimilate predictions from Earth system science models (e.g. GISS, GFDL, NCEP, SpoRT, and the Earth Science laboratories).
Outcome 1.2.3	*By 2012, benchmark the assimilation of observations and predictions resulting from NASA Earth Science research in*

Theme: Earth Science Applications

Outcomes/Annual Performance Goals (APGs)	
	8-10 decision support systems serving national priorities and the missions of federal agencies.
5ESA7	National applications: Benchmark enhancements to at least 2 national decision support systems using NASA results, specifically in the Disaster Management, Public Health, and Air Quality communities. These projects will benchmark the use of observations from 5 sensors from NASA research satellites.
5ESA8	Crosscutting Solutions: Verify and validate solutions for at least 5 decision support systems in areas of national priority associated with the FY03 selected REASoN projects.
Outcome 3.1.3	*By 2012, in partnership with the Department of Homeland Security, the Department of Defense, and the Department of State, deliver 15 observations and 5 model predictions for climate change, weather prediction and natural hazards to national and global organizations and decision-makers to evaluate 5 scenarios and optimize the use of Earth resources (food, water, energy, etc.) for homeland security, environmental security and economic security.*
5ESA9	Benchmark the use of predictions from 2 NASA Earth system science models (including the GISS 1200 and NCEP weather prediction) for use in national priorities, such as support for the Climate Change Science Program (CCSP) and Climate Change Technology Program (CCTP) and the NOAA National Weather Service.
5ESA10	Benchmark the use of observations and predictions of Earth science research results in 2 scenarios assessment tools, such as tools used by the Environmental Protection Agency (specifically in the Community Multi-scale and Air Quality (CMAQ) Improvement Program tools) and the Department of Energy.
Outcome 7.1.4	*Engage the public in NASA missions, discoveries and technology through public programs, community outreach, mass media, and the Internet.*
5ESA11	Provide in public venues at least 50 stories on the scientific discoveries, the practical benefits, or new technologies sponsored by the Earth Science Enterprise.
Uniform Measures	
5ESA12	Deliver at least 90% of scheduled operating hours for all operations and research facilities.
5ESA13	At least 80%, by budget, of research projects will be peer-reviewed and competitively awarded.

INDEPENDENT REVIEWS

Review Types	Performer	Last Review Date	Next Review Date	Purpose
Independent Annual Review	ESS Advisory Council	7/03	7/04	Alignment of Earth Science Enterprise and Research Strategies.
National Academy of Sciences review	NAS/NRC/SSB	9/02	6/05	Alignment of national Earth Science priorities and educational blueprint.

BUDGET

Budget Authority ($ millions)	FY 2003	FY 2004	Change	FY 2005	Comments
Earth Science Applications	**78.0**	**90.8**	**-13.9**	**76.9**	
Research	50.8	52.0	-7.1	44.9	
Research - National Applications Program	29.7	30.3	-8.5	21.8	
Research - Earth Science Education	21.1	21.7	+1.4	23.1	
Crosscutting Solutions	27.2	38.8	-6.8	32.0	

Indicates changes since the previous year's President's Budget Submit

Indicates budget numbers in full cost.

Theme: Earth Science Applications
Research: National Applications Program

PURPOSE

Objectives	Performance Measures
1.2, 3.1	5ESA2,7,9-10,12-13

The National Applications program extends the use of Earth observations into practical applications of knowledge. The program makes significant contributions to the President's Management Agenda, the E-Government initiative, and will contribute to the education and workforce development objectives of the Administration. The program serves the NASA vision "to improve life here" and the NASA mission "to understand and protect our home planet."

OVERVIEW

The 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 the nation 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, DHS, DoD, and DOE, to improve predictions of weather, climate, and natural hazards using NASA Earth science research and development in those agencies' operational decision support systems. NASA contributes systems engineering, human capital development, and scientific 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. The National Applications program funds projects to benchmark solutions with other agencies for fixed periods of time in order to address practical challenges, making a unique contribution. Once solutions using Earth Science research results are benchmarked, the program hands those applications over for operational use to the implementing agencies. Project-level and systems-level solutions are solicited through Cooperative Agreement Notices, such as REASoN and GLOBE competitive sourcing solicitations.

Link to Project Homepage for more information: http://gaia.hq.nasa.gov/eseapps/.

PROGRAM MANAGEMENT

The Earth Science Applications program is managed from Headquarters (HQ) with performing center activity at Stennis Space Center (SSC), Goddard Space Flight Center (GSFC), Langley Research Center (LRC), and Marshall Space Flight Center (MSFC). 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

Technical commitment was baselined in the FY 2004 budget.

Technical Specifications	FY 2005 President's Budget	Change from Baseline
Environmental Protection Agency	CMAQ Air Quality Decision Support System (DSS): Community Model for Air Quality	--
Federal Emergency Management Agency	HAZUS Disaster Management DSS	--
Centers for Disease Control/ National Institute of Health	EHTN Public Health DSS	--
Department of Agriculture	Enable implementation of Section 1605(B) of the Energy Act of 1992 (EA92)	--
Department of Agriculture	Crop Assessment Data Retrieval and Evaluation (CADRE) System	--
U.S. Geologic Survey	Biological Invasive Species DSS	--
Bureau of Reclamation - USGS/BoR	BoR RiverWare Water Management DSS	--
Federal Aviation Administration	National Airspace System DSS	--
Department of Energy	Natural Renewable Energy DSS	--
National Oceanic and Atmospheric Admin (NOAA)	Harmful Algal Bloom Coastal Management DSS	--
		--
The National Applications program will benchmark the process of assimilating observations and predictions from NASA missions into the decision support systems of the agencies listed in the table above. (Benchmarking involves systematically determining the improvements to decision support systems that are enabled by NASA results.)		

Schedule	FY 2005 President's Budget	Baseline	Change from Baseline
FAA/Nat'l Airspace System-DSS Benchmark Complete	Jun-04	Same	--
Disaster Management-DSS Benchmark complete	Jul-05	New	--
NIH/Public Health-DSS Benchmark Complete	Sept-05	Benchmark 2nd DSS	--

ACQUISITION STRATEGY AND PERFORMING ORGANIZATIONS

The acquisition strategy is based on two primary components: 1) Competitive sourcing, 2) Space Act Agreements. Performing organizations include NASA field centers (SSC, GSFC, LRC, MSFC, Ames Research Center (ARC), Jet Propulsion Lab (JPL)) partnering agencies, and competitively selected organizations.

Current Acquisition	Actual*	Selection Method	Actual*	Performer	Actual*
Cooperative Agreement	11%	Full & Open Competition	80%	Industry	15%
Cost Reimbursable	0%	Sole Source	20%	Government	0%
Fixed Price	2%			NASA Intramural	30%
Grants	66%		100%	University	50%
Other	21%	Sci Peer Review	%	Non Profit	5%
* as of FY03 direct procurement	100%	* as of FY03 direct procurement		* as of FY03 direct procurement	100%

Future Acquisition	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 from, the aviation safety program in the Office of Aerospace Technology. External: Memoranda of Understanding with USDA, NOAA, USGS, EPA, DoD, USFS, DOE, WGA, FEMA. International: UNESCO, IAA, CCAD, CEOS, CENR. Changes since FY 2004 Pres. Budget: None.

INDEPENDENT REVIEWS

Review Types	Performer	Last Review Date	Next Review Date	Purpose
Independent Annual Review	ESSAAC	7/03	2/04	Assess alignment with Enterprise Strategy.
National Academy of Sciences	SSB	9/02	6/05	Assess alignment with Enterprise Strategy.

Theme: Earth Science Applications
Research: National Applications Program

BUDGET

Budget Authority ($ millions)	FY 2003	FY 2004	FY 2005	Comments
FY2005 PRESBUD	29.7	30.3	21.8	
Applications Research	0.2			
National Applications	26.4	23.8	16.5	
Program Planning and Analysis	3.1	6.5	5.3	
Changes since 2004 PRESBUD	+8.9	+6.3		
Applications Research	-15.2			
National Applications	+26.4	+6.3		
Program Planning and Analysis	-2.3			Realigned to National Applications
FY2004 PRESBUD	20.8	24.0		
Applications Research	15.4			
National Applications		17.5		
Program Planning and Analysis	5.4	6.5		

Indicates changes since the previous year's President's Budget Submit

Indicates budget numbers in full cost.

Theme: Earth Science Applications
Research: Earth Science Education

PURPOSE

Objectives	Performance Measures
7.1	5ESA11, 13

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	FY 2005 President's Budget	Change from Baseline
Investigator Program	Continue research and educational support for current projects and Earth scientists and/or engineers, and solicit new applications.	--
GLOBE Program	Continue worldwide implementation and U.S. coordination, in partnership with the National Science Foundation.	--
Earth Science Education Cyber Infrastructure	Systems architecture designed to deliver real time 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 Program	Support graduate students in pursuit of Master or Ph.D. degrees in Earth System Science applications.	--

Schedule	FY 2005 President's Budget	Change from Baseline
Earth System Science Fellowship Program	Solicitation Dec-03, Selection Jun-04, Awards in Sept-04 (Annual selection)	--
GLOBE: Worldwide Implementation and U.S. Country Coordinator	Selection in Mar-08 and Awards placement in Dec-08 (Selection every 5 years)	--
Investigator Program	Solicitation Sept-04, Selection May-05, Awards in Jun-05 (Selection every 18 months)	--
K-16/Informal Education Program	Solicitation Jun-04, Selection May-05, Awards in Jun-05	--

Theme: Earth Science Applications
Research: Earth Science Education

ACQUISITION STRATEGY AND PERFORMING ORGANIZATIONS

The acquisition strategy is based on two primary components: 1) Competitive sourcing, 2) Space Act Agreements. Performing organizations include NASA field centers (SSC, GSFC, LaRC, MSFC, ARC, JPL), research laboratories, partnering agencies, and competitively selected organizations.

Current Acquisition	Actual*	Selection Method	Actual*	Performer	Actual*
Cooperative Agreement	3%	Full & Open Competition	80%	Industry	4%
Cost Reimbursable	0%	Sole Source	20%	Government	0%
Fixed Price	43%			NASA Intramural	23%
Grants	37%		100%	University	73%
Other	17%	Sci Peer Review	%	Non Profit	0%
* as of FY03 direct procurement	100%	* as of FY03 direct procurement		* as of FY03 direct procurement	100%

Future Acquisition	Selection	Goals
FELLOWSHIPS	Jun 2004	100% Full & Open Competition
REASoN Cooperative Agreement (CAN)	Jan 2005	100% Full and Open Competition
GLOBE	Mar 2008	100% Full & Open Competition

AGREEMENTS

Internal: The program has a component that is dependent on, and benefits, the Agency Education programs in the Education and Space Science Enterprises. 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 2004 Pres. Budget: None.

RISK MITIGATION

Top Risks	G	Overall	G	Cost	G	Schedule	G	Technical	Probability	Impact	Mitigation Plan
G	Risk negligible										

INDEPENDENT REVIEWS

Review Types	Performer	Last Review Date	Next Review Date	Purpose
Independent Peer Review	ESSAAC	7/03	2/04	Assess alignment with NASA and Enterprise Strategy.
National Academy of Sciences	SSB	9/02	6/05	Assess alignment with NASA and Enterprise Strategy.

Theme: Earth Science Applications
Research: Earth Science Education

BUDGET

Budget Authority ($ millions)	FY 2003	FY 2004	FY 2005	Comments
FY2005 PRESBUD	21.1	21.7	23.1	
Earth Science Education	12.2	12.3	12.2	
Fellowships & New Investigators	7.9	8.4	8.8	
Outreach	1.0	1.0	2.1	
Changes since 2004 PRESBUD	+3.0	+0.9		
Earth Science Education	+3.1	+0.9		
Fellowships & New Investigators	-0.1			
FY2004 PRESBUD	18.1	20.8		
Earth Science Education	9.1	11.4		
Fellowships & New Investigators	8.0	8.4		
Outreach	1.0	1.0		

Indicates changes since the previous year's President's Budget Submit
Indicates budget numbers in full cost.

Theme: Earth Science Applications
Technology and Advanced Concepts: Crosscutting Solutions

PURPOSE

Objectives	Performance Measures
1.2	5ESA1,3-6,8

The Crosscutting Solutions element delivers science and engineering capabilities to partner organizations, enabling them to use NASA's research results and technologies in their decision support systems. This element contributes to human capital development, which focuses on the unique aspects of applying Earth science results in national and international decision support solutions.

OVERVIEW

The Crosscutting Solutions program provides four core elements: 1) integrated benchmark systems; 2) solutions networks; 3) geospatial interoperability, and 4) human capital development. The integrated benchmark systems 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 integrated benchmark systems 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 the Nation including data sources, data products, data handling systems, and models and decision support systems, moving from research to operations.

Link to Project Homepage for more information: http://www.earth.nasa.gov/eseapps.

PROGRAM MANAGEMENT

The Crosscutting 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 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

Schedule	FY 2005 President's Budget	Baseline	Change from Baseline
Q3 FY05	Benchmark access to NASA EOS Data by Sponsorship/major participant in an OGC initiative prototyping Decision Support tools using open standards.	Q3 FY05	--
Q1 FY05	Open GIS Web Services Phase II.	Q1 FY05	--
Award in Q3 FY05	Solutions Networks for future Earth Science Research Results Solicitation.	Award in Q3 FY05	--
Award in Q3 FY05	Integrated System Solutions using Earth Science Research Results Solicitation.	Award in Q3 FY05	--
Award in FY04	REASoN CAN support.	Award in FY04	--
Q1 FY05	Expand Workforce Development Program (as part of DEVELOP Program) from 21 to 26 states.	Q1 FY05	--

ACQUISITION STRATEGY AND PERFORMING ORGANIZATIONS

The acquisition strategy is based on two primary components: 1) Competitive sourcing; 2) Space Act Agreements. Performing organizations include NASA field Centers (SSC, GSFC, LaRC, MSFC, Ames ARC, JPL) partnering agencies, and competitively selected organizations. Changes since FY 2004 Pres. Budget: None.

Current Acquisition	Actual*	Selection Method	Actual*	Performer	Actual*
Cooperative Agreement	8%	Full & Open Competition	80%	Industry	20%
Cost Reimbursable	0%	Sole Source	20%	Government	0%
Fixed Price	28%		100%	NASA Intramural	30%

Theme: Earth Science Applications
Technology and Advanced Concepts: Crosscutting Solutions

Grants	20%			University	40%
Other	44%	Sci Peer Review	%	Non Profit	10%
* as of FY03 direct procurement	100%	* as of FY03 direct procurement		* as of FY03 direct procurement	100%

Future Acquisition	Selection	Goals
REASoN Cooperative Agreement Notice	Jan 05	100% Full & Open Competition.
Integrated Systems Solutions Solicitation	Apr 05	100% Full & Open Competition.
Solutions Networks Solicitation	Apr 05	100% Full & Open Competition.

AGREEMENTS

Internal: Agreements with SSC, LaRC, GSFC, MSFC, JPL, ARC, 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, and partners in the DEVELOP program. Changes since FY 2004 Pres. Budget: None.

RISK MITIGATION

Top Risks	G	Overall	G	Cost	G	Schedule	G	Technical	Probability	Impact	Mitigation Plan
G	Negligible risk involved										

INDEPENDENT REVIEWS

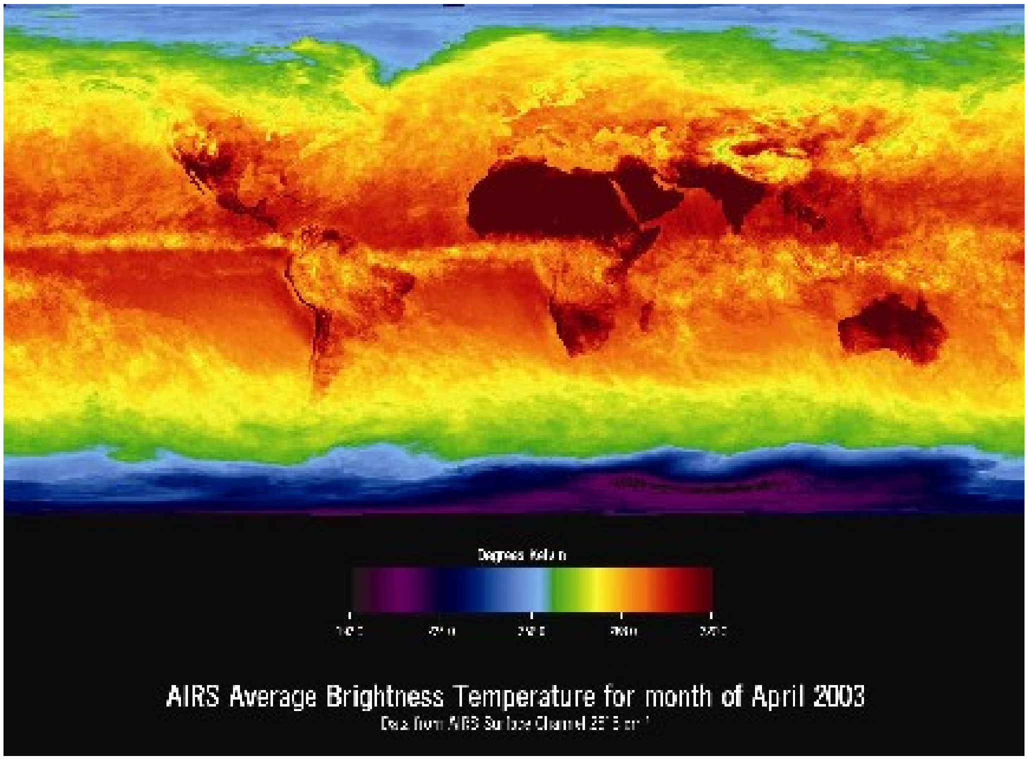
Review Types	Performer	Last Review Date	Next Review Date	Purpose
Independent Peer Review	ESSAAC	7/03	2/04	Ensure consistency with ESE mission.
National Academy of Sciences	NAS	6/02	6/05	Review commitment to partnerships.

BUDGET

Budget Authority ($ millions)	FY 2003	FY 2004	FY 2005	Comments
FY2005 PRESBUD	27.2	38.8	32.0	
Cross cutting solutions	27.2	38.8	32.0	
Changes since 2004 PRESBUD	+4.4	+8.8		
Applications Development	-22.8			
Cross cutting solutions	+27.2	+8.8		Realignment to National Applications program.
FY2004 PRESBUD	22.8	30.0		
Applications Development	22.8			
Cross cutting solutions		30.0		

Indicates changes since the previous year's President's Budget Submit

Indicates budget numbers in full cost.



The Atmospheric Infrared Sounder (AIRS) and Advanced Microwave Sounding Unit (AMSU) instruments on the Aqua satellite are generating the most accurate, high resolution measurements ever taken from space of the infrared brightness (radiance) of Earth's atmosphere, yielding a global, three-dimensional map of atmospheric temperature and humidity.

Earth System Science

Major Events in FY 2005

- Several Explorer missions (OCO, Aquarius) begin implementation in FY05.
- In FY05, NASA remote sensing and modeling research in the North American Carbon Program will be supporting major intensive field campaigns, very likely in the mid-continental U.S. and in one or more coastal regions, with the exact regions to be identified through peer review processes occurring in 2004. Also, NASA, DOE, and NOAA will be completing the preparation and release of the first State of the Carbon Cycle Report, a Carbon Cycle Science Plan (CCSP) Synthesis and Assessment product.
- Cloudsat and CALIPSO will launch in FY05 and will begin providing key measurements to improve climate predictions. Specifically, these satellites will observe the roles of clouds in Earth's climate, and the role of clouds and aerosols in the Earth's radiation budget.
- NASA's next generation Earth-observing satellite, Aura, will begin supplying the most complete information yet on the health of Earth's atmosphere. The data flowing from these global observations will help scientists track the sources and processes controlling global and regional air quality, quantify the impact of aerosols, tropospheric ozone and upper tropospheric water vapor on Earth's climate, and answer other key scientific questions.
- In FY05, the Earth Science Enterprise will complete the first phase of the Earth System Modeling Framework (ESMF) development. With the completion of ESMF, new science will be enabled and the collaboration between the Earth system modeling centers will be enhanced.
- The Earth Science Enterprise will continue to conduct research, analysis, modeling, and will use data and information resulting from NASA satellites that contribute to answering critical scientific questions on the Earth system to aid policy and economic decision-makers.

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 (such as 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 2005 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 these Goals
To 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.
To Inspire the Next Generation of Explorers	7. Engage the public in shaping and sharing the experience of exploration and discovery.	7.1 Improve public understanding and appreciation of science and technology, including NASA aerospace technology, research, and exploration missions.

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. NASA's 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 2005 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 continuing 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. The Theme also builds capacity for productive use of Earth science results, technology, and information in resolving everyday practical problems via the Earth Science Applications Theme.

IMPLEMENTATION

Earth System Science employs a constellation of more than 18 Earth observing satellites that routinely make 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. 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. Each science focus area (see "Theme Elements" in the table below) has an implementation roadmap that shows the combination of technology, observations, modeling efforts, basic research, and partnerships needed to answer the questions over time.

Earth System Science is a multiple-project program with Theme responsibility in the Office of Earth Science at NASA Headquarters (HQ). Enterprise official is Dr.Ghassem Asrar, Associate Administrator for Earth Science at HQ. Theme Director is Dr. Jack Kaye at HQ. The Science focus area roadmaps listed below can be seen at: http://earth.nasa.gov/roadmaps.

Theme: Earth System Science

Theme Element	Purpose
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. Some mission activities that support this science area include Terra, Aqua, Cloudsat, ICESat, Glory, Aquarius, and OCO.
Weather	Develop the technology, observational and modeling capacity needed to improve daily and extreme weather forecasting (e.g., hurricanes, tornadoes). Some mission activities that support this science area include Quikscat, GPM, and Aqua.
Atmospheric Compsoition	Understand the trace constituent and particulate composition of the Earth's atmosphere and predict its future evolution. Some mission activities that support this science area include SAGE, UARS, TOMS, Aura, Glory, OCO, and Calipso.
Carbon Cycle and Ecosystems	Understand and predict changes in the Earth's terrestrial and marine ecosystems and biogeochemical cycles. Some mission activities that support this science area include Landsat and Landsat Continuity, NPP, OCO, Terra, and Aqua.
Water and Energy cycles	Characterize and predict trends and changes in the global water and energy cycles. Some mission activities that support this science area include TRMM, GRACE, Cloudsat, Hydros, and GPM.
Earth Surface and Interior	Utilize state-of-the-art measurements and advanced modeling techniques to understand and predict changes in the Earth's surface and interior. Some mission activities that support this science area include GRACE, ICESat, and the Geodetic Network.

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

STATUS

In FY03, this Theme advanced our knowledge of the Earth system in many ways:

- NASA ozone research over the past decade is paying dividends. Recent analyses of annual Antarctic ozone depletion over the past five years indicates a reduction in the rate of depletion. This may be an indication that worldwide efforts to reduce emissions of ozone depleting chemicals are working. NASA continues to monitor ozone concentrations.
- A NASA - Department of Energy jointly-funded study concludes that the Earth has been greening over the past 20 years. The article, appearing in the journal "Science," states climate changes have provided extra doses of water, heat and sunlight in areas where the lack of one or more of those ingredients may have been limiting plant growth. At the same time, another NASA study has found the net primary productivity has decreased over the world's oceans since the early 1980s. The decline in oceanic productivity occurred mostly at high latitudes, while ecosystems in all tropical regions and in the high latitudes of the Northern Hemisphere accounted for 80% of the increase in terrestrial productivity.
- The Atmospheric Infrared Sounder (AIRS) and Advanced Microwave Sounding Unit (AMSU) instruments on the Aqua satellite are generating the most accurate, highest resolution measurements ever taken from space of the infrared brightness (radiance) of Earth's atmosphere, yielding a global, three-dimensional map of atmospheric temperature and humidity. U.S. and European research meteorologists are using these data to improve weather models, and will employ them in an operational mode in the coming months.
- Scientists operating the joint U.S.-German GRACE satellite released the most accurate map of Earth's gravity field. GRACE is the oceanographers' newest tool to unlock the secrets of ocean circulation and its effects on climate. These early data have already improved by 10 to 100 times the accuracy of our knowledge of Earth's gravity field.
- Launching spacecraft with cutting-edge technology and instruments in a timely and cost effective manner is a key element for the continued success of Earth system research and analysis. FY 2003 saw the launch of two Earth observing satellites, ICESat and the Solar Radiation and Climate Experiment (SORCE). The instruments on these satellites will add to the 16 existing operating missions in orbit and continue to provide users with unprecedented volumes of information and data.
- South America is the latest continent for which detailed topographic data has been generated from the Shuttle Radar Topography Mission.

PERFORMANCE MEASURES

Outcomes/Annual Performance Goals (APGs)	
Outcome 1.1.1	*Enable prediction of polar and global stratospheric ozone recovery (amount and timing) to within 25% by 2014.*
5ESS1	Integrate satellite, suborbital, ground based observations, coupled with laboratory studies and model calculations to assess potential for future ozone depletion in the Arctic. Characterize properties and distributions of clouds and aerosols as they relate to the extinction of solar radiation in the atmosphere. Specific output: first release of validated Aura data. Progress toward achieving outcomes will be validated by external review. See Atmospheric Composition Roadmap
Outcome 1.1.2	*Predict the global distribution of tropospheric ozone and the background concentration in continental near-surface air to within 25% by 2014.*
5ESS1	Integrate satellite, suborbital, ground based observations, coupled with laboratory studies and model calculations to assess potential for future ozone depletion in the arctic. Characterize properties and distributions of clouds and aerosols as they relate to the extinction of solar radiation in the atmosphere. Specific output: first release of validated Aura data. Progress toward achieving outcomes will be validated by external review. See Atmospheric Composition Roadmap.
Outcome 1.1.3	*Enable extension of air quality forecasts for ozone and aerosols from 24 to 72 hours by 2010.*
5ESS1	Integrate satellite, suborbital, ground based observations, coupled with laboratory studies and model calculations to assess potential for future ozone depletion in the arctic. Characterize properties and distributions of clouds and aerosols as they relate to the extinction of solar radiation in the atmosphere. Specific Output: first release of validated Aura data. Progress will be validated by external review. See Atmospheric Composition Roadmap.
Outcome 1.1.4	*Use satellite data to help enable decreased hurricane landfall uncertainty from +/- 400 km to +/- 100 km in the three-day forecasts by 2010.*
5ESS2	Improve predictive capabilities of regional models using satellite-derived localized temperature and moisture profiles and ensemble modeling. Progress toward achieving outcomes will be validated by external review. See Weather Roadmap.
Outcome 1.1.5	*Use satellite data to help extend more accurate regional weather forecasting from 3 days to 5 days by 2010.*
5ESS2	Improve predictive capabilities of regional models using satellite-derived localized temperature and moisture profiles and ensemble modeling. Progress toward achieving outcomes will be validated by external review. See Weather Roadmap.
Outcome 1.1.6	*Develop projections of future atmospheric concentrations of carbon dioxide and methane for 10-100 years into the future with improvements in confidence of >50% by 2014.*
5ESS3	Reduce land cover errors in ecosystem and carbon cycle models, and quantify global terrestrial and marine primary productivity and its interannual variability. Specific output: Produce a multi-year global inventory of fire occurrence and extent. Progress toward achieving outcomes will be validated by external review. See Carbon Cycles and Ecosystems Roadmap.
Outcome 1.1.7	*By 2014, develop in partnership with other agencies, credible ecological forecasts that project the sensitivities of terrestrial and aquatic ecosystems to global environmental changes for resource management and policy-related decision-making.*
5ESS4	Reduce land cover errors in ecosystem and carbon cycle models, and quantify global terrestrial and marine primary productivity and its interannual variability. Specific Output: Release first synthesis of results from research on the effects of deforestation and agricultural land use in Amazonia. Progress toward achieving outcomes will be validated by external review. See Carbon Cycle and Ecosystems Roadmap.
Outcome 1.1.8	*Report changes in global land cover, productivity, and carbon inventories with accuracies sufficient for use in the food industry, in evaluating resource management activities, and in verifying inventories of carbon emissions and storage.*
5ESS5	Reduce land cover errors in ecosystem and carbon cycle models, and quantify global terrestrial and marine primary productivity and its interannual variability. Specific output: Improve knowledge of processes affecting carbon flux within the coastal zone, as well as sources and sinks of aquatic carbon, to reduce uncertainty in North American carbon models. Progress toward achieving outcomes will be validated by external review. See Carbon Cycle and Ecosystems Roadmap.
Outcome 1.1.9	*Enable development of seasonal precipitation forecasts with > 75% accuracy by 2014.*
5ESS6	Enhance land surface modeling efforts, which will lead to improved estimates of soil moisture and run-off. Specific output: launch Cloudsat. Progress toward achieving outcomes will be validated by external review. See Water and Energy Cycle Roadmap.
Outcome 1.1.10	*Improve estimates of the global water and energy cycles by 2012 to enable balancing of the global and regional water and energy budgets to within 10%.*
5ESS6	Enhance land surface modeling efforts, which will lead to improved estimates of soil moisture and run-off. Specific output: launch Cloudsat. Progress toward achieving outcomes will be validated by external review. See Water and Energy Cycle Roadmap.
Outcome 1.1.11	*Reduce uncertainty in global sea level change projections by 50% by the year 2014, and include regional estimates of deviation from global mean.*
5ESS7	Assimilate satellite/in situ observations into variety of ocean, atmosphere, and ice models for purposes of state estimation; provide experimental predictions on variety of climatological timescales; determine plausibility of these predictions using validation strategies. Specific output: documented assessment of relative impact of different climate forcings on long-term climate change and climate sensitivities to those various forcings. See Climate, Variability and Change Roadmap.
Outcome 1.1.12	*Enable 10-year or longer climate forecasts by the year 2014 with a national climate modeling framework capable of supporting policy decision-making at regional levels.*
5ESS8	Assimilate satellite/in situ observations into variety of ocean, atmosphere, and ice models for purposes of state estimation; provide experimental predictions on variety of climatological timescales; determine plausibility of these predictions using validation strategies. Specific output: An assimilated product of ocean state on a quarter degree grid. See Climate, Variability and Change roadmap.

Theme: Earth System Science

Outcomes/Annual Performance Goals (APGs)	
Outcome 1.1.13	*Enable 30-day volcanic eruption forecasts with > 50% confidence by 2014.*
5ESS9	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. Progress toward achieving outcomes will be validated by external review. See Earth Surface and Interior Roadmap.
Outcome 1.1.14	*Enable estimation of earthquake likelihood in North American plate boundaries with > 50% confidence by 2014.*
5ESS9	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. Progress toward achieving outcomes will be validated by external review. See Earth Surface and Interior Roadmap.
Outcome 7.1.4	*Engage the public in NASA missions, discoveries and technology through public programs, community outreach, mass media, and the Internet.*
5ESS10	Post the most exciting imagery and explanations about Earth science on the Earth observations/ESE website.
Uniform Measures	
5ESS11	Complete all development projects within 110% of the cost and schedule baseline.
5ESS12	Deliver at least 90% of scheduled operating hours for all operations and research facilities.
5ESS13	At least 80%, by budget, of research projects will be peer-reviewed and competitively awarded.

INDEPENDENT REVIEWS

Review Types	Performer	Last Review Date	Next Review Date	Purpose
External Peer Review	Earth Science Advisory Committee	7/03	2/04	Annual peer review
External Peer Review	National Academy of Sciences	7/03	10/05	Review of strategic plan

BUDGET

Budget Authority ($ millions)	FY 2003	FY 2004	Change	FY 2005	Comments
Earth System Science	**1,304.1**	**1,522.4**	**-113.9**	**1,408.5**	
Development	488.5	402.7	-160.3	242.4	
AURA	98.3	52.2	-47.7	4.5	
SeaWinds	5.5	4.5	-1.5	3.0	
NPOESS Preparatory Project (NPP)	128.8	103.5	+37.6	141.1	
Cloud-Aerosol Lidar and Infrared Pathfinder Satellite	32.5	28.2	-18.1	10.1	
CloudSat	25.7	16.4	-13.3	3.1	
EOSDIS	122.6	143.0	-102.8	40.2	
IceSAT	8.6				
GIFTS	22.2	26.8	-10.3	16.5	
Small Projects	44.4	28.1	-4.2	23.9	
Operations	249.1	314.9	-7.7	307.2	
Research	410.4	521.6	+38.4	560.0	
Technology and Advanced Concepts	156.1	283.2	+15.7	298.9	
Technology Infusion Program	75.0	85.3	-26.3	59.0	
Missions in Formulation	81.1	197.9	+42.0	239.9	

Indicates changes since the previous year's President's Budget Submit.
Indicates budget numbers in full cost.

Theme: Earth System Science
Development: CloudSat

PURPOSE

Objectives	Performance Measures
1.1	5ESS9-10,16

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 a 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 largest 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. The mission will fly in formation with Aqua and CALIPSO. CSA is contributing instrument components and the U.S. Air Force (USAF) is contributing ground operations. CloudSat will provide critical data helping to 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 Goddard Space Flight Center (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 Director 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	FY 2005 President's Budget	Change from Baseline
Instrument	The CloudSat instrument is the Cloud Profiling Radar (CPR). The CPR is a 94-GHz nadir-looking radar that 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 formation with Aqua and CALIPSO.	--
Science Data Products and Processing	The CloudSat CPR provides calibrated, range-resolved radar reflectivity measurements.	--
Mission Operations	The USAF Space Test Program will provide ground operations and manage communications. It is expected that the data will be downlinked up to seven times per day.	--
Data Archiving and Distribution	Colorado State University Cooperative Institute for Research in the Atmosphere will be responsible for processing, archiving and distributing the mission science data.	--

Schedule	FY 2005 President's Budget	Baseline	Change from Baseline
Instrument Delivery to I&T	Under replan, NET Mar-04	Nov-03	Minimum +4 months
Launch	Under replan - no earlier than 3/05	April-04	+11 months
Mission Design Life	Two years	--	--

Theme: Earth System Science
Development: CloudSat

ACQUISITION STRATEGY AND PERFORMING ORGANIZATIONS

Major acquisitions for CloudSat are: Science investigations; 94 GHz Cloud Profiling radar and spacecraft bus; and operations system development. MOU with CSA for radar components, and science operations (2 years). 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 FY04 Pres. Budget: None.

Current Acquisition	Actual*	Selection Method	Actual*	Performer	Actual*
Cooperative Agreement	0%	Full & Open Competition	100%	Industry	3%
Cost Reimbursable	99%	Sole Source	0%	Government	0%
Fixed Price	0%		100%	NASA Intramural	94%
Grants	1%			University	3%
Other	0%	Sci Peer Review	100%	Non Profit	0%
*As of FY 2003 direct procurement	100%	*As of FY 2003 direct procurement		*As of FY 2003 direct procurement	100%

Future Acquisition -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, 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 FY04 Pres. Budget: Implementation Phase of contracts.

RISK MITIGATION

Top Risks	Y	Overall	Y	Cost	Y	Schedule	Y	Probability	Impact	Mitigation Plan
Y	Launch delay due to problems with High Voltage Power Supply (HVPS)							High	Medium	JPL tiger team rework HVPS

INDEPENDENT REVIEWS

Review Types	Performer	Last Review Date	Next Review Date	Purpose
Flight Readiness Review	IIRT	N/A	1/05	Update status; certify flight readiness; open MMR issues.
Launch Readiness Review	IIRT	N/A	1/05	Final review before launch.
Mission Readiness Review	IIRT	N/A	1/05	Assess readiness of mission to proceed with launch and operations.
Operational Readiness Review	IIRT	N/A	12/04	Verify that system elements meet mission requirement and are ready for launch.
Pre-environmental Review	IIRT	N/A	3/04	Assess flight hardware, software, and environmental test facilities.

Theme: Earth System Science
Development: CloudSat

BUDGET/LIFE CYCLE COST

Budget Authority ($ millions)	Prior	FY03	FY04	FY05	FY06	FY07	FY08	FY09	BTC	Total	Comments
FY2005 PRESBUD	93.6	25.7	16.4	3.1	1.4					140.2	
Development	82.0	17.0	7.3	3.1	1.4					110.9	Includes operations
Launch Vehicle	11.6	8.6	9.1							29.3	
Changes since 2004 PRESBUD		-1.7	-0.1	+0.4	-0.3					-1.6	
Development		+0.7	-0.2	+3.1	+1.4					+5.0	Ops incl in dev. Full cost adj; launch date change.
Launch Vehicle		-2.4	+2.1							-0.4	
Operations			-1.9	-2.7	-1.7					-6.3	
FY2004 PRESBUD	93.6	27.4	16.5	2.7	1.7					141.8	
Launch Vehicle	11.6	11.1	7.0							29.7	
Development	82.0	16.3	7.5							105.9	
Operations			1.9	2.7	1.7					6.3	
Initial Baseline	100.9	10.3	3.1	1.5						115.8	
Development	76.5	3.7								80.2	FY01 PRESBUD
Operations		1.2	3.1	1.5						5.8	
Launch Vehicle	24.4	5.4								29.8	

Indicates changes since the previous year's President's Budget Submit.
Indicates budget numbers in full cost.

Theme: Earth System Science

Development: Cloud-Aerosol Lidar and Infrared Pathfinder Satellite Observations (CALIPSO)

PURPOSE

Objectives	Performance Measures
1.1	5ESS1,11

The 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 predicitions 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), integrated observatory 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 January 2005. Link to project homepage for more information: http://www-calipso.larc.nasa.gov/ .

PROGRAM MANAGEMENT

CALIPSO is part of the Earth Explorers program with program responsibility delegated to GSFC. LaRC and GSFC jointly chair an integrated Program Management Council (PMC). The PMC has CALIPSO Project governing responsibility. Enterprise official is Dr. Ghassem Asrar, Associate Administrator for Earth Science. Theme Director is Dr. Jack Kaye. Program Director is Doug McCuistion.

TECHNICAL COMMITMENT

The baseline for this technical commitment was made in February 2001 and is detailed in the Earth Explorers Program Commitment Agreement (PCA).

Technical Specifications	FY 2005 President's Budget	Change from Baseline
Instruments	Three-channel Lidar, Imaging Infrared Radiometer, and Wide Field Camera.	--
Launch and Mission Profile	Satellite planned to be launched into 705km altitude, 98.08 degrees inclined orbit. CALIPSO is planned to be co-manifested w/CloudSat on a Delta II launch vehicle & fly in formation w/Aqua & CloudSat.	--
Science Data Products and Processing	Science data sets: aerosol & cloud vertical dist., aerosol extinction & optical depth/cloud extinction, optical depth, emissivity, & effective particle size & surface atmospheric radiative fluxes.	--
Mission Operations	Mission Operations Control Center at LaRC and the CNES-contributed Satellite Operations Control Center in Toulouse, France.	--

Schedule	FY 2005 President's Budget	Baseline	Change from Baseline
Spacecraft Bus Delivery to I&T	Dec-03	May-03	+ 7 months
Instrument delivery to I&T	Feb-04	May-03	+9 months
Launch	Under replan - no earlier than 3/05	April-04	+11 months
Mission Design Life	Three years	Three years	None

Theme: Earth System Science

Development: Cloud-Aerosol Lidar and Infrared Pathfinder Satellite Observations (CALIPSO)

ACQUISITION STRATEGY AND 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 FY04 Pres. Budget: None.

Current Acquisition	Actual*	Selection Method	Actual*	Performer	Actual*
Cooperative Agreement	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%
*As of FY 2003 direct procurement	100%	*As of FY 2003 direct procurement		*As of FY 2003 direct procurement	100%

Future Acquisition -Major	Selection	Goals
No major acquisitions 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 June 2003. Changes since FY04 Pres. Budget: None.

RISK MITIGATION

Top Risks	Y	Overall	Y	Cost	Y	Schedule	Y	Probability	Impact	Mitigation Plan
Y	CNES S/C does not meet NASA launch site safety requirements							Medium	Medium	Develop safety mitigation plan

INDEPENDENT REVIEWS

Review Types	Performer	Last Review Date	Next Review Date	Purpose
Flight Readiness Review	IIRT	N/A	1/05	Certify flight readiness; open MMR issues.
Launch Readiness Review	IIRT	N/A	1/05	Final review before launch.
Mission Readiness Review	IIRT	N/A	1/05	Assess readiness of system to launch and assess operations.
Satellite Pre-Ship Review	IIRT	N/A	11/04	Certify that mission elements meet requirements and are ready for launch.

Theme: Earth System Science

Development: Cloud-Aerosol Lidar and Infrared Pathfinder Satellite Observations (CALIPSO)

BUDGET/LIFE CYCLE COST

Budget Authority ($ millions)	Prior	FY03	FY04	FY05	FY06	FY07	FY08	FY09	BTC	Total	Comments
FY2005 PRESBUD	86.0	32.5	28.2	10.1	3.7	2.6	0.1	0.1		163.3	
Development	74.4	23.8	19.1	10.1	3.7	2.6	0.1	0.1		133.9	Includes operations.
Launch Vehicle	11.6	8.7	9.1							29.3	
Changes since 2004 PRESBUD		-1.3	-0.2	+2.5	-0.8	-0.4	+0.1	+0.1			
Development		+1.1	+18.9	+10.1	+3.7	+2.6	+0.1	+0.1		+36.6	Full cost adjustments; launch date change. Ops funding incl in dev
Launch Vehicle		-2.4	+2.1							-0.3	
Operations			-21.2	-7.6	-4.5	-3.0				-36.3	
FY2004 PRESBUD	86.0	33.8	28.4	7.6	4.5	3.0				163.3	
Development	74.4	22.8	0.2							97.4	
Operations			21.2	7.6	4.5	3.0				36.3	
Launch Vehicle	11.6	11.0	7.0							29.7	
Initial Baseline	89.5	16.0	4.5	2.2						112.2	
Development	65.0	3.2								68.2	FY2001 President's Budget
Operations		7.5	4.5	2.2						14.2	
Launch Vehicle	24.5	5.3								29.8	

Indicates changes since the previous year’s President’s Budget Submit.

Indicates budget numbers in full cost.

Theme: Earth System Science
Development: GIFTS

PURPOSE

Objectives	Performance Measures
1.1	5ESS2, 6, 11

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 geosynchronous 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 arrays; low-power, high-efficiency mechanical cooler; and new data readout and signal processor 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 National Oceanic and Atmospheric Administration (NOAA). The Office of Naval Research (ONR) in the Department of the U.S. Navy had been a partner but has since been unable to continue its commitment. At this time, the instrument will be completed and NASA will continue to explore rides of opportunity and potential partnerships via U.S. inter-agency agreements, commercial, and/or international opportunities.

Link to project homepage for more information: http://nmp.jpl.nasa.gov/.

PROGRAM MANAGEMENT

GIFTS is part of the New Millennium Program (NMP), managed by the JPL NMP office. The mission is a collaboration between NASA and NOAA. 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 Director is Doug McCuistion.

TECHNICAL COMMITMENT

The baseline for this technical commitment was made in the NMP Program Commitment Agreement (PCA).

Technical Specifications	FY 2005 President's Budget	Change from Baseline
1	Measure the surface temperature to better than 1/2 Kelvin;	--
2	Measure temperature profiles of the atmosphere to better than +/- 1 Kelvin for 1 km layers (1 sigma);	--
3	Measure and spatially resolve the wind velocity to better than 4 m/s for 2 km layers (1 sigma);	--
4	Measure the water vapor level to better than 20% accuracy for 2 km layers (1 sigma).	--
Design for two-year lifetime. Includes an initial year to demonstrate breakthrough technologies and measurement concept, as well as an extended period over the Indian Ocean to provide imaging and other weather products.		

Schedule	FY 2005 President's Budget	Baseline	Change from Baseline
Start of Formulation	Nov-99	--	--
GIFTS Instrument Critical Design Review	Jun-04	Jun-03	+1 year
GIFTS Instrument delivery to spacecraft	Sept-05	Aug-04	+13 months
Observatory Launch Readiness Date (LRD)	TBD	Nov-05	TBD
Delivery of Mission Validation Data	Checkout +6 months	Jun-07	TBD
Observatory Operational Lifetime	Two years with 50% reliability	7 years	- 5 years

Theme: Earth System Science
Development: GIFTS

Acquisition Strategy and Performing Organizations

Major acquisitions for GIFTS-IOMI are: Contract with Space Dynamics Laboratory for the imaging interferometer instrument, complete with subcontracts for detector assemblies (BAE), high reliability lasers (Tesat), cryocoolers (Lockheed-Martin), and star tracker assemblies (Texas A&M University). Changes since FY04 Pres. Budget: None.

Current Acquisition	Actual*	Selection Method	Actual*	Performer	Actual*
Cooperative Agreement	0%	Full & Open Competition	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 FY 2003 direct procurement	100%	*As of FY 2003 direct procurement		*As of FY 2003 direct procurement	100%

Future Acquisition -Major	Selection	Goals
Control Module	FY03/04	N/A
Radiation Tolerant Processor	FY03/04	N/A

Agreements

Internal: The program is not dependent on other NASA activities outside of the control of the Associate Administrator of Earth Science. External: Memoranda of Agreement have been signed with the Department of the Navy and NOAA. The USN withdrawal has rendered the MOA ineffectual and Project replanning is underway. NOAA-provided funding remains in effect.

Risk Mitigation

Top Risks	Y	Overall	Y	Cost	Y	Schedule	G	Probability	Impact	Mitigation Plan
Y	Risk assessment pending project replan reviews w/HQ (Mar 04)							Medium	Medium	In work

Independent Reviews

Review Types	Performer	Last Review Date	Next Review Date	Purpose
Delta Confirmation Assessment	SMO	3/02	3/04	Establish maturity of developmental technology components; project health.
Instrument CDR	SMO/IRT	N/A	6/04	Determine instrument readiness to proceed to fabrication and assembly.
Launch Readiness Review (On Hold)	SMO/IRT	N/A	TBD	Determine overall system readiness to launch.
Mission CDR (On Hold)	SMO/IRT	N/A	TBD	Determine mission readiness to proceed to production.
Mission Confirmation Review (On Hold)	SMO	4/02	4/02	Determine readiness to proceed to implementation.
Mission Pre-Ship Review (On Hold)	SMO/IRT	N/A	TBD	Determine completeness of observatory verification and test.
Mission Readiness Review (On Hold)	Smo/IRT	N/A	TBD	Assess completeness of mission coordination, ops planning, and ground system.
Preliminary Design Review (PDR)/CDR	SMO	3/01	10/04	Establish design readiness to proceed to implementation.

Theme: Earth System Science
Development: GIFTS

BUDGET/LIFE CYCLE COST

Budget Authority ($ millions)	Prior	FY03	FY04	FY05	FY06	FY07	FY08	FY09	BTC	Total	Comments
FY2005 PRESBUD	56.8	22.2	26.8	16.5	2.0	1.8	0.3			126.4	
Development	56.8	22.2	26.8	16.5	2.0	1.8	0.3			126.4	
Changes since 2004 PRESBUD		-0.1	-0.2	+1.0	+2.0	+1.8	+0.3			+4.8	
Development		-0.1	-0.2	+1.0	+2.0	+1.8	+0.3			+4.8	
FY2004 PRESBUD	56.8	22.3	27.0	15.5						121.6	
Development	56.8	22.3	27.0	15.5						121.6	
Initial Baseline	71.8	7.3	13.4	6.7	4.0					103.2	
Development	71.8	7.3	13.4	6.7	4.0					103.2	FY2002 President's Budget

Indicates changes since the previous year's President's Budget Submit.

Indicates budget numbers in full cost.

Theme: Earth System Science
Development: EOSDIS

PURPOSE

Objectives	Performance Measures
7.1	5ESS10, 11

Earth Observing System Data and Information System (EOSDIS) 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

The EOSDIS is an end-to-end satellite ground data and information system, which commands and controls satellites, retrieves observations from them, and converts these observations into useful scientific information. EOSDIS Development will be completed after its final release to support the upcoming EOS Aura mission in FY 2004. In addition, EOSDIS supports the development of Science Investigator-led Processing Systems (SIPS) for Aura instruments. EOSDIS also supports new Earth Science Enterprise missions and the evolution of existing systems to support new missions. Specifically, it will support the ESE Data Systems Evolution through the next decade. It is one of the largest and most successful "e-science" systems built in the U.S. that serves more than two million users of NASA-obtained data and information each year. 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. ESE Data System Evolution, including peer reviewed data projects, are managed by Headquarters beginning in FY 2004. 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 Director is Doug McCuistion.

TECHNICAL COMMITMENT

The EOSDIS baseline was established in 1986. The requirements are detailed in the EOS PCA.

Technical Specifications
EOSDIS supports the ground ops of the EOS missions to include s/c and instrument control, data acquisition, telemetry processing, operation of 8 DAACs, and science investgator-led processing.
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 (DAACs), which archive and distribute the data; to support science investigator-led processing; and to add additional capabilities for new missions in an evolutionary manner.

Schedule	FY 2005 President's Budget	Change from Baseline
Start of Formulation	Nov-88	--
Start of Implementation	Oct-90	--
Data Validation Period	6 months to 1 year after receipt by investigators (depends on maturity of instrument technology)	--
Operational Lifetime	20 years	--

ACQUISITION STRATEGY AND 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 procurements from multiple contracts to a consolidated 5-year GSA contract (FY03 - FY07). Changes since FY04 Pres. Budget: None.

Theme: Earth System Science
Development: EOSDIS

Current Acquisition	Actual*	Selection Method	Actual*	Performer	Actual*
Cooperative Agreement	0%	Full & Open Competition	100%	Industry	99%
Cost Reimbursable	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 FY 2003 direct procurement	100%	*As of FY 2003 direct procurement		*As of FY 2003 direct procurement	100%

Future Acquisition -Major	Selection	Goals
REASoN Cooperative Agreement Notice	Spring 2006	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 FY04 Pres. Budget: None.

Risk Mitigation

Top Risks	G	Overall	G	Cost	G	Schedule	G	Probability	Impact	Mitigation Plan
G	No Risks identified							N/A	N/A	N/A

Independent Reviews

Review Types	Performer	Last Review Date	Next Review Date	Purpose
Annual Review	ESSAAC	11/03	2/04	Validation and peer review of program direction.
Independent Annual Review	IPAO	3/03	3/05	Affirmation of Program Commitment Agreement.

Budget/Life Cycle Cost

Budget Authority ($ millions)	Prior	FY03	FY04	FY05	FY06	FY07	FY08	FY09	BTC	Total	Comments
FY2005 PRESBUD	2,456.3	122.6	143.0	40.2	39.7	39.9	39.6	39.6		2,920.9	
Development	2,456.3	122.6	143.0	40.2	39.7	39.9	39.6	39.6		2,920.9	Funding maintained at FY05 level
Changes since 2004 PRESBUD	+0.1	+48.3	+44.7	-58.4	-60.9	-59.5	-65.1	+39.6		-111.3	
Development	+0.1	+48.3	+44.7	-58.4	-60.9	-59.5	-65.1	+39.6		-111.3	Alignment to sustaining system maintenance.
FY2004 PRESBUD	2,456.3	74.3	98.3	98.6	100.6	99.4	104.7			3,032.3	
Development	2,456.3	74.3	98.3	98.6	100.6	99.4	104.7			3,032.3	

Indicates changes since the previous year's President's Budget Submit.
Indicates budget numbers in full cost.

Theme: Earth System Science
Development: AURA

PURPOSE

Objectives	Performance Measures
1.1	5ESS1, 11

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 (CFCs) has caused a 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, a harmful by-product 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 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 Director 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	FY 2005 President's Budget	Change from Baseline
The Aura project	Four instruments on the EOS Common Spacecraft launched into a 705 km, 98.2-degree inclination, sun-synchronous orbit. The spacecraft will have an equatorial crossing time (ascending node) of 1:45 pm.	--
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	FY 2005 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 Date	June 04	Dec-02	+16 Months
Data Validation Period	One yr after receipt by investigators	--	--
Observatory Operational Lifetime	5 years	5 years	None

Theme: Earth System Science
Development: AURA

ACQUISITION STRATEGY AND PERFORMING ORGANIZATIONS

Major acquisitions for Aura are: three U.S. instruments, spacecraft development, launch vehicle services through the Kennedy Space Center (KSC). 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 and Finland. The spacecraft is being built as part of the EOS common spacecraft contract by NGST for GSFC. Changes since FY04 Pres. Budget: None.

Current Acquisition	Actual*	Selection Method	Actual*	Performer	Actual*
Cooperative Agreement	0%	Full & Open Competition	100%	Industry	63%
Cost Reimbursable	100%	Sole Source	0%	Government	11%
Fixed Price	0%		100%	NASA Intramural	0%
Grants	0%			University	26%
Other	0%	Sci Peer Review	100%	Non Profit	0%
*As of FY 2003 direct procurement	100%	*As of FY 2003 direct procurement		*As of FY 2003 direct procurement	100%

Future Acquisition -Major	Selection	Goals
None, as the program is within a half year of 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 FY04 Pres. Budget: None.

RISK MITIGATION

Top Risks	Y	Overall	Y	Cost	Y	Schedule	Y	Probability	Impact	Mitigation Plan
Y	Launch delay due to failure of HIRDLS Cryo-cooler							High	High	To be assessed mid Dec-03

INDEPENDENT REVIEWS

Review Types	Performer	Last Review Date	Next Review Date	Purpose
Independent Annual Review	IPAO - LARC	10/00	N/A	Affirmation of Program Commitment Agreement.
Pre-Environmental Review	SMO	3/03	N/A	Confirm Observatory is ready for environmental tests.
Pre-Ship Review	SMO	N/A	2/04	Confirm Observatory is ready for launch.

Theme: Earth System Science
Development: AURA

BUDGET/LIFE CYCLE COST

Budget Authority ($ millions)	Prior	FY03	FY04	FY05	FY06	FY07	FY08	FY09	BTC	Total	Comments
FY2005 PRESBUD	621.6	98.3	52.2	4.5	3.5	0.1	0.1	0.6		780.9	
Development	604.8	63.9	45.1	4.5	3.5	0.1	0.1	0.6		722.6	
Launch Vehicle	16.8	34.4	7.1							58.3	
Changes since 2004 PRESBUD		+13.0	-0.3	-0.1	+0.1			+0.6	-0.1	+13.2	
Development	+4.3	+8.7		-0.1	+0.1			+0.6	-0.1	+13.4	Technical difficulties with TES and MLS instruments.
Launch Vehicle	-4.3	+4.3	-0.3							-0.3	
FY2004 PRESBUD	621.6	85.3	52.5	4.6	3.4	0.1	0.1		0.1	767.7	
Development	600.5	55.2	45.1	4.6	3.4	0.1	0.1		0.1	709.1	
Launch Vehicle	21.1	30.1	7.4							58.6	

Indicates changes since the previous year's President's Budget Submit.
Indicates budget numbers in full cost.

Theme: Earth System Science
Development: NPOESS Preparatory Project (NPP)

PURPOSE

Objectives	Performance Measures
1.1	5ESS4, 7, 11

NPP will continue to fulfill a national commitment to obtain and make available a 15-year data record for fundamental global climate change observations started by the Moderate-resolution Imaging Spectroradiometer (MODIS), Atmospheric Infrared Sounder (AIRS), and the combination of the Advanced Microwave Sounding Unit/Humidity Sounder Brazil (AMSU/HSB), which are the primary instruments on the EOS Terra and Aqua satellites. This is also 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 joint NASA, NOAA, DoD effort. This arrangement assures NASA's long-term science observational needs are met by the operational system, and assures transfer of key technologies NASA developed as part of the EOS program into the next generation of operational satellites.

OVERVIEW

The NPP spacecraft carries the following instruments: The Advanced Technology Microwave Sounder (ATMS), developed and provided by NASA (in conjunction with the Cross-Track Infrared Sounder (CrIS)) to provide daily global observation of atmospheric temperature and humidity profiles; The Visible Infrared Imaging Radiometer Suite (VIIRS) developed and provided by NPOESS IPO to obtain global observations of land, oceans, and atmosphere for climate research and weather forecasting; The Cross-Track Infrared Sounder (CrIS) developed and provided by NPOES IPO (in conjunction with ATMS) to provide daily global observation of atmospheric temperature and humidity profiles; the Ozone Mapping and Profiler Suite (OMPS).

PROGRAM MANAGEMENT

NPP is part of the EOS program with program responsibility delegated to the GSFC. The GSFC Program Management Council (PMC) has NPP governing responsibility. Enterprise official is Ghassem Asrar, Associate Administrator for Earth Science at HQ. Theme Director is Dr. Jack Kaye. Program Director is Doug McCuistion.

TECHNICAL COMMITMENT

The baseline for this technical commitment was made in November 2003 and is detailed in the NPP Program Commitment Agreement (PCA).

Technical Specifications	FY 2005 President's Budget	Change from Baseline
The NPP Project	It will launch four instruments on the NPP spacecraft into an 824 km sun-synchronous orbit, with a descending equatorial crossing time of 10:30 AM.	--
VIIRS, supplied by IPO	Multi-spectral scanning radiometer designed to measure land, ocean, and atmospheric parameters.	--
CrIS, supplied by IPO	Michelson interferometer designed to measure temperature and moisture profiles.	--
OMPS, supplied by IPO	Nadir and limb pushbroom spectrometers designed to monitor total column and vertical ozone profiles.	--
ATMS	Scanning passive microwave radiometer designed to measure temperature and moisture profiles.	--

Schedule	FY 2005 President's Budget	Change from Baseline
MCR	4th Quarter 2003	--
CDR	4th Quarter 2003	--
Operational Readiness Review (ORR)	2nd Quarter 2006	--
Launch Readiness	1st Quarter FY 2007	--

ACQUISITION STRATEGY AND 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. Changes since FY04 Pres. Budget: None.

Theme: Earth System Science
Development: NPOESS Preparatory Project (NPP)

Current Acquisition	Actual*	Selection Method	Actual*	Performer	Actual*
Cooperative Agreement	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 FY 2003 direct procurement	100%	*As of FY 2003 direct procurement		*As of FY 2003 direct procurement	100%

Future Acquisition - Major	Selection	Goals
No major future acquisitions remain.		

AGREEMENTS

Initial Implementation Agreement with Integrated Program Office (IPO--includes NOAA and DoD) for NPP, signed 11/21/99. Final Implementation Agreement with IPO for ATMS, signed 8/2/00.

RISK MITIGATION

Top Risks	G	Overall	G	Cost	Y	Schedule	G	Probability	Impact	Mitigation Plan
Y	Delivery of IPO instruments (VIIRS and CrIS)							Medium	High	Mitigate with the IPO

INDEPENDENT REVIEWS

Review Types	Performer	Last Review Date	Next Review Date	Purpose
Mission Critical Design Review	IIRT	10/03	N/A	Approval to proceed to flight build.
Mission Confirmation Review	IPAO	11/03	N/A	Approval to proceed to implementation phase.
Mission Operations Requirements Review	IIRT	N/A	7/05	Confirm operations requirements of ground system.
Launch Readiness Review	IIRT	N/A	10/06	Determine launch readiness.

BUDGET/LIFE CYCLE COST

Budget Authority ($ millions)	Prior	FY03	FY04	FY05	FY06	FY07	FY08	FY09	BTC	Total	Comments
FY2005 PRESBUD	127.3	128.8	103.5	141.1	61.6	6.9				569.2	
Development	127.3	128.8	103.5	141.1	61.6	6.9				569.2	
Changes since 2004 PRESBUD	+127.3	+128.8	+103.5	+141.1	+61.6	+6.9				+569.2	
Development	+127.3	+128.8	+103.5	+141.1	+61.6	+6.9				+569.2	Moved from formulation into development
FY2004 PRESBUD.											

(light blue box)	Indicates changes since the previous year's President's Budget Submit.
(yellow box)	Indicates budget numbers in full cost.

Theme: Earth System Science
Operations

PURPOSE

Objectives	Performance Measures
1.1	5ESS1-9,12

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.

Note: Mission operations for Principal Investigator (PI)-managed projects such as Cloudsat, CALIPSO, Grace, and SORCE, are budgeted with the development activity for those missions. Operations for QuikScat and ACRIMSat are also budgeted under small projects development.

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 Director is Doug McCuistion.

TECHNICAL COMMITMENT

The baseline for each mission in operations was established during the project's Non-Advocate Review (NAR). The requirements are detailed in each mission's Program Commitment Agreement (PCA).

Technical Specifications	FY 2005 President’s Budget	Change from Baseline
Operating Missions TOMS, UARS, TRMM, ERBS, Topex, ASF	Missions in their prime phase are expected to achieve their individual data delivery objectives; extended phases have reduced objectives.	--
EOS (e.g., Terra, Aqua, ICESat)	Committed to capturing 95% of science data, maintaining processing and through-put rates for all instruments, and providing archive and distribution services until 3 years after end of mission.	--
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	FY 2005 President’s Budget	Change from Baseline
EOS-DAACS, ESMO, PI Processing Federation, Networks, etc.	EOS schedules are commensurate with spacecraft prelaunch, launch and postlaunch milestones for check-out, end-to-end test, and operations throughout spacecraft prime mission lifetime plus 3 years.	--
Earth Radiation Budget Satellite (ERBS)	1986-2004	1 year extension
Ground Network	In transition from Gov't assets to commercial services. NASA plans to maintain a reliable capability to support current and future missions. Older underutilized tracking antenna sys will be retired.	--
Operating Missions (includes Alaska SAR Facility)	These operating missions have met prime objectives and are in extended mission phases.	--
TOPEX	1992-2004	1 year extension
Total Ozone Mapping Spectrometer (TOMS)	1996-2004	--
Tropical Rainfall Measuring Mission (TRMM)	1997-2004	--
Upper Atmosphere Research Satellite (UARS)	1991-2004	1 year extension

Theme: Earth System Science

Operations

Acquisition Strategy and 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 covered 5 years of operations, ending in December 2003. SMCDS is the follow on contract vehicle. The prime contractor on the EOS mission is Raytheon. Changes since FY04 Pres. Budget: None

Current Acquisition	Actual*	Selection Method	Actual*	Performer	Actual*
Cooperative Agreement	0%	Full & Open Competition	96%	Industry	87%
Cost Reimbursable	84%	Sole Source	4%	Government	0%
Fixed Price	4%			NASA Intramural	7%
Grants	5%		100%	University	6%
Other	7%	Sci Peer Review	%	Non Profit	0%
*As of FY 2003 direct procurement	100%	*As of FY 2003 direct procurement		*As of FY 2003 direct procurement	100%

Future Acquisition	Selection	Goals
Follow-on contract to MOMS and NENS	Dec 08	100% Full & Open Competition
Follow-on to EMD	Mar 08	100% Full & Open Competition

Agreements

Internal: MOA for Mission Services and Space Communications with NASA Space Flight and Space Science Enterprises. External: National Research Council review of DAACS. Changes since FY04 Pres. Budget: None.

Risk Mitigation

Top Risks	G	Overall	G	Cost	G	Schedule	G	Probability	Impact	Mitigation Plan
G	No risks for missions in operation									

Independent Reviews

Review Types	Performer	Last Review Date	Next Review Date	Purpose
None	N/A			N/A

Budget/Life Cycle Cost

Budget Authority ($ millions)	FY 2003	FY 2004	FY 2005	Comments
FY2005 PRESBUD	249.1	314.9	307.2	
UARS, ERBS, TRMM, QuikTOMS, Seastar/Seawifs, TOMS	31.5	28.0	14.4	
Earth Science Ops	175.5	243.7	231.0	
Ground Network	42.1	43.2	61.8	
Changes since 2004 PRESBUD	+1.3	-7.3		
UARS, ERBS, TRMM, QuikTOMS, Seastar/Seawifs, TOMS	+2.7	+5.8		ERBS, UARS, TRMM continuation
Earth Science Ops	-1.1	-12.8		Alignment with Task 1 of new EMD contract
Ground Network	-0.3	-0.3		Transition from CSOC
FY2004 PRESBUD	247.8	322.2		
UARS, ERBS, TRMM, QuikTOMS, Seastar/Seawifs, TOMS	28.8	22.2		
Earth Science Ops	176.6	256.5		
Ground Network	42.4	43.5		

Indicates changes since the previous year's President's Budget Submit.

Indicates budget numbers in full cost.

Theme: Earth System Science
Research

PURPOSE

Objectives	Performance Measures
1.1	5ESS1-9,12, 13

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 System 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 1,500 U.S. scientific research tasks through the Research and Analysis activity. Scientists from approximately 17 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 FY05, NASA Earth System Science Research program will continue to provide the technology, observations, and modeling results that contribute to 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 Science Enterprise has responsibility for the Earth System Science Research program. The Enterprise official is Dr. Ghassem Asrar, Associate Administrator for Earth Science. The Science Division Director is Dr. Jack Kaye.

TECHNICAL COMMITMENT

Technical Specifications
Earth science research strategy outlines technology, observations, modeling, and basic research requirements needed to answer science questions. View roadmaps at: http://earth.nasa.gov/roadmaps.

Schedule	FY 2005 President's Budget	Change from Baseline
Research Announcements: Earth Observing System & OSTM	Estimated Selection Date: Q1 FY04	--
Research Announcements: New Investigator Program	Estimated Selection Date: Q2 FY04	--
Research Announcement: Carbon Cycle	Estimated Selection Date: Q3 FY04	--
Research Announcements: Modeling/Analysis & Physical Oceanography	Estimated Selection Date: Q3 FY04	--
Tropospheric Chemistry and the INTEX Field Mission	Estimated Selection Date: Q3 FY04	--
Research Announcements: Energy & Water Cycle	Estimated Selection Date: Q3 FY04	--
Research Announcements: CAMEX 5	Estimated Selection Date: Q4 FY04	--

ACQUISITION STRATEGY AND 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 FY04 President's Budget: None.

Theme: Earth System Science
Research

Current Acquisition	Actual*	Selection Method	Actual*	Performer	Actual*
Cooperative Agreement	13%	Full & Open Competition	81%	Industry	8%
Cost Reimbursable	0%	Sole Source	19%	Government	7%
Fixed Price	16%			NASA Intramural	24%
Grants	51%		100%	University	61%
Other	20%	Sci Peer Review	95%	Non Profit	0%
*As of FY03 direct procurement	100%	*As of FY03 direct procurement		*As of FY03 direct procurement	100%

Future Acquisition	Selection	Goals
Earth Observing System	FY04 - 1st Qtr.	95% Sci Peer Review, 100% Grants
Ocean Surface Topography	FY04 - 1st Qtr.	95% Sci Peer Review, 100% Grants
New Investigator Program	FY04 - 2nd Qtr.	95% Sci Peer Review, 100% Grants
Carbon Cycle	FY04 - 3rd Qtr.	95% Sci Peer Review, 100% Grants
Modeling/Analysis	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
Energy & Water Cycle	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 Memoranda of Understanding and Agreements with NOAA, National Science Foundation (NSF), USGS, and other Federal and foreign entities. Changes since FY04 Pres. Budget: None.

INDEPENDENT REVIEWS

Review Types	Performer	Last Review Date	Next Review Date	Purpose
External Peer Review	ESSAAC	7/03	2/04	Overall assessment of progress and priorities.

Theme: Earth System Science

Research

BUDGET/LIFE CYCLE COST

Budget Authority ($ millions)	FY 2003	FY 2004	FY 2005	Comments
FY2005 PRESBUD	410.4	521.6	560.0	
EOS Science	51.3	66.6	75.7	
Suborbital Science	24.8	35.2	36.9	
Information Systems	10.4	14.8	16.2	
Algorithm Development	72.0			
Mission Science Teams	91.5	189.5	217.0	
Research & Analysis	160.4	215.5	214.2	
Changes since 2004 PRESBUD	+53.1	-1.8		
EOS Science	-4.9	-0.4		
Suborbital Science	-0.2	-0.2		
Information Systems	-0.1	-0.1		
Algorithm Development	+71.0	-81.2		Aligned with missions science teams.
Mission Science Teams	-7.9	+80.1		Algorithm development transfer and full cost adjustment.
Research & Analysis	-1.4			
CofF	-3.4			
FY2004 PRESBUD	357.3	523.4		
EOS Science	56.2	67.0		
Suborbital Science	25.0	35.4		
Information Systems	10.5	14.9		
Algorithm Development	1.0	81.2		
Mission Science Teams	99.4	109.4		
Research & Analysis	161.8	215.5		
CofF	3.4			

Indicates changes since the previous year's President's Budget Submit.

Indicates budget numbers in full cost.

Theme: Earth System Science

Technology and Advanced Concepts: Technology Infusion Program

PURPOSE

Objectives	Performance Measures
1.1	5ESS1-9

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. ESTP also ensures consistency between the ESE Strategic Plan and the implementing technology strategy, as manifest in the Earth Science Technology Program 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: Advanced Technology Initiatives (ATI), to implement a broad array of technology developments for state-of-the-art components for instruments and Earth- and space-based platforms; the Instrument Incubator Program (IIP) to develop new and innovative instruments and measurement techniques at the system level, including laboratory development and airborne validation; Advanced Information Systems Technology (AIST) to develop end-to-end information technologies that enable new Earth observation measurements and information products; and Advanced Platform Technology (APT).

Metrics include maturing two to three technologies to the point where they can be demonstrated in space or in an operational environment, annually advancing 25% of funded technology developments one Technology Readiness Level (TRL), and enabling one new science measurement capability or significantly improve performance of an existing one.

ESTO will leverage technology investments through internal NASA program synergy and external partnerships. These efforts will include: Small Business Innovative Research (SBIR), the Mission and Science Measurement Technology Program (MSMT), which includes the NASA Institute of Advanced Concepts (NIAC) and Revolutionary Aero Space Concepts (RASC), and other agencies' (e.g., DoD) programs. Link to program homepage for more information at: http://esto.nasa.gov/.

PROGRAM MANAGEMENT

The program responsibility has been assigned to the ESTO office located at 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 technical commitment is the PCA.

Technical Specifications		FY05 Budget Submit							Change from Baseline
		FY03	FY04	FY05	FY06	FY07	FY08	FY09	
Instrument Incubator Program: maintain on average a portfolio of 30 technology investments working toward an average TRL 5.	TRL	5	5	5	5	5	5	5	--
	$M	22	30	30	30	30	30	30	--
Advanced Technolgy Initiatives: Component and subsystem technologies matured to TRL 4 or 5.	TRL	4	4	4	5	5	5	5	--
	$M	16	12	12	12	12	12	12	--
Advanced Information Systems Technology: Info systems/subsystem technology matured to an average TRL 6.	TRL	6	6	6	6	6	6	6	--
	$M	13	11	11	11	11	11	11	--

Theme: Earth System Science

Technology and Advanced Concepts: Technology Infusion Program

Schedule	FY 2005 President's Budget	Baseline	Change from Baseline
Integrated Technology Development Plan	2nd Qtr FY04	2nd Qtr FY03	+1 year
Advanced Technology Initiatives (ATI) NRA	3rd Qtr FY04	2nd Qtr FY04	+1 Qtr
Instrument Incubator Program (IIP) NRA	2nd Qtr FY05	3 rd Qtr FY04	+ 3 Qtrs
Advanced Info Systems Technology (AIST) NRA	4th Qtr FY05	3rd Qtr FY05	+ 1 Qtr

ACQUISITION STRATEGY AND PERFORMING ORGANIZATIONS

Technology studies and development efforts are procured primarily through the NRA process. Changes since FY04 Pres. Budget: None.

Current Acquisition	Actual*	Selection Method	Actual*	Performer	Actual*
Cooperative Agreement	6%	Full & Open Competition	80%	Industry	11%
Cost Reimbursable	81%	Sole Source	20%	Government	7%
Fixed Price	10%		100%	NASA Intramural	38%
Grants	3%			University	20%
Other	0%	Sci Peer Review	%	Non Profit	24%
*As of FY 2003 direct procurement	100%	*As of FY 2003 direct procurement		*As of FY 2003 direct procurement	100%

Future Acquisition	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.

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 FY04 Pres. Budget: None.

INDEPENDENT REVIEWS

Review Types	Performer	Last Review Date	Next Review Date	Purpose
External Review Committee	ESSAAC	7/03	2/04	Overall assessment of progress and priorities.

Theme: Earth System Science
Technology and Advanced Concepts: Technology Infusion Program

BUDGET/LIFE CYCLE COST

Budget Authority ($ millions)	FY 2003	FY 2004	FY 2005	Comments
FY2005 PRESBUD	75.0	85.3	59.0	
Instrument Incubator Program	21.9	26.8	30.0	
Advanced Info Systems Technology	12.6	15.4	11.0	
Advanced Technology Initiatives	16.4	15.2	11.9	
Computational Technology	18.9	21.8		
IDPT	5.2	6.1	6.1	
Changes since 2004 PRESBUD	+29.0	+6.4		
Instrument Incubator Program	-0.1	-0.2		
Advanced Info Systems Technology	+2.8	+3.9		
Advanced Technology Initiatives	+7.9	+2.9		
Computational Technology	+18.9	-0.1		
IDPT	-0.5			
FY2004 PRESBUD	46.0	78.9		
Instrument Incubator Program	22.0	27.0		
Advanced Info Systems Technology	9.8	11.5		
Advanced Technology Initiatives	8.5	12.3		
Computational Technology		21.9		
IDPT	5.7	6.1		

Indicates changes since the previous year's President's Budget Submit.
Indicates budget numbers in full cost.

Theme: Earth System Science
Technology and Advanced Concepts: Missions in Formulation

PURPOSE

Objectives	Performance Measures
1.1	5ESS1-8

The next generation of Earth Science 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 NASA 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).

Missions in formulation include: Aquarius, which will provide the first global measurements of salt concentration on the ocean's surface (global salinity maps at 0.2 PSU accuracy on a monthly basis at 100 km resolution for three years); Glory, which includes an Aerosol Polarimeter Sensor (APS) to study black carbon interactions and impacts on Earth's climate; GPM, which will measure global precipitation and improve global water cycle prediction (precipitation products with data latency < 3 hours, research products with data latency < 72 hours, 3 years measurement with goal of 5); Landsat Data Continuity Mission (LDCM), which will continue the global land cover data set and provide synoptic, repetitive multispectral, high-resolution, digital imagery of Earth's land surfaces, and will improve assessment of rates of land-cover changes. Subsequent to the cancellation of the previously planned procurement, an interagency working group was established to study options for ensuring the continuity of Landsat data into the future. Partnership options are being investigated within the guidelines of public law, as well as existing interagency relationships. The working group is expected to present its findings in February 2004; Ocean Surface Topography, which will provide 3-year measurement of ocean surface topography, with a goal of 5 years, and will maintain the accuracy of Jason-1 (e.g., ocean topogrophy to 4.2 cm at 1/sec along-track data rate with a goal of 2.5 cm); Orbiting Carbon Observatory, which will provide global carbon dioxide measurement to characterize carbon dioxide sources and quantify their variability, and will create time-dependent global maps of carbon dioxide with relative accuracies of 0.3%.

PROGRAM MANAGEMENT

The program responsibility for each mission will be delegated to a responsible Center, or the Enterprise, as it enters implementation. Enterprise official is Dr. Ghassem Asrar, Associate Administrator for Earth Science at HQ. Program Directer is Doug McCuistion.

TECHNICAL COMMITMENT

Technical specifications of missions are subject to final approval before proceeding to implementation, and are baselined in a Program Commitment Agreement (PCA).

Schedule	FY 2005 President's Budget	Change from Baseline
GPM start of Formulation	12/01	--
GPM Mission Confirmation Review	1/07	--
GPM Launch Readiness	8/11 Core; 8/12 Constellation	--
GPM operational lifetime	3 years (5 year goal)	--
LDCM Start of Formulation.	April 2002	--
Ocean Surface Topography Mission Start of Formulation	Late 2002	--
Ocean Surface Topography Mission Confirmation Review	July 2004	--
Ocean Surface Topography Launch Readiness	Late 2007	--
Ocean Surface Topography Operational Lifetime	3 years (5 year goal)	--
Aquarius start of Formulation	October 2003	--
Aquarius Mission Confirmation Review	August 2005	--
Aquarius Launch Readiness	September 2008	--
Aquarius Operational Lifetime	3 years (5 year goal)	--
Glory (CCRI) start of Formulation	October 2003	--
Glory Mission Confirmation Review	TBD	--

Theme: Earth System Science

Technology and Advanced Concepts: Missions in Formulation

Schedule	FY 2005 President's Budget	Change from Baseline
Glory Launch Readiness	2008 (Final date TBD based on schedule changes as a result of the pending funding level included in the FY04 Omnibus Appropriations Bill.)	--
Orbiting Carbon Observatory Start of Formulation	Late 2003	--
Orbiting Carbon Observatory Mission Confirmation Review	TBD	--
Orbiting Carbon Observatory Launch Readiness	2007	--
Orbiting Carbon Observatory Operational Lifetime	2 years (4 year goal)	--

Acquisition Strategy and Performing Organizations

Major acquisitions: OSTM: Laser reflector array from ITE, Inc.; GPS from Spectrum Astro; Wide Swath Ocean Altimeter mast from AEC-Able. Figures in table below represent OSTM only. The remainder of these missions are still in early formulation and the acquisition strategy is still being defined. Changes since FY04 Pres. Budget: None.

Current Acquisition	Actual*	Selection Method	Actual*	Performer	Actual*
Cooperative Agreement	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	%	Non Profit	0%
*As of FY 2003 direct procurement	100%	*As of FY 2003 direct procurement		*As of FY 2003 direct procurement	100%

Future Acquisition	Selection	Goals
GPM: Microwave imager		100% competed

Agreements

LDCM: NASA - USGS Initial Implementation Agreement, 1/11/01. Changes since FY04 Pres. Budget: None.

Risk Mitigation

Top Risks	G	Overall	G	Cost	G	Schedule	G	Probability	Impact	Mitigation Plan
G	GPM: Reduction in International partnership contribution							Low	High	Negotiations in process

Independent Reviews

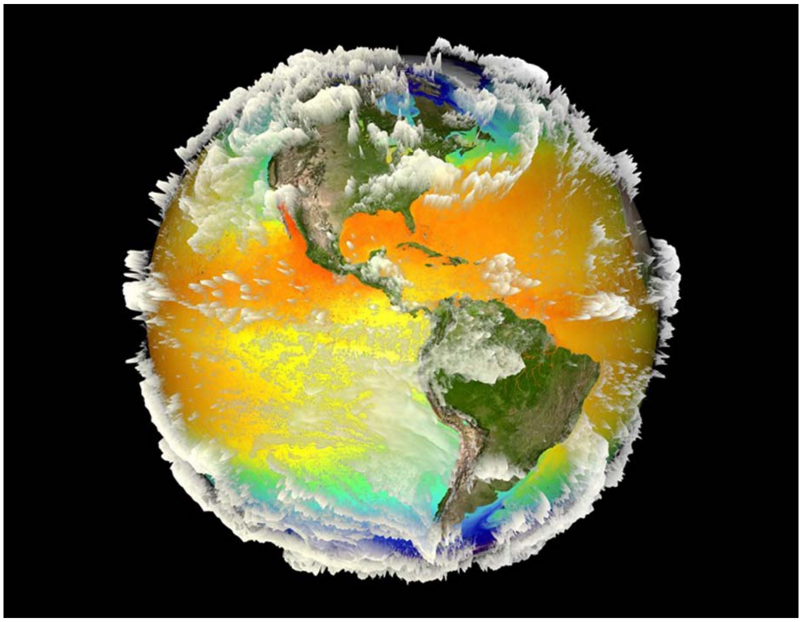
Review Types	Performer	Last Review Date	Next Review Date	Purpose
GPM Independent Implementation Review	IRT/IPAO	N/A	9/07	Annually during Implementation.
GPM Independent Assessment	IRT/IPAO	N/A	12/04	Assess reqs, design concepts, implementation plans, risks, and life cycle cost.
GPM Non-Advocate Review	IRT/IPAO	N/A	10/07	
OSTM Mission Confirmation Review	IPAO	N/A	7/04	Evaluate readiness to proceed to implementation.

Theme: Earth System Science
Technology and Advanced Concepts: Missions in Formulation

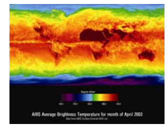
BUDGET/LIFE CYCLE COST

Budget Authority ($ millions)	FY 2003	FY 2004	FY 2005	Comments
FY2005 PRESBUD	81.1	197.9	239.9	
GPM	11.5	28.0	29.4	Mission deferred by 2 years
LDCM	26.2	59.6	41.9	
Ocean Winds	1.0	2.7		Mission proposed for termination in FY05
Ocean Topography	23.0	39.8	26.1	
Total Column Ozone	0.2			
EOS Follow-on Missions	6.9	11.6	0.1	Mission proposed for termination in FY05
Future ESSP Missions	5.3	18.3	22.5	
Aquarius	1.0	8.2	20.5	
Orbit Carbon Observatory	2.0	17.6	45.4	
CCRI	4.0	12.1	54.0	
Changes since 2004 PRESBUD	-164.9	-76.5		
NPP	-153.1	-95.6		Transferred to development and rephase to later launch date
GPM	+2.6	-0.2		
LDCM	-18.8	-0.4		Rephasing pending consideration of mission options
Ocean Winds	+1.0			
Ocean Topography	-8.5	-0.2		Rephase to align with new mission LRD
Solar Irradiance		-2.6		Measurement aligned with Glory mission
Total Column Ozone	+0.2	-0.3		
EOS Follow-on Missions	+6.9	+10.8		
Future ESSP Missions	-2.2	-26.0		Funds distributed to OCO and Aquarius missions
Aquarius	+1.0	+8.2		Transfer from Future ESSP missions
Orbit Carbon Observatory	+2.0	+17.6		Transfer from Future ESSP missions
CCRI	+4.0	+12.1		Improperly booked under development last year; launch date moved up one year
FY2004 PRESBUD	246.0	274.4		
NPP	153.1	95.6		
GPM	8.9	28.2		
LDCM	45.0	60.0		
Ocean Winds		2.7		
Ocean Topography	31.5	40.0		
Solar Irradiance		2.6		
Total Column Ozone		0.3		
EOS Follow-on Missions		0.8		
Future ESSP Missions	7.5	44.3		

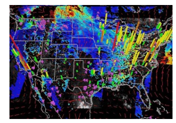
Indicates changes since the previous year's President's Budget Submit.
Indicates budget numbers in full cost.



THEMES



Earth System Science



Earth Science Applications

Seeing Earth through the lens of Science: This Earth image is a compilation of several data sets of the type produced by NASA's Earth Observing System, including cloud cover, vegetation, fires, and sea surface temperature. From the latter, the 1997-98 El Niño is clearly visible.

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 enables us to improve prediction of climate, weather, and natural hazards. NASA brings to this endeavor the unique vantage point of space, allowing global views of Earth system change. NASA is a provider of scientific information via observation, research, modeling, and integrated solutions to meet national priorities. NASA has been studying Earth from space from its beginnings as an Agency. NASA research and development of aerospace science and technology has resulted in deployment of the first series of Earth Observing System (EOS) satellites, which deliver observations of 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 Earth changing and what are the consequences for life on Earth?

FY 2003 Accomplishments

NASA's Solar Radiation and Climate Experiment (SORCE) was successfully launched in January 2003. SORCE is studying the Sun's influence on Earth and will measure how the Sun affects the Earth's ozone layer, atmospheric circulation, clouds, and oceans.

The NASA-sponsored Gravity Recovery and Climate Experiment (GRACE) mission produced the most accurate map ever created of Earth's gravity field. Using 111 days of satellite data, the GRACE science team generated a model of the Earth's gravity field that is up to 100 times more accurate than the previous model, which was constructed from decades of geodetic data. These precise gravity maps, and resulting geoid models, facilitate investigations into the time-variable distribution of the Earth's mass and the structure of tectonic features, such as deep ocean trenches. Also, precise gravity data are improving satellite altimetry observations of sea surface height and ocean circulation, contributing to improved predictions of weather and climate change.

New evidence from NASA Earth observation systems and Earth science models reveals how urban areas, with their asphalt, buildings, and aerosols, are impacting local and possibly global climate processes. To study urban impact on local rainfall, NASA and university scientists used the world's first space-based rain radar system, aboard NASA's TRMM satellite, and a dense network of in-situ rain gauges to determine that there are higher rainfall rates during the summer months downwind of large cities like Houston and Atlanta. These results offer new evidence that rainfall patterns and daily precipitation trends have changed in regions downwind of Houston from a period of pre-urban growth, 1940 to 1958, to a post-urban growth period, 1984 to 1999. Warming from urban heat islands, the varied heights of urban structures that alter winds, and interactions with sea breezes are believed to be the primary causes for the findings in a coastal city like Houston.

NASA launched the Ice, Cloud, and Land Elevation Satellite (ICESat) in January 2003 to quantify ice sheet growth (or retreat) and help answer questions concerning many related aspects of the Earth's climate system, including global climate and sea level changes. The global perspective and frequent polar coverage of Earth observation satellites have enabled comprehensive studies of how polar regions are changing, providing insight into their interactions with the rest of the climate system. In 2003, a NASA-led research team reported significant changes in sea ice distribution accompanying warming over much of the Arctic by as much as 4º F in the 1980s and 1990s. Not only has the aerial extent of sea ice coverage in the Arctic decreased by about three percent per decade in the last 24 years, but more notably, the extent of the older and thicker perennial sea ice has decreased by nearly ten percent per decade. Sea ice changes in the Antarctic have been much less than those in the Arctic, and while the extent of Antarctic sea ice has been decreasing over the last three decades, total Antarctic ice has actually increased slightly in the last 20 years. NASA's Landsat 7 and Terra satellites also showed large floating ice shelves breaking away from Antarctica's coastal regions, and the motion of ice in "ice streams" and outlet glaciers has accelerated as a result.

NASA measurements, mainly from the Terra, Aqua, Tropical Rainfall Measuring Mission (TRMM), and Total Ozone Mapping Spectromoter (TOMS) satellites and the AERONET surface network, are contributing to the first global assessment of the aerosol direct radiative effects and the time dependence and strength of the main aerosol sources around the world. The influence of aerosols on air quality and human and ecosystem health is well documented, but large uncertainties exist about the net impact and the diverse warming and cooling influences of the very complex mixture of aerosol types and their spatial distribution within the atmosphere. Researchers at NASA and the U.S. Environmental Protection Agency (EPA) developed a data fusion of the NASA observations from the Moderate Resolution Imaging Spectrometer (MODIS) sensors on Terra and Aqua with the EPA in-situ monitoring network as a tool to assist air quality forecasters in assessing particulate pollution and aerosol transport. Forecasters use a three-day visualization of this data fusion to assess transport of aerosols into their region and develop the air quality forecasts issued throughout the United States.

A NASA-DoE jointly funded study published in the June 2003 issue of Science showed that patterns of primary productivity of plants on land and phytoplankton in the ocean are changing in ways linked to changes in climate. New analyses of observations from several Earth observation satellites from the 1980s to the present have documented a net increase in primary productivity of six percent over the past 18 years, with 25 percent of the global land area showing significant increases and seven percent showing significant decreases. Ecosystems in all tropical regions and in the high latitudes of the Northern Hemisphere accounted for most of the increase. The tropical increases were attributed to decreased cloud cover and the resulting increase in solar radiation. Increases in other regions were due to the combined effects of increasing temperature, changes in rainfall, and changes in solar radiation. Meanwhile, other NASA-sponsored researchers showed that global ocean primary production has declined more than six percent since the early 1980s, and almost 70 percent of this decline occurred in the high latitudes. However, decreases in primary production in the Antarctic basin were not associated with significant warming. Research to date has not determined whether the oceanic changes observed are part of a long-term trend or if they might be related to decadal-scale oscillatory events. Humans are dependent on primary productivity for food, fiber, fuel, and structural materials, and change in the geographic distribution of primary productivity will have profound economic and societal impact around the globe.

Enterprise: Earth Science

THEME DISTRIBUTION

Budget Authority ($ in millions)	FY 2003	FY 2004	FY 2005
Earth System Science	1304.1	1522.4	1408.5
Earth Science Applications	78.0	90.8	76.9
Institutional Support	334.7	-	-
Total	1716.8	1613.2	1485.4

Note: For all formats, the FY 2003 column reflects the FY 2003 Congressional Operating Plan, dated 9/04/03. The FY 2004 column reflects the FY 2004 Conference committee report. The FY 2005 column represents the FY 2005 President's Budget Submit.

Indicates budget numbers in full cost

Earth System Science

This Theme is deploying and operating the first phase of an integrated constellation of Earth observation research satellites designed to reveal interactions among Earth's continents, atmosphere, oceans, ice, and life. These Earth processes produce the conditions that sustain life on Earth. Data and information from NASA Earth observation satellites enable researchers to understand the causes and consequences of global change and inform the decisions made by governments, industry, and citizens to improve our quality of life.

OVERALL BUDGET

The FY 2005 request is $1,408.5 million, a $114 million (or 7 percent) decrease from the FY 2004 President's Request (as amended by likely enacted Conference committee report):

- The decrease in the budget from FY 2004 to FY 2005 reflects major development programs that are past their peak development spending and are preparing for launches in 2004 and 2005, including Aura, Cloudsat, and CALIPSO, as well as deferrals and cancellations of some future missions.
- $141 million is requested for the NPOESS Preparatory Project (NPP), under development in partnership with the National Oceanic and Atmospheric Administration and the Department of Defense. NPP transfers critical research instruments to operational agencies and maintains data continuity for NASA sponsored scientific investigations.
- $560 million is requested for scientific research, analysis, modeling, and use of data and information resulting from NASA Earth observatories that contribute to answering critical scientific questions on the Earth system to aid policy and economic decision-makers.

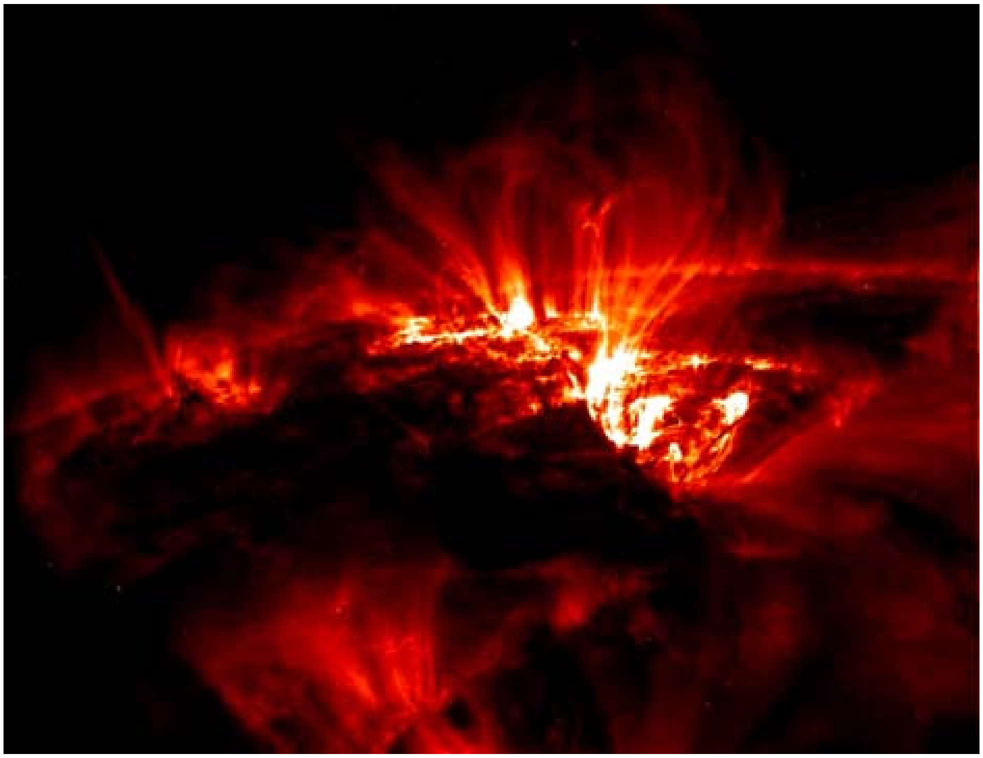
Earth Science Applications

Within this Theme, NASA works with other Federal agencies to apply Earth Science research results and information products to twelve applications of national priority and to serve national priorities in education. NASA has identified applications where its partner agencies have decision support systems that are being improved based on NASA-sponsored scientific research and technological innovations. Examples include the Federal Aviation Administration (FAA) National Airspace System and the U.S. Department of Agriculture (USDA) Crop Assessment Data Retrieval and Evaluation (CADRE) system. For each application and education program, NASA works via partnerships to benchmark the enhancements that result from delivering Earth science research results through integrated system solutions. The benchmarks for these crosscutting solutions advance the use of NASA information and technology across a range of additional innovative decision support systems and education projects, both domestically and internationally.

OVERALL BUDGET

The FY 2005 request is $76.9 million, a $14 million (or 15 percent) decrease from the FY 2004 President's Request (as amended by likely enacted Conference committee report):

- The request includes $14.3 million for an enhanced outreach and education program to communicate significant Earth science research and application results, and to expand the Digital Earth Virtual Environment and Learning Outreach Project (DEVELOP).
- The request includes funding for benchmarking the use of Earth observations from nine NASA Earth observatories into decision support tools through partnerships with eight Federal agencies for air quality, agricultural efficiency, aviation, carbon management, coastal management, disaster management, ecological forecasting, energy management, invasive species, public health, and water management.
- The request will sponsor over 150 projects to develop post-graduate, graduate, K-12, and informal education capacity for extending the use of Earth system science research results to serve society.



Iron ions heated to a temperature of 1.3 million degrees illuminate filamentary magnetic structures in the Sun's atmosphere. This extreme ultraviolet snapshot, obtained by the Transition Region And Coronal Explorer (TRACE) satellite in September 2000 also shows intricate bright patterns, called "moss," near the solar surface.

Link to Sun-Earth Connection at "http://sec.gsfc.nasa.gov/".

Sun-Earth Connection

MAJOR EVENTS IN FY 2005

- The Solar-Terrestrial Relations Observatory (STEREO) will launch in November 2005. STEREO will use two identically equipped spacecraft to provide revolutionary 3-D imaging of Coronal Mass Ejections.
- The Solar Dynamics Observatory (SDO) will continue in development in FY 2005. It is a cornerstone mission in the Living With a Star program. SDO will study the Sun's magnetic field and the dynamic processes that influence space weather.

Theme: Sun-Earth Connection

OVERVIEW

Life and society on Earth can prosper within a relatively stable and safe biosphere because the Sun provides a steady energy source to Earth, and 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 Earth's magnetic field). This is evident in auroral displays at Earth's poles, and in the belts of high-energy particles encircling Earth and extending out to distances where communication and weather spacecraft operate. The Sun-Earth Connection (SEC) program seeks to understand how the Sun, geospace, and Earth's upper atmosphere are connected in a single system.

Missions	Goals supported by this Theme	Objectives supporting these Goals
To 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.
To 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.	5.6 Understand the changing flow of energy and matter throughout the Sun, heliosphere, and planetary environments.
		5.7 Understand the fundamental physical processes of space plasma systems.

RELEVANCE

The system comprised of the Sun, Earth's upper atmosphere, their magnetic fields, 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. The public is 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 web site 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.

IMPLEMENTATION

The SEC 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 Space Science Enterprise (SSE) at NASA Headquarters. Enterprise official is Dr. Edward Weiler, Associate Administrator for SSE. Theme director and point of contact is Dr. Richard Fisher, director of the SEC Division at Headquarters. This theme is in full compliance with NPG 7120.5B.

Implementation Schedule

Theme Element	Schedule by Fiscal Year 98 99 00 01 02 03 04 05 06 07 08 09	Purpose
Solar-Terrestrial Relations Observatory (STEREO)		Understand the cause and mechanisms of Coronal Mass Ejection initiation.
Time History of Events and Macroscale Interactions During Substorms (THEMIS)		Answer fundamental questions regarding magnetospheric substorm instability, a dominant mechanism of transport and explosive release of solar wind energy within Geospace.
Aeronomy of Ice in the Mesosphere (AIM)		Study Polar Mesospheric Clouds.
Thermosphere Ionosphere Mesosphere Energetics and Dynamics (TIMED)		Prime Mission.
Reuven Ramaty High Energy Solar Spectroscopic Imager (RHESSI)		Prime Mission.
Solar Dynamics Observatory (SDO)		Observe Sun's dynamics to help determine the nature and sources of solar variability.
Solar B		Reveal the mechanisms of solar variability.
Two Wide-angle Imaging Neutral-atom Spectrometers (TWINS) - A		Establish global connectivities & causal relationships in different regions of magnetosphere.
Two Wide-angle Imaging Neutral-atom Spectrometers (TWINS) - B		Establish global connectivities & causal relationships in different regions of magnetosphere.
Coupled Ion Neutral Dynamics Investigation (CINDI)		Understand the dynamics of Earth's ionosphere.
Space Technology (ST) 5		Demonstrate and flight-qualify a set of nanosats for application to future space missions.
Solar and Heliospheric Observatory (SOHO)		Extended missions are based on senior review.
Wind		Extended mission (based on senior review)
Polar		Extended mission (based on senior review)
Geotail		Extended mission (based on senior review)
Ulysses		Extended mission (based on senior review)
Voyager		Extended mission (based on senior review)
Advanced Composition Explorer (ACE)		Extended mission (based on senior review)
Fast Auroral SnapshoT Explorer (FAST)		Extended mission (based on senior review)
Solar Anomalous and Magnetospheric Particle Explorer (SAMPEX)		Extended mission (based on senior review)
Transition Region and Coronal Explorer (TRACE)		Extended mission (based on senior review)
Imager for Magnetopause-to-Aurora Global Exploration (IMAGE)		Extended mission (based on senior review)
Magnetospheric Multiscale (MMS)		Understand fundamental processes that connect broad ranges of the magnetosphere.
Global Electrodynamic Connections (GEC)		Obtain 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.
Radiation Belt Mapper (RBM) Geospace Mission		Study of effects of changes in solar actvity on Earth's radiation belts.

Tech & Adv Concept   Development   Operations   Research

No exceptions to NPG 7120.5B have been taken

Theme: Sun-Earth Connection

STATUS

During 2003, the SEC theme accomplished the following: completed the Living with a Star (LWS) Geospace Missions definition team report; updated the SEC roadmap; awarded science investigations and began Phase A for Solar Terrestrial Probes (STP) MMS; delivered both CINDI instruments to host; completed three industry pre-concept studies for STP GEC; awarded investigations for the LWS Space Environment Testbed-1 NRA and the STP MMS AO; started Phase B for the LWS SDO and the Explorers THEMIS and AIM missions; completed the Preliminary Design Review for New Millennium Program (NMP) ST-7 (Disturbance Reduction System), the CDR for the STP STEREO Observatory, at the Flight Readiness Review for NMP ST-6 Autonomous Sciencecraft Experiment; awarded 10 NMP ST-8 concept studies; successfully launched the Explorers GALEX mission; launched 25 sounding rockets; conducted SEC Senior Review of the science proposal from 14 operating missions and made recommendations to SEC Division director; and, achieved minimum science requirement for the Explorers RHESSI mission.

PERFORMANCE MEASURES

Outcomes/Annual Performance Goals (APGs)	
Outcome 1.3.1	*Develop the capability to predict solar activity and the evolution of solar disturbances as they propagate in the heliosphere and affect the Earth.*
5SEC2	Successfully complete Solar Dynamics Observatory (SDO) Critical Design Review (CDR).
5SEC3	Successfully complete THEMIS Critical Design Review (CDR).
5SEC6	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.
Outcome 1.3.2	*Specify and enable prediction of changes to the Earth's radiation environment, ionosphere, and upper atmosphere.*
5SEC4	Complete Announcement of Opportunity (AO) Selection for Geospace Missions far ultraviolet Imager
5SEC7	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.
Outcome 1.3.3	*Understand the role of solar variability in driving space climate and global change in the Earth's atmosphere.*
5SEC8	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.
Outcome 5.6.1	*Understand the structure and dynamics of the Sun and solar wind and the origins of magnetic variability.*
5SEC1	Complete Solar Terrestrial Relations Observatory (STEREO) instrument integration.
5SEC9	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.
Outcome 5.6.2	*Determine the evolution of the heliosphere and its interaction with the galaxy.*
5SEC10	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.
Outcome 5.6.3	*Understand the response of magnetospheres and atmospheres to external and internal drivers.*
5SEC11	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.
Outcome 5.7.1	*Discover how magnetic fields are created and evolve and how charged particles are accelerated.*
5SEC12	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
Outcome 5.7.2	*Understand coupling across multiple scale lengths and its generality in plasma systems.*
5SEC13	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
Uniform Measures	
5SEC14	Complete all development projects within 110% of the cost and schedule baseline.
5SEC15	Deliver at least 90% of scheduled operating hours for all operations and research facilities.
5SEC16	At least 80%, by budget, of research projects will be peer-reviewed and competitively awarded.

Theme: Sun-Earth Connection

INDEPENDENT REVIEWS

Review Types	Performer	Last Review Date	Next Review Date	Purpose
Nat'l Academy of Sciences	SScAC	8/03	3/04	Review sci. strategy, program implementation strategy
Nat'l Academy of Sciences	Space Studies Board	6/02	10/12	Decadal survey of effectiveness and quality of the program
Nat'l Academy of Sciences	NAC	6/03	3/04	Review sci. strategy, program implementation strategy
SScAC	SEC Advisory Subcommittee	3/03	2/04	Review sci. strategy, program implementation strategy

BUDGET

Budget Authority ($ millions)	FY 2003	FY 2004	Change	FY 2005	Comments
Sun-Earth Connection	**479.7**	**755.4**	**-9.5**	**745.9**	
Development	166.7	218.7	+58.4	277.1	
Solar Terrestrial Relations Observatory (STEREO)	68.3	98.7	-24.9	73.8	
Solar Dynamics Observatory (SDO)	57.8	65.8	+92.6	158.4	
Small Development Projects	40.6	54.2	-9.3	44.9	
Operations	35.1	57.0	-23.1	33.9	
Research	134.3	177.2	+17.4	194.6	
Technology	143.6	302.5	-62.2	240.3	

Indicates changes since the previous year's President's Budget Submit

Indicates budget numbers in full cost.

Theme: Sun-Earth Connection
Development: Solar Terrestrial Relations Observatory (STEREO)

PURPOSE

Objectives	Performance Measures
5.6	5SEC1,9,14

The STEREO project will lead to an understanding of the cause and mechanisms of Coronal Mass Ejection (CME) initiation; characterize the propagation of the CMEs through the heliosphere; discover the mechanisms and sites of 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: SEC Coronal and Heliospheric Investigation (SECCHI) using a 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. In recent months STEREO has experienced technical difficulties, which will result in schedule and cost increases. These will be fully documented in NASA's Initial FY 2004 Operating Plan. Link to STEREO Homepage for more information. http://stp.gsfc.nasa.gov/missions/stereo/stereo.htm

PROGRAM MANAGEMENT

STEREO is the third mission within the STP Program, with program and project responsibility delegated to Goddard Space Flight Center. The Enterprise Program Management Council (PMC) has STEREO governing responsibility. Enterprise official is Dr. Ed Weiler, Associate Administrator for SSE at HQ. The Theme director and the point of contact is Dr. Richard Fisher, director of the SEC Division at HQ. The program is in full compliance with NPG7120.5B.

TECHNICAL COMMITMENT

The baseline for this commitment is detailed in the 6/2003 STP Program Commitment Agreement (PCA).

Technical Specifications	FY 2005 President's Budget	Change from Baseline
CME Initiation Time:	Accuracy of order 10[120] minutes	None
Location of CME Initiation:	+/- 5 [30] degrees of solar latitude and longitude	None
Operational capability:	Prime mission life=2 yrs for both spacecraft; assuming CME rate consistent w/ minimum of solar magnetic activity cycle, observe at least 60 CME w/ remote sensing instruments & 24+interplanetary events	None
Science Instruments:	4 major science instrument suites	None
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	FY 2005 President's Budget	Change from Baseline
Start of Formulation	May 2001	--
Start of Implementation	Mar 2002	--
Mission Critical Design Review	Feb. 2003	2 month slip
Complete S/C I & T	Sept 2004	2 month slip
Complete Observatory S/C I&T	June 2005	--
Launch	Nov 2005	--

Theme: Sun-Earth Connection

Development: Solar Terrestrial Relations Observatory (STEREO)

ACQUISITION STRATEGY AND 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 FY 2004 President's Budget: None.

Current Acquisition	Actual*	Selection Method	Actual*	Performer	Actual*
Cooperative Agreement	0%	Full & Open Competition	45%	Industry	7%
Cost Reimbursable	96%	Sole Source	55%	Government	21%
Fixed Price	0%		100%	NASA Intramural	4%
Grants	2%			University	68%
Other	2%	Sci Peer Review	100%	Non Profit	0%
*As of FY 2003 direct procurement	100%	*As of FY 2003 direct procurement		*As of FY 2003 direct procurement	100%

Future Acquisition - Major	Selection	Goals
None		

AGREEMENTS

Internal: The program is not dependent on other NASA activities outside of the control of the Associate Administrator for the Space Science Enterprise. External: LOAs are in place with CNES (France), Hungary, Switzerland, PPARC (Particle Physics CNES), the German Aerospace Center and the European Space Agency. An MOU with ESA will also be developed. Changes since FY 2004 President's Budget: None.

RISK MITIGATION

Top Risks		Overall		Cost		Schedule		Technical	Probability	Impact	Mitigation Plan
Y	Spacecraft Software Schedule								Medium	Medium	In Place
Y	cPCI Connector Qualification								Medium	Medium	In Place
Y	Launch Vehicle Cost								Medium	Medium	In Place

INDEPENDENT REVIEWS

Review Types	Performer	Last Review Date	Next Review Date	Purpose
Confirmation Review	Independent Review Team	3/02	3/02	Approval to proceed into Development
Delta Independent Implementation Review	Independent Review Team	4/03	5/04	Annual review to look at implementation

Theme: Sun-Earth Connection
Development: Solar Terrestrial Relations Observatory (STEREO)

BUDGET/LIFE CYCLE COST

Budget Authority ($ millions)	Prior	FY03	FY04	FY05	FY06	FY07	FY08	FY09	BTC	Total	Comments
FY2005 PRESBUD	96.6	68.3	98.7	73.8	32.6	19.3	12.3	2.9		404.5	
Development	96.6	68.3	98.7	73.8	17.0					354.4	
Mission Operations & Data Analysis					15.6	19.3	12.3	2.9		50.1	
Changes since 2004 PRESBUD	+0.3	-6.0	-0.6	+5.5	-10.0	-5.4	-2.7	+2.9	-2.5	-18.5	
Development	+0.3	-6.0	-0.6	+5.5	-5.2					-6.1	ELV realignment
Operations					-10.8	-10.2	-2.1			-23.1	move DSN to STP Future
Mission Operations & Data Analysis					+15.6	+19.3	+12.3	+2.9		+50.1	MO&DA combined
Data Analysis					-9.6	-14.5	-12.9		-2.5	-39.5	
FY2004 PRESBUD	96.3	74.3	99.3	68.3	42.6	24.7	15.0		2.5	423.0	
Development	96.3	74.3	99.3	68.3	22.2					360.4	
Operations					10.8	10.2	2.1			23.1	
Data Analysis					9.6	14.5	12.9		2.5	39.5	
Initial Baseline	90.1	74.3	90.0	61.2	36.5	23.1	17.3	2.8		395.3	
Pre-Development	58.2									58.2	
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	2.8		37.5	

Indicates changes since the previous year's President's Budget Submit
Indicates budget numbers in full cost.

Theme: Sun-Earth Connection
Development: Solar Dynamics Observatory

Purpose

Objectives	Performance Measures
1.3	5SEC2,6,14

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 solar irradiance.

Overview

The SDO is a cornerstone mission within the LWS program. SDO will use instrument suites in geosynchronous Earth orbit to 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 our capability to predict solar variations (or space weather) and their effects on life on Earth and on technological systems. The project includes funding for the spacecraft, launch vehicle, data analysis (6 years), project operations (five years), education, and outreach. Prime mission operations should end five years and thirty days after launch. Phase A began in 8/2002 when awards for three SDO science investigations were announced. Funding guidelines are subject to change as the requirements, science content and design mature, and will be capped when SDO is confirmed to start development. Link to SDO Homepage for more information. http://sdo.gsfc.nasa.gov/

Program Management

The SDO spacecraft will be built in-house at the Goddard Space Flight Center (GSFC). GSFC is also responsible for mission management, design, integration, test, and operation. The GSFC Program Management Council (PMC) had SDO governing responsibility until March 2003. The Enterprise PMC confirmed SDO to start Phase B at the PDR/NAR. The Agency PMC began providing oversight and will continue to do so until SDO starts development. The Enterprise will then resume oversight for the remainder of the mission. Enterprise official is Dr. Ed Weiler, Associate Administrator for SSE at HQ. The Theme director/point of contact is Dr. Richard Fisher, director of the SEC Division at HQ. This program is in full compliance with NPG7120.5B.

Technical Commitment

No technical commitments will be made until mission is confirmed to start development in FY04. SDO guidelines are in mission Form Auth Doc (FAD) and may change as mission requirements/design mature.

Technical Specifications	FY 2005 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 Experiment (EVE)	Measure extreme ultraviolet irradiance and study it in relationship with the Sun's magnetic features.	--
Solar Heliospheric Activity Res. & Prediction Program (SHARPP)	Study the Sun's atmosphere and develop space weather predictions by using an Atmospheric Imaging Assembly and a white light coronagraph.	--

Schedule	FY 2005 President's Budget	Change from Baseline
Start of Formulation	August 2002	--
Initial Confirmation Review	August 2003	+2 Months
Start of Implementation	April 2004	+3 Months
Launch	April 2008	+8 Months
End of Prime Mission	May 2013	+8 Months

Theme: Sun-Earth Connection
Development: Solar Dynamics Observatory

ACQUISITION STRATEGY AND 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 GSFC. The launch vehicle will be purchased through Kennedy Space Center. International agreements with Italy, France, and Belgium will provide significant components of instruments. Changes since FY 2004 Pres. Budget: Retraction of United Kingdom contribution.

Current Acquisition	Actual*	Selection Method	Actual*	Performer	Actual*
Cooperative Agreement	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 FY 2003 direct procurement	100%	*As of FY 2003 direct procurement		*As of FY 2003 direct procurement	100%

Future Acquisition - Major	Selection	Goals
Ground system Contracts	Fall 03	100% Sci Peer Review, 20% University, 11% Non Profit.
Instrument Contracts	Fall 03	100% Full and Open Competition, 100% Cost type contracts.
Support Service contract extensions	Fall 03	

AGREEMENTS

Internal: Dependence on other NASA activities outside of the control of the Associate Administrator for the Space Science Enterprise will be established when the 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 FY 2004 President's Budget: Retraction of United Kingdom contributions.

RISK MITIGATION

Top Risks	Overall	Cost	Schedule	Technical	Probability	Impact	Mitigation Plan
G	Lack of adequate development of 4Kx4K CCDs				TBD	TBD	In Formulation
G	Lack of adequate international coordination will delay launch				TBD	TBD	In Formulation
G	Verification approach for science pointing				TBD	TBD	In Formulation
G	Mission lifetime and reliability in severe GEO radiation environment				TBD	TBD	In Formulation

INDEPENDENT REVIEWS

Review Types	Performer	Last Review Date	Next Review Date	Purpose
Before Initial Confirm. Review (IRC)	Independent Review Team		12/03	Confirm to start Phase B/obtain life cycle cost estimate as directed by Congress
Preliminary Design Review	Independent Review Team		3/04	Assure completed designs meet project specifications
Non-Advocate Review	Independent Review Team	12/03 (LWS)	2/04 (SDO)	Seek approval to start Implementation (tentative date)

Theme: Sun-Earth Connection

Development: Solar Dynamics Observatory

BUDGET/LIFE CYCLE COST

Budget Authority ($ millions)	Prior	FY03	FY04	FY05	FY06	FY07	FY08	FY09	BTC	Total	Comments
FY2005 PRESBUD	9.8	57.8	65.8	158.4	128.9	112.7	40.9	19.1	52.6	646.1	
Development	9.8	57.8	65.8	158.4	128.9	112.7	40.9	19.1	52.6	646.1	
Changes since 2004 PRESBUD	-0.5	+31.2	-0.4	+68.4	+30.0	+24.2	+20.9	+19.1	+52.6	+245.6	
Development	-0.5	+31.2	-0.4	+68.4	+30.0	+24.2	+20.9	+19.1	+52.6	+245.6	
FY2004 PRESBUD	10.3	26.6	66.2	90.0	98.9	88.5	20.0			400.5	
Development	10.3	26.6	66.2	90.0	98.9	88.5	20.0			400.5	

Indicates changes since the previous year's President's Budget Submit

Indicates budget numbers in full cost.

Theme: Sun-Earth Connection
Development: Small Development Projects

PURPOSE

Objectives	Performance Measures
1.3, 5.6	5SEC9,11,14

The SEC Small Projects include the Explorer Program and the Solar-B mission (which is the second mission in the STP 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 $120M (fiscal 2003 dollars). Also 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 SEC Small Projects are as follows: - 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 plane package, x-ray telescope and the extreme ultraviolet imaging spectrometer. - Coupled Ion Neutral Dynamics Investigation (CINDI) will study ion-neutral interactions in Earth's ionosphere to discover their role in the electrodynamic connection between the Sun and Earth's upper atmosphere. These interactions can interfere with communications and navigation systems. - Two Wide-angle Imaging Neutral-atom Spectrometers (TWINS) A and B 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 elliptical) orbits around Earth. - Aeronomy of Ice in the Mesosphere (AIM) 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.

Link to Solar B: "http://stp.gsfc.nasa.gov/missions/solar-b/solar-b.htm".

Link to TWINS: "http://nis-www.lanl.gov/nis-projects/twins/".

Link to CINDI: " http://129.110.7.63/heelis/cindi.html".

Link to AIM: " http://aim.hamptonu.edu/".

PROGRAM MANAGEMENT

CINDI, TWINS, and AIM are projects within the Explorer Program with management responsibility delegated to Goddard Space Flight Center. CINDI and TWINS are in development. AIM will enter into development in March 2004. The Enterprise Program Management Council (PMC) has governing responsibility. Enterprise official is Dr. Ed Weiler, Associate Administrator for SSE at HQ. The Theme director and the point of contact is Dr. Richard Fisher, director of the SEC Division at HQ. The program is in full compliance with NPG7120.

TECHNICAL COMMITMENT

The baseline for CINDI, TWINS and AIM are detailed in Explorer Program Commitment Agreement (PCA). The baseline for Solar-B was made in 12/00 and is detailed in its Program Level I Requirements.

Technical Specifications	FY 2005 President's Budget	Change from Baseline
Solar-B Focal Plane Package polarimetric accuracy	within 0.001	--
Solar-B X-ray Telescope Angular Resolution	2.0 arcsec	--
Solar-B EUV Imaging Spectrometer spatial resolution	2.0 arcsec	--
CINDI Measure Total Ion Concent. with a spatial separation of at least 1km	200 passes/month	--
TWINS- Two dimensional views of Earth's energetic magnetosphere	~10 images per day	--
AIM	TBD/Confirmation Review 12/03	n/a

Schedule	FY 2005 President's Budget	Change from Baseline
AIM Launch	September 2006	n/a
CINDI Launch	January 2004	+ 3 Months
Solar-B Launch	September 2006	+ 1 Year
TWINS Launch	2nd Qt/2004 & 2nd Qt/2005	+ 6 Months

Theme: Sun-Earth Connection

Development: Small Development Projects

ACQUISITION STRATEGY AND 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 focal plane package, Smithsonian Astrophysical Observatory for the x-ray telescope, and the Naval Research Laboratory for the EIS. CINDI's science investigation and both instruments are being developed at the University of Texas at Dallas. CINDI will be launched on a Pegasus XL by the U.S. Air Force. TWINS Principal Investigator is located at the Southwest Research Institute. The AIM Principal Investigator's institution is Hampton University, which is developing four major instruments. Spacecraft is being built by Ball Aerospace & Technologies Corp; AIM will be launched from Vandenberg Air Force Base on a Pegasus. Changes since FY 2004 President's Budget: None.

Current Acquisition	Actual*	Selection Method	Actual*	Performer	Actual*
Cooperative Agreement	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 FY 2003 direct procurement	100%	*As of FY 2003 direct procurement		*As of FY 2003 direct procurement	100%

Future Acquisition - Major	Selection	Goals
AIM Spacecraft	1st Qt FY 2004	Cost Plus Fixed Fee

AGREEMENTS

Internal: These projects are not dependent on other NASA activities outside of the control of the Associate Administrator of the Space Science Enterprise. External: CINDI -- MOA with USAF. Solar-B -- LOA between NASA and Japan's Institute of Space and Astronautical Science (ISAS), February 3, 2001; LOA between NASA and the Particle Physics and Astronomy Research Council of the United Kingdom, March 24, 2000; MOU with ISAS in process. Changes since FY 2004 President's Budget: None.

RISK MITIGATION

Top Risks	Overall / Cost / Schedule / Technical	Probability	Impact	Mitigation Plan
G	AIM: Cost and Margins	Medium	Medium	Accept Risk
G	Solar-B: Japan Schedule Performance	Medium	Very High	Under Dev
G	Solar-B: ISAS/NASA Merger	Very High	Medium	Accept Risk
G	Solar-B: Lack of Margins and Control Values for Mass Properties	High	Medium	Accept Risk

INDEPENDENT REVIEWS

Review Types	Performer	Last Review Date	Next Review Date	Purpose
AIM Confirmation Review	Goddard Space Flight Center		3/04	Approval to proceed into Dev. from the AA for Space Sci.
CINDI Confirmation Review	Goddard Space Flight Center	11/01	11/01	Approval to proceed into Dev. from the AA for Space Sci.
SOLAR-B Independent Implement. Review	IPAO	10/02	6/04	Annual implementation review
TWINS Confirmation Review	Goddard Space Flight Center	4/99	4/99	Approval to proceed into Dev. from the AA for Space Sci.

Theme: Sun-Earth Connection
Development: Small Development Projects

BUDGET/LIFE CYCLE COST

Budget Authority ($ millions)	Prior	FY03	FY04	FY05	FY06	FY07	FY08	FY09	BTC	Total	Comments
FY2005 PRESBUD	87.4	40.6	54.2	44.9	23.6	0.7				251.3	
SOLAR-B	64.9	17.2	12.4	12.2	11.3					118.0	
TWINS	14.4	1.7	1.1	0.5						17.7	
AIM	2.2	19.0	39.8	32.2	12.3	0.7				106.1	
CINDI	5.9	2.7	0.9							9.5	
Changes since 2004 PRESBUD	+1.5	+20.7	-0.3	+16.6	+12.8	+0.7				+52.1	
SOLAR-B		+1.0	-0.1	+1.8	+11.3					+14.1	1-year launch delay
TWINS	+0.3	+1.1		+0.1						+1.5	launch delay/contingency
AIM	+2.0	+19.0	-0.2	+14.7	+1.5	+0.7				+37.7	new SMEX selection
CINDI	-0.8	-0.4								-1.2	
FY2004 PRESBUD	85.9	19.9	54.5	28.3	10.8					199.3	
SOLAR-B	64.9	16.2	12.5	10.4						103.9	
CINDI	6.7	3.1	0.9							10.7	
TWINS	14.1	0.6	1.1	0.4						16.2	
AIM	0.2		40.0	17.5	10.8					68.4	
Initial Baseline	62.0	16.8	9.8	7.7						96.3	
SOLAR-B	62.0	16.8	9.8	7.7						96.3	D 12/20/00; Launch Sept. 05

Indicates changes since the previous year's President's Budget Submit
Indicates budget numbers in full cost.

Theme: Sun-Earth Connection
Operations

PURPOSE

Objectives	Performance Measures
1.3, 5.6, 5.7	5SEC6-13,15

This program element sponsors the maintenance of existing mission operations infrastructure and the development of new control center capabilities at GSFC. The program element also supports the multi-mission operations activities at Goddard Space Flight Center (GSFC). These multi-mission activities support both current and future missions for the SEC, ASO, and SEU themes.

OVERVIEW

There are currently 14 operational SEC missions. These include the venerable Voyager spacecraft, Solar and Heliospheric Observatory (SOHO), and the Transition Region and Coronal Explorer (TRACE). Also included is the Thermosphere Ionosphere Mesosphere Energetics and Dynamics (TIMED) mission -- the first of the STP missions. Many missions involve foreign partners, including the European Space Agency and Japan's Institute of Space and Astronautical Science (ISAS). The program element also supports the multi-mission operations activities at GSFC. As a result of the reprioritized Agency activities, the FY 2005 and outyear budgets for SEC Operations have been reduced. The impacts to these programs will be fully assessed as part of the development of the FY 2006 budget.

Starting in FY 2005, the operations funding for SOHO, the Solar-Terrestrial Relations Observatory (STEREO), Wind, Polar, the Advanced Composition Explorer (ACE), Geotail, TIMED, Ulysses, Voyager, TRACE, the Reuven Ramaty High Energy Solar Spectroscopic Imager (RHESSI), the Imager for Magnetopause-to-Aurora Global Exploration (IMAGE), Aeronomy of Ice in the Mesosphere (AIM), and Time History of Events and Macroscale Interactions during Substorms (THEMIS) will be combined with the Data Analysis funding for those missions (see Enterprise summary section for more information).

Link to Office of Space Science Missions homepage for more information http://spacescience.nasa.gov/missions/index.htm

PROGRAM MANAGEMENT

Enterprise official is Dr. Ed Weiler, Associate Administrator for the Space Science Enterprise at HQ. The Theme director and the point of contact is Dr. Richard Fisher, director of the SEC Division at HQ. TIMED operations are managed by the Johns Hopkins University Applied Physics Laboratory. Ulysses and Voyager are managed by the Jet Propulsion Laboratory. All other activities are managed by the GSFC. The SEC Operations responsibility is retained at Headquarters. The program is in full compliance with NPG7120.5B.

TECHNICAL COMMITMENT

Technical Specifications	Change from Baseline
All missions will meet Level I specifications as identified in the Program Plan.	None.

Mission	Launch Date	Change from Baseline
ACE	Aug. 25, 1997	Mission Extended.
FAST	Aug. 21, 1996	Mission Extended.
Geotail	July 24, 1992	Mission Extended.
IMAGE	Mar. 25, 2000	Mission Extended.
IMP-8	Oct. 26, 1973	Ext Mission Terminated Oct. 2001.
Polar	Feb. 24, 1996	Mission Extended.
RHESSI	Feb. 5, 2002	Prime mission through Feb. 2005.
SAMPEX	July 3, 1992	Mission Extended.
SOHO	Dec. 2, 1995	Mission Extended.
TIMED	Dec. 7, 2001	Mission Extended.
TRACE	Apr. 1, 1998	Mission Extended.
Ulysses	Oct. 6, 1990	Mission Extended.
Voyager-2	Aug. 20, 1977	Mission Extended.
Wind	Nov. 1, 1994	Mission Extended.

Theme: Sun-Earth Connection
Operations

ACQUISITION STRATEGY AND PERFORMING ORGANIZATIONS

Approximately 75% of the activity was supported by the Consolidated Space Operations Contract (CSOC); this contract expired in Dec. 2003. NASA released a request for proposal in April 2003 for a series of new contracts to replace CSOC. The new contracts were put in place by Dec. 2003, including a new contract at GSFC, which assumed the activities sponsored under this budget item. Approximately 25% of the activity involves engineering support and engineering research to improve the technology to be employed in future mission control centers. Changes since FY 2004 President's Budget: None.

Current Acquisition	Actual*	Selection Method	Actual*	Performer	Actual*
Cooperative Agreement	0%	Full & Open Competition	100%	Industry	59%
Cost Reimbursable	75%	Sole Source	0%	Government	0%
Fixed Price	1%			NASA Intramural	19%
Grants	0%		100%	University	22%
Other	24%			Non Profit	0%
*As of FY 2003 direct procurement	100%	*As of FY 2003 direct procurement		*As of FY 2003 direct procurement	100%

Future Acquisition	Selection	Goals
None.		

AGREEMENTS

Internal: The program is not dependent on other NASA activities outside of the control of the Associate Administrator for the Space Science Enterprise. External: None. Changes since FY 2004 President's Budget: None.

INDEPENDENT REVIEWS

Review Types	Performer	Last Review Date	Next Review Date	Purpose
Senior Review	Sr. Review committee	7/03	7/05	To recommend approval and funding level for extending science investigations.

Theme: Sun-Earth Connection
Operations

BUDGET

Budget Authority ($ millions)	FY 2003	FY 2004	FY 2005	Comments
FY2005 PRESBUD	35.1	57.0	33.9	
SOHO	3.4	2.8		
TIMED	2.1	1.6		
Voyager	2.8	2.0	0.1	
Multi-Mission Ops	19.6	43.9	33.8	
ACE	1.0	1.1		
FAST	0.3			
Geotail	0.1	0.1		
IMAGE	0.4	0.5		
Polar	1.6	1.4		
RHESSI	0.5	0.5		
SAMPEX	0.2			
TRACE	0.5	0.6		
Ulysses	2.2	2.1		
Wind	0.4	0.4		
Changes since 2004 PRESBUD	-8.4	-0.3		MO&DA combined
SOHO	+2.5			
TIMED	-1.0			
Voyager	+2.0			
Multi-Mission Ops	-17.8	-0.3		
ACE	+1.0	+1.1		
FAST	+0.3			
Geotail	+0.1	+0.1		
IMAGE	+0.4	+0.5		
Polar	+1.6	+1.4		
RHESSI	+0.5	+0.5		
SAMPEX	+0.2			
TRACE	+0.5	+0.6		
Ulysses	+2.2	+2.1		
Wind	+0.4	+0.4		
All Other SEC Operations	-1.3	-6.7		
FY2004 PRESBUD	43.5	57.3		
SOHO	0.9	2.8		
TIMED	3.1	1.6		
Voyager	0.8	2.0		
Multi-Mission Ops	37.4	44.2		
All Other SEC Operations	1.3	6.7		

Indicates changes since the previous year’s President’s Budget Submit
Indicates budget numbers in full cost.

Theme: Sun-Earth Connection
Research

PURPOSE

Objectives	Performance Measures
1.3, 5.6, 5.7	5SEC6-13,15-16

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 & 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 (NRA) 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. As a result of the reprioritized Agency activities, the FY 2005 and outyear budgets for R&A, DA, and the Sounding Rockets program have been reduced. The impacts to these programs will be fully assessed as part of the development of the FY 2006 budget.

Starting in FY 2005, the operations funding for the following missions will be combined with the Data Analysis funding for those missions (see Enterprise summary section for more information): the Solar and Heliospheric Observatory (SOHO), the Solar-Terrestrial Relations Observatory (STEREO), Wind, Polar, the Advanced Composition Explorer (ACE), Geotail, Thermosphere, Ionosphere, Mesosphere, Energetics and Dynamics (TIMED), Ulysses, Voyager, the Transition Region and Coronal Explorer (TRACE), the Reuven Ramaty High Energy Solar Spectroscopic Imager (RHESSI), the Imager for Magnetopause-to-Aurora Global Exploration (IMAGE), Aeronomy of Ice in the Mesosphere (AIM), and Time History of Events and Macroscale Interactions during Substorms (THEMIS).

Links to NASA Research Opportunities: http://research.hq.nasa.gov/code_s/code_s.cfm and http://spacescience.nasa.gov/missions/opmsns.htm

Link to Sounding Rockets Program: http://www.wff.nasa.gov/pages/soundingrockets.html

PROGRAM MANAGEMENT

The SEC 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 the Space Science Enterprise at HQ. The Theme director and the point of contact is Dr. Richard Fisher, director of the SEC 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	FY 2005 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	FY 2005 President's Budget	Change from Baseline
R&A Research Opportunities in Space Science (ROSS)	Suspended	Usually released each Feb.
Sounding Rockets Research Opportunities in Space Science (ROSS)	Campaigns run all year	--
Data Analysis Senior Reviews	Every two years	--

ACQUISITION STRATEGY AND PERFORMING ORGANIZATIONS

The R&A, DA, and Sounding Rockets programs make awards following peer-reviewed competitions under NRAs, 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 2003, direct procurement represented 100% of budget authority. Changes since FY 2004 President's Budget: None.

Current Acquisition	Actual*	Selection Method	Actual*	Performer	Actual*
Cooperative Agreement	1%	Full & Open Competition	95%	Industry	33%
Cost Reimbursable	41%	Sole Source	5%	Government	7%
Fixed Price	4%			NASA Intramural	7%
Grants	40%		100%	University	42%
Other	14%			Non Profit	11%
`*As of FY 2003 direct procurement	100%	*As of FY 2003 direct procurement		*As of FY 2003 direct procurement	100%

Future Acquisition	Selection	Goals
None.		

AGREEMENTS

Internal: The program is not dependent on other NASA activities outside of the control of the Associate Administrator for the Space Science Enterprise. External: Four of the program elements depend on international agreements with the European Space Agency (the Solar and Heliospheric Observatory, Cluster, and Ulysses) and Japan's Institute of Space and Astronautical Science (Geotail). Changes since FY04 Pres. Budget: None.

INDEPENDENT REVIEWS

Review Types	Performer	Last Review Date	Next Review Date	Purpose
SEC MO&DA Senior Review	Sr. Review committee	7/03	7/05	To recommend approval and funding level for extending science investigations.

Theme: Sun-Earth Connection
Research

BUDGET/LIFE CYCLE COST

Budget Authority ($ millions)	FY 2003	FY 2004	FY 2005	Comments
FY2005 PRESBUD	134.3	177.2	194.6	
SEC Research and Analysis	30.4	35.0	37.6	
Science Data and Computing Tech.	9.9	14.9	15.0	
SOHO Mission Operations & Data Analysis	11.0	14.0	16.5	
SEC Mission Operations & Data Analysis	52.9	69.3	80.0	
Sounding Rockets	30.1	44.0	45.5	
Changes since 2004 PRESBUD	+10.0	-1.1		MO&DA combined
SEC Research and Analysis	-0.2	-0.2		
Science Data and Computing Tech.	-1.6	-0.1		
SOHO Mission Operations & Data Analysis	+11.0	+14.0		
SEC Mission Operations & Data Analysis	+52.9	+69.3		
Sounding Rockets	-0.2	-0.3		
SOHO Data Analysis	-10.4	-14.1		
SEC Data Analysis	-41.5	-69.7		
FY2004 PRESBUD	124.3	178.3		
SEC Research and Analysis	30.6	35.2		
Science Data and Computing Tech.	11.5	15.0		
SOHO Data Analysis	10.4	14.1		
SEC Data Analysis	41.5	69.7		
Sounding Rockets	30.3	44.3		

Indicates changes since the previous year's President's Budget Submit
Indicates budget numbers in full cost.

Theme: Sun-Earth Connection
Technology and Advanced Concepts

PURPOSE

Objectives	Performance Measures
1.3, 5.6, 5.7	5SEC3,4,6-13

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 available with 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 Earth's ionosphere, thermosphere, and radiation belts, and how mass and particle ejections from the Sun propagate to 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. As a result of the reprioritized Agency activities, the FY 2005 and outyear budgets for STP, Future Explorers, and construction of facilities have been reduced. The impacts to these programs will be fully assessed as part of the development of the FY 2006 budget.

OVERVIEW

Technology and Advanced Concepts efforts are dedicated to mission studies, and the pre-concept and formulation phases of flight projects. Space science programs and projects are required to clear all major technology hurdles 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 needs and availability with future missions. 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 concepts. SEC includes the following pre-development components: the Solar-Terrestrial Probes (STP) program's Magnetospheric Multiscale (MMS) and Global Electrodynamics Connection (GEC) missions; the Living With a Star (LWS) program's Geospace Missions; and future Explorer missions that are not yet selected. Technology and Advanced Concepts includes funding for the Time History of Events and Macroscale Interactions during Substorms (THEMIS) mission, a new Explorer selected in FY 2003 and currently in pre-development. 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 for all Space Science Themes.

PROGRAM MANAGEMENT

The SSE is responsible for all SEC programs. The Enterprise Program Management Council (EPMC) is the Governing Program Management Council (GPMC) for the STP. Except for SDO, and before LWS is confirmed, the LWS Program's governing PMC is the EPMC. Goddard Space Flight Center is responsible for the Explorers program, and the Jet Propulsion Laboratory for the New Millennium Program. Enterprise official is Dr. Edward Weiler, Associate Administrator for the Space Science Enterprise at HQ. The Theme director and the point of contact is Dr. Richard Fisher, director of the SEC 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		FY05 Budget Submit							Change from Baseline
		FY03	FY04	FY05	FY06	FY07	FY08	FY09	
New Millennium Program Space Technology-5 (ST-5)	TRL	5	6	6	7				Tests advanced technologies in space flight. Demonstrate and flight qualify a set of nanosats for application to future space missions.
	$M	15.0	30.4	8.8					
New Millennium Program Space Technology-6 (ST-6)	TRL	5	6	7					Improve spacecraft attitude control and pointing.
	$M	13.0	1.6	0.6					
New Millennium Program Space Technology-7 (ST-7)	TRL	5	5	6	7				Validate technologies for a drag free spacecraft.
	$M	15.7	21.0	9.2	2.7	1.3			

Theme: Sun-Earth Connection

Technology and Advanced Concepts

Schedule	FY 2005 President's Budget	Baseline	Change from Baseline
GEC Launch	March 2011	no baseline until confirmation	--
MMS Launch	July 2009	no baseline until confirmation	--
Geospace Mission - ITM Launch	August 2010	no baseline until confirmation	--
Geospace Mission - RBM Launch	August 2010	no baseline until confirmation	--
SDO Launch	April 2008	no baseline until confirmation	--
NMP ST-5	December 2004	LRD at Conf. was May 2004	+7 Months

ACQUISITION STRATEGY AND PERFORMING ORGANIZATIONS

Major acquisitions include: Completion of Phase A studies for STP MMS and LWS Geospace Missions - FUV Imager and ITM; technology investigations and spacecraft providers selected for NMP ST-9 and ST-10. Changes since FY 2004 President's Budget: LWS SDO moved to Development; future Explorers work delayed one year.

Current Acquisition	Actual*	Selection Method	Actual*	Performer	Actual*
Cooperative Agreement	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%			Non Profit	2%
*As of FY 2003 direct procurement	100%	*As of FY 2003 direct procurement		*As of FY 2003 direct procurement	100%

Future Acquisition	Selection	Goals
Instrument investigations & spacecraft GM-ITM	Winter 04	40% Full & Open Comp, (Instruments); 60% APL Sole Source
Phase A studies MMS	Sept. 03	85% Full & Open Competition, 15% GSFC mgmt

AGREEMENTS

Internal: The program is not dependent on other NASA activities outside of the control of the Associate Administrator of SSE. External: None at this time; may be baselined prior to mission confirmation. Changes since FY 2004 President's Budget: None.

INDEPENDENT REVIEWS

Review Types	Performer	Last Review Date	Next Review Date	Purpose
LWS Program & LWS SDO CDR	LWS IRT	12/03	1/06	Confirm SDO for design meets requirements
STP Program & STP IIR	STP IRT	4/03	5/04	Annual assessment of STP projects, including technology

Theme: Sun-Earth Connection

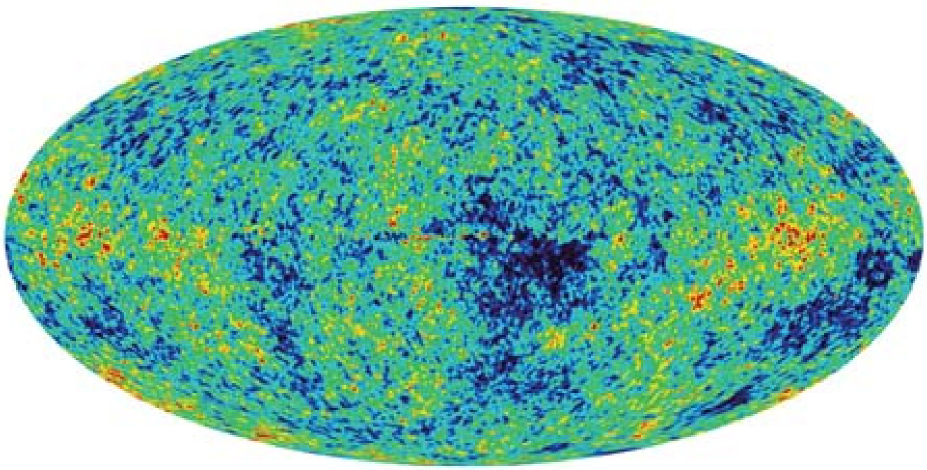
Technology and Advanced Concepts

BUDGET

Budget Authority ($ millions)	FY 2003	FY 2004	FY 2005	Comments
FY2005 PRESBUD	143.6	302.5	240.3	
New Millennium Program (NMP)	63.2	86.3	82.0	
Future Explorers	19.9	104.7	96.3	
Solar Terrestrial Probes (STP)	11.2	46.2	15.1	
Living With A Star (LWS)	44.1	49.6	46.9	
Program CoF	5.2	15.7		
Changes since 2004 PRESBUD	-112.0	-11.5		
New Millennium Program (NMP)	+0.4	-0.5		
Future Explorers	-76.5	-13.3		Institutional adjustments
Solar Terrestrial Probes (STP)	-1.7	+2.7		Rephased to Solar-B & STEREO
Living With A Star (LWS)	-34.2	-0.3		
Program CoF		-0.1		Rephasing of SS Building at GSFC
FY2004 PRESBUD	255.6	314.0		
New Millennium Program (NMP)	62.8	86.8		
Future Explorers	96.4	118.0		
Solar Terrestrial Probes (STP)	12.9	43.5		
Living With A Star (LWS)	78.3	49.9		
Program CoF	5.2	15.8		

Indicates changes since the previous year's President's Budget Submit

Indicates budget numbers in full cost.



The First Detailed Full-Sky Image of the Oldest Light in the Universe - The Wilkinson Microwave Anisotropy Probe (WMAP) team has made the first detailed full-sky map of the oldest light in the universe. In this "baby picture" of the universe, colors indicate "warmer" (red) and "cooler" (blue) spots. WMAP resolves slight temperature fluctuations, which vary by only millionths of a degree. The oval shape is a projection to display the whole sky; similar to the way the globe of the Earth can be projected as an oval.

The microwave light captured in this picture is from 379,000 years after the Big Bang, over 13 billion years ago -- the equivalent of taking a picture of an 80-year-old person on the day of their birth. The new data support and strengthen the Big Bang and Inflation theories.

Structure and Evolution of the Universe

MAJOR EVENTS IN FY 2005

- Astro-E2, a powerful x-ray observatory developed jointly by the U.S. and Japan, will be launched.
- A host of missions, including the Chandra X-Ray Observatory, WMAP, and GALEX, will continue their operations and science investigations.

Theme: Structure and Evolution of the Universe

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 Structure and Evolution of the Universe (SEU) Theme seeks to understand these cycles and how they created the conditions for our own existence.

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; and space itself contains some kind of energy that is pulling the universe apart. Observations confirm these remarkable predictions, the last finding being made only a few 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 these Goals
To 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 Discover what powered the Big Bang and the nature of the mysterious dark energy that is pulling the Universe apart.
		5.11 Learn what happens to space, time, and matter at the edge of a black hole.
		5.12 Understand the development of structure and the cycles of matter and energy in the evolving Universe.

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, compel the attention of the news media and entertainment industry, and are central elements in K-12 science literacy standards and curricula. SEU seeks to provide the raw material for museum exhibits, planetarium shows, radio and other media outlets, and classrooms. SEU has already made a number of great strides towards meeting this goal. The touring museum exhibit "Cosmic Questions" attracted a record 300,000 visitors during its stay at the Boston Museum of Science, and the demand for the planetarium show "Journey to the Edge of Space and Time" was so great that the Delta College Planetarium and Learning Center extended its run by three months. In partnership with the University of California-Berkeley's Great Explorations in Math and Science program, SEU has developed "Invisible Universe," an educator's guide to gamma-ray bursts that is in alignment with national standards and can reach over one-quarter of our Nation's students. The SEU theme also enhances science education and science literacy through mission-specific tools such as educator workshops, lesson plans, and classroom materials.

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 Space Science Enterprise 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

IMPLEMENTATION SCHEDULE

Theme Element	Schedule by Fiscal Year 02 03 04 05 06 07 08 09 10	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.
Wilkinson Microwave Anisotropy Probe (WMAP)		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		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.

Tech & Adv Concept   Development   Operations   Research

No exceptions to NPG 7120.5B have been taken.

STATUS

RXTE, Chandra, XMM, HETE-2, WMAP, INTEGRAL, CHIPS and GALEX are operational and producing outstanding science. In 2003, spectacular WMAP images of the cosmic microwave background were released that precisely measure the age and content of the universe, Chandra observed evolution in x-ray jets in a galactic black hole binary, and HETE-2 observed one of the brightest and closest gamma ray bursts, providing convincing evidence that it was associated with a massive supernova explosion.

Theme: Structure and Evolution of the Universe

PERFORMANCE MEASURES

Outcomes/Annual Performance Goals (APGs)	
Outcome 5.10.1	*Search for gravitational waves from the earliest moments of the Big Bang.*
5SEU4	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.
Outcome 5.10.2	*Determine the size, shape, and matter-energy content of the Universe.*
5SEU5	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.
Outcome 5.10.3	*Measure the cosmic evolution of dark energy.*
5SEU6	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
Outcome 5.11.1	*Determine how black holes are formed, where they are, and how they evolve.*
5SEU7	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.
Outcome 5.11.2	*Test Einstein's theory of gravity and map space-time near event horizons of black holes.*
5SEU8	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.
Outcome 5.11.3	*Observe stars and other material plunging into black holes.*
5SEU9	Successfully demonstrate progress in observing stars and other material plunging into black holes. Progress towards achieving outcomes will be validated by external review.
Outcome 5.12.1	*Determine how, where, and when the chemical elements were made, and trace the flows of energy and magnetic fields that exchange them between stars, dust, and gas.*
5SEU10	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.
Outcome 5.12.2	*Explore the behavior of matter in extreme astrophysical environments, including disks, cosmic jets, and the sources of gamma-ray bursts and cosmic rays.*
5SEU1	Complete the integration and testing of the Gamma-ray Large Area Space Telescope (GLAST) spacecraft bus.
5SEU11	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.
Outcome 5.12.3	*Discover how the interplay of baryons, dark matter, and gravity shapes galaxies and systems of galaxies.*
5SEU12	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.
Uniform Measures	
5SEU13	Complete all development projects within 110% of the cost and schedule baseline.
5SEU14	Deliver at least 90% of scheduled operating hours for all operations and research facilities.
5SEU15	At least 80%, by budget, of research projects will be peer-reviewed and competitively awarded.

INDEPENDENT REVIEWS

Review Types	Performer	Last Review Date	Next Review Date	Purpose
Federal Advisory Committee	NAC	12/03	3/04	Review science strategy, program implementation strategy.
Federal Advisory Committee	SScAC	11/03	3/04	Review science strategy, program implementation strategy
National Academy of Sciences	Space Studies Board	7/00	7/10	Decadal Survey for Astronomy and Astrophysics
SScAC	SEU Subcommittee	10/03	2/04	Review science strategy, program implementation strategy

Theme: Structure and Evolution of the Universe

BUDGET

Budget Authority ($ millions)	FY 2003	FY 2004	Change	FY 2005	Comments
Structure and Evolution of the Universe	**402.0**	**406.0**	**-28.3**	**377.7**	
Development	231.6	149.2	-26.2	123.0	
Gravity Probe-B	65.0				
Gamma-ray Large Area Space Telescope (GLAST)	57.3	115.0	-11.8	103.2	
Swift Gamma-Ray Burst Explorer	47.5				
Small Development Projects	61.8	34.2	-14.4	19.8	
Operations	8.4	10.3	-6.0	4.3	
Research	140.9	187.5	+22.5	210.0	
Technology	21.1	59.0	-18.6	40.4	

Indicates changes since the previous year's President's Budget Submit

Indicates budget numbers in full cost.

Theme: Structure and Evolution of the Universe
Development: Gravity Probe-B

PURPOSE

Objectives	Performance Measures
5.11	5SEU8,13

The purpose of Gravity Probe-B (GP-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 Earth, and, more profoundly, how Earth's rotation drags space-time around with it.

GP-B's launch date is under review, but the mission will launch no earlier than April 2004. These changes will be documented in NASA's Initial FY 2004 Operating Plan.

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	FY 2005 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	FY 2005 President's Budget	Baseline	Change from Baseline
Payload/SC Integration	Oct-01	Oct-99	+2.0 years
Launch	Nov-03 (delayed to NET 4-04)	Oct-00	Delay TBD

ACQUISITION STRATEGY AND 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 FY 2003, direct procurement represented 100% of budget authority. Changes since FY 2004 President's Budget: None.

Theme: Structure and Evolution of the Universe
Development: Gravity Probe-B

Current Acquisition	Actual*	Selection Method	Actual*	Performer	Actual*
Cooperative Agreement	0%	Full & Open Competition	6%	Industry	7%
Cost Reimbursable	92%	Sole Source	94%	Government	0%
Fixed Price	3%		100%	NASA Intramural	4%
Grants	0%			University	88%
Other	5%	Sci Peer Review	100%	Non Profit	1%
*As of FY 2003 direct procurement	100%	*As of FY 2003 direct procurement		*As of FY 2003 direct procurement	100%

Future Acquisition - 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: None. Changes since FY 2004 Pres. Budget: None.

Independent Reviews

Review Types	Performer	Last Review Date	Next Review Date	Purpose
Annual Review	Independent Review Team	1/03		Annual review, with focus on mission operations.
Acceptance Review	Independent Review Team	6/03		Assess vehicle readiness for delivery.

Budget/Life Cycle Cost

Budget Authority ($ millions)	Prior	FY03	FY04	FY05	FY06	FY07	FY08	FY09	BTC	Total	Comments
FY2005 PRESBUD	619.4	65.0	14.6	22.1	6.5					727.6	
Development	619.4	65.0								684.4	
Operations			1.1							1.1	
Mission Ops and Data Analysis			13.5	22.1	6.5					42.1	
Changes since 2004 PRESBUD	+0.1	+36.1		+16.3	+6.5					+59.0	
Development	+0.1	+45.3								+45.4	Launch Delay
Operations		-2.0								-2.0	
Mission Ops and Data Analysis		-7.2	-0.1	+16.3	+6.5					+15.5	MO&DA combined
FY2004 PRESBUD	619.3	28.9	14.6	5.8						668.6	
Development	619.3	19.7								639.0	
Operations		2.0	1.1							3.1	
Data Analysis		7.2	13.6	5.8						26.6	
Initial Baseline	550.4									550.4	
Development	529.6									529.6	
Operations	3.0									3.0	
Data Analysis	17.8									17.8	

Indicates changes since the previous year's President's Budget Submit
Indicates budget numbers in full cost.

Theme: Structure and Evolution of the Universe
Development: Gamma-ray Large Area Space Telescope (GLAST)

PURPOSE

Objectives	Performance Measures
5.12	5SEU1,11,13

The Gamma-Ray Large Area Space Telescope (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, with corresponding improvement in 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 astrophysical 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 observe the effects of 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 correlation at other wavelengths; these unidentified high-energy sources constitute the bulk of the 273 sources known. GLAST is a collaboration with the Department of Energy, France, Italy, Sweden, Japan and Germany. Due to the withdrawal of international partners and Large Area Telescope (LAT) rebaselining, GLAST will not launch until May 2007. These changes will be reflected in NASA's Initial FY 2004 Operating Plan.

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	FY 2005 President's Budget	Change from Baseline
LAT - Large Area Telescope - Collection Area	Peak effective area 8000 sq. centimeters	--
LAT - Large Area Telescope - Energy Range	30 MeV - 100 GeV	--
LAT - Large Area Telescope - Sensitivity (5 sigma)	<0.000000009 photons/sq cm/second	--
Operational Capability	5-yr. life, pointing and scanning modes, immediate burst notice to ground.	--
GBM - GLAST Burst Monitor - Collection Area	40-110 sq. centimeters (depends on photon energy and off-axis angle)	--
GBM - GLAST Burst Monitor - Energy Range	10 keV - 25 MeV	--
GBM - GLAST Burst Monitor - Spatial Resolution	15 degrees for burst alerts, 3 degrees after final processing	--

Schedule	FY 2005 President's Budget	Change from Baseline
Non-Advocate Review	June-03	+ 3 mos
Preliminary Design Review	June-03	+ 4 mos
Critical Design Review	Feb-04	--
Launch	Sep-06 (delayed to May 2007)	None 9/06 (delay adds 8 months)

ACQUISITION STRATEGY AND 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 Goddard Space Flight Center (GSFC) development. Guest Observers will be selected via a NASA solicitation. The Mission Operations Center will be managed in-house by GSFC. Changes since FY 2004 President's Budget: None.

Current Acquisition	Actual*	Selection Method	Actual*	Performer	Actual*
Cooperative Agreement	0%	Full & Open Competition	100%	Industry	46%
Cost Reimbursable	88%	Sole Source	0%	Government	0%
Fixed Price	5%		100%	NASA Intramural	10%
Grants	0%			University	26%
Other	7%	Sci Peer Review	100%	Non Profit	18%
*As of FY 2003 direct procurement	100%	*As of FY 2003 direct procurement		*As of FY 2003 direct procurement	100%

Future Acquisition - Major	Selection	Goals
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: Collaboration with Dept. of Energy, France, Italy, Japan, Sweden and Germany. Changes since FY 2004 President's Budget: withdrawal of international partners.

INDEPENDENT REVIEWS

Review Types	Performer	Last Review Date	Next Review Date	Purpose
Confirmation Review	Agency PMC	12/03		Authorization to proceed to development phase.
Critical Design Review	Center PMC		6/04	Critical Design Review.
Independent Annual Review	IRT	6/03	6/04	Outside Review.

Theme: Structure and Evolution of the Universe
Development: Gamma-ray Large Area Space Telescope (GLAST)

BUDGET/LIFE CYCLE COST

Budget Authority ($ millions)	Prior	FY03	FY04	FY05	FY06	FY07	FY08	FY09	BTC	Total	Comments
FY2005 PRESBUD	45.8	57.3	115.0	103.2	100.7	63.6	49.4	24.3	192.6	751.9	
Pre-Development	45.8	55.6								101.4	
Development		1.8	115.0	103.2	100.5	41.9	26.8	5.9		395.0	
Mission Ops and Data Analysis					0.2	21.7	22.6	18.4	192.6	255.5	
Changes since 2004 PRESBUD	+12.6	-11.9	-0.7	+16.6	+9.5	+3.2	+24.3	+24.3	+20.1	+97.9	
Pre-Development	+15.5	+55.6								+71.0	Withdrawal of International Partners
Development	-2.9	-67.5	-0.7	+16.6	+9.3	+3.3	+26.8	+5.9		-9.3	Withdrawal of International Partners
Operations						-5.5	-5.8		-28.2	-39.4	Withdrawal of International Partners
Mission Ops and Data Analysis					+0.2	+5.4	+3.2	+18.4	+48.3	+75.6	Withdrawal of International Partners/MO&DA combined
FY2004 PRESBUD	33.3	69.2	115.7	86.6	91.2	60.4	25.1		172.5	654.0	
Pre-Development	30.3									30.3	
Development	2.9	69.2	115.7	86.6	91.2	38.6				404.3	
Operations						5.5	5.8		28.2	39.4	
Data Analysis						16.3	19.4		144.3	179.9	

Indicates changes since the previous year's President's Budget Submit

Indicates budget numbers in full cost.

Theme: Structure and Evolution of the Universe
Development: Swift Gamma-ray Burst Explorer

PURPOSE

Objectives	Performance Measures
5.12	5SEU11,13

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 NASA 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 NASA 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 2004. 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. In recent months SWIFT has experienced technical difficulties which will result in schedule and cost increases. These will be fully documented in NASA's Initial FY 2004 Operating Plan.

PROGRAM MANAGEMENT

Swift is a NASA medium size Explorer (MIDEX) mission with project responsibility delegated to Goddard Space Flight Center. Enterprise official is Dr. Ed Weiler, Associate Administrator for SSE 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	FY 2005 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	2 years	-1 year
Operations	All GRB positions will be made available within seconds of their generation. Processed data will be available within 30 minutes.	--

Schedule	FY 2005 President's Budget	Change from Baseline
Start of Implementation	February 2001	--
Mission Critical Design Review	July 2001	--
Complete spacecraft integration and testing	October 2002	-9 Months
NSI Instrument Delivery	November 2002	--
BAT Instrument Delivery	August 2003	+ 6 Months
Launch	January 2004 (delay TBD)	+4 Months (+delay TBD)

ACQUISITION STRATEGY AND PERFORMING ORGANIZATIONS

The Swift project has three instruments: the Burst Alert Telescope built by Goddard Space Flight Center (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 FY 2004 President's Budget: None.

Current Acquisition	Actual*	Selection Method	Actual*	Performer	Actual*
Cooperative Agreement	0%	Full & Open Competition	60%	Industry	80%
Cost Reimbursable	57%	Sole Source	40%	Government	0%

Fixed Price	24%		100%	NASA Intramural	2%
Grants	0%			University	18%
Other	19%	Sci Peer Review	100%	Non Profit	0%
*As of FY 2003 direct procurement	100%	*As of FY 2003 direct procurement		*As of FY 2003 direct procurement	100%

Future Acquisition - Major	Selection	Goals
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 the Space Science Enterprise. 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 FY 2004 President's Budget: None.

INDEPENDENT REVIEWS

Review Types	Performer	Last Review Date	Next Review Date	Purpose
Confirmation Review	GSFC	2/01	2/01	Approval to proceed into development.
Mission Operation Review	GSFC	8/02		To certify all operations are ready to proceed.
Mission Readiness Review	GSFC		12/03	Verify readiness for launch.

BUDGET/LIFE CYCLE COST

Budget Authority ($ millions)	Prior	FY03	FY04	FY05	FY06	FY07	FY08	FY09	BTC	Total	Comments
FY2005 PRESBUD	139.2	47.8	6.2	5.5	5.0	3.2				206.9	
Development	139.2	47.5								186.7	
Operations			3.0							3.0	
Mission Ops and Data Analysis		0.3	3.2	5.5	5.0	3.2				17.2	
Changes since 2004 PRESBUD		+13.7		+0.2	+5.0	+3.2				+22.1	
Development		+14.0								+14.0	instruments overruns
Operations				-2.1						-2.0	3 month launch delay
Mission Ops and Data Analysis		-0.3		+2.2	+5.0	+3.2				+10.1	3 month launch delay/MO&DA combined
FY2004 PRESBUD	139.2	34.1	6.2	5.3						184.8	
Development	139.2	33.5								172.7	
Operations			3.0	2.1						5.0	
Data Analysis		0.6	3.2	3.3						7.1	
Initial Baseline	123.0	33.7	3.9	3.2	3.0					166.8	
Development	123.0	33.7								156.7	
Operations			2.6	1.9	2.0					6.5	
Data Analysis			1.3	1.3	1.0					3.6	

Indicates changes since the previous year's President's Budget Submit
Indicates budget numbers in full cost.

Theme: Structure and Evolution of the Universe
Development: Small Development Projects

PURPOSE

Objectives	Performance Measures
5.11, 5.12	5SEU9-11,13

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.

OVERVIEW

The following are missions in development that are included in SEU Small Projects: 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. The Spectroscopy and Photometry of the IGM's [InterGalactic Medium] Diffuse Radiation (SPIDR) project was terminated in FY 2003 because, after an independent and external review, it was determined that SPIDR would not achieve the sensitivity originally proposed.

PROGRAM MANAGEMENT

Astro-E2 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	FY 2005 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.	--
SPIDR	Terminated	Terminated

Schedule	FY 2005 President's Budget	Change from Baseline
Astro-E2	Launch February 2005	--
Herschel	Launch 2007	--
Planck	Launch 2007	--
SPIDR	Terminated	Terminated

ACQUISITION STRATEGY AND 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 M5 with a redesigned first stage.

Current Acquisition	Actual*	Selection Method	Actual*	Performer	Actual*
Cooperative Agreement	10%	Full & Open Competition	100%	Industry	40%
Cost Reimbursable	40%	Sole Source	0%	Government	15%
Fixed Price	50%		100%	NASA Intramural	15%
Grants	0%			University	30%
Other	0%	Sci Peer Review	100%	Non Profit	0%
*As of FY 2003 direct procurement	100%	*As of FY 2003 direct procurement		*As of FY 2003 direct procurement	100%

Future Acquisition	Selection	Goals
None- all major acquisitions are in place.	N/A	N/A

Theme: Structure and Evolution of the Universe
Development: Small Development Projects

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 2004 President's Budget: None.

INDEPENDENT REVIEWS

Review Types	Performer	Last Review Date	Next Review Date	Purpose
Other				International missions are not normally subjected to independent reviews.

BUDGET/LIFE CYCLE COST

Budget Authority ($ millions)	Prior	FY03	FY04	FY05	FY06	FY07	FY08	FY09	BTC	Total	Comments
FY2005 PRESBUD	214.8	61.8	34.2	19.8	12.7	11.2				354.5	
Herschel	51.2	20.2	11.7	6.1	6.5	6.1				101.8	
Planck	25.3	12.4	12.4	7.7	6.1	5.0				68.9	
Astro-E2	12.8	11.6	10.0	5.9						40.4	
Future and Other Payloads		0.1	0.1	0.1	0.1	0.1				0.5	
CHIPS	24.1	1.3								25.4	
INTEGRAL	11.4	0.5								11.9	
GALEX	88.9	6.2								95.2	
SPIDR	1.0	9.5								10.5	
Changes since 2004 PRESBUD	+19.7	+39.4	-23.9	-12.0	+0.3	+0.2				+23.7	
Herschel		+4.8	-0.1	+0.1	+0.1	+0.1				+5.1	
Planck		+7.5	-0.1	+0.2	+0.1	+0.1				+7.8	
Astro-E2	-0.6	+11.6	-0.1	+0.6						+11.6	New SMEX Selection
Future and Other Payloads	-0.1									-0.1	
CHIPS	+17.7	-0.2								+17.5	Instrument Complications
GALEX	+1.8	+6.2								+8.1	Instrument Complications
SPIDR	+0.8	+9.5	-23.7	-12.9						-26.3	Mission Terminated
FY2004 PRESBUD	195.1	22.4	58.1	31.8	12.4	11.0				330.8	
INTEGRAL	11.4	0.5								11.9	
Herschel	51.2	15.4	11.8	6.0	6.4	6.0				96.7	
Planck	25.3	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	87.1									87.1	
SPIDR	0.2		23.7	12.9						36.7	
Future and Other Payloads	0.1	0.1	0.1	0.1	0.1	0.1				0.6	

Indicates changes since the previous year's President's Budget Submit
Indicates budget numbers in full cost.

Theme: Structure and Evolution of the Universe
Operations

PURPOSE

Objectives	Performance Measures
5.10, 5.11, 5.12	5SEU4-12,14

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 2005: 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 October 9, 2000 and studies gamma ray bursts (GRBs) with ultraviolet, x-ray, and gamma ray instruments. The Wilkinson Microwave Anisotropy Probe (WMAP) was launched June 30, 2001. WMAP is mapping the temperature fluctuations of cosmic microwave background radiation (radiation left over from the Big Bang). GALEX was launched April 28, 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. CHIPS, launched January 12, 2003, is studying the local bubble of hot gas surrounding our Solar System. Gravity Probe B's (GP-B) launch date is under review, but it will be no earlier than April 2004. GP-B will test two predictions of Albert Einstein's general theory of relativity. The Swift Gamma Ray Burst Explorer is scheduled for a 2004 launch. Swift will produce arcsecond positions and multiwavelength light curves for gamma ray burst afterglows. Operations of XMM-Newton are provided by the European Space Agency.

Starting in FY 2005, the operations funding for GP-B, the Rossi X-ray Timing Explorer (RXTE), WMAP, Swift, and the Gamma ray Large Area Space Telescope (GLAST) will be combined with the Data Analysis funding for those missions (see Enterprise summary section for more information).

For more information, link to the 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, WMAP, 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
All missions will meet Level I specifications as identified in each mission's respective program plan.

Mission	Launch Date	Comments
Chandra	July 23, 1999	Mission Extended from 5 to 10 yrs.
GALEX	April 28, 2003	28 months of ops.
GP-B	November 2003	launch delayed (TBD).
WMAP	June 30, 2001	Mission Extended
RXTE	December 30, 1995	Mission Extended
Swift	January 2004	launch delayed (TBD).
XMM-Newton	December 10, 1999	Ops duration ESA's prerogative
CHIPS	January 12, 2003	Mission ends July 2005.
INTEGRAL	October 17, 2002	Ops duration ESA's prerogative
HETE-2	October 9, 2000	Mission Extended

Theme: Structure and Evolution of the Universe

Operations

ACQUISITION STRATEGY AND PERFORMING ORGANIZATIONS

The prime contractor for Chandra operations is the Smithsonian Astrophysical Observatory (SAO). The contract for Chandra was renewed in FY 2003 for a period of five years. RXTE and WMAP were operated by Lockheed Martin through the Consolidated Space Operations Contract (CSOC), which expired in December 2003 and was replaced by seven new contracts at NASA HQ and the Centers. Lockheed Martin also operated GALEX until after the CSOC recompetition. GP-B will be operated by Stanford University. In FY 2003, direct procurement represented 100% of budget authority. Changes since FY 2004 President's Budget: None.

Current Acquisition	Actual*	Selection Method	Actual*	Performer	Actual*
Cooperative Agreement	0%	Full & Open Competition	35%	Industry	33%
Cost Reimbursable	87%	Sole Source	65%	Government	0%
Fixed Price	13%			NASA Intramural	5%
Grants	0%		100%	University	0%
Other	0%	Sci Peer Review	100%	Non Profit	62%
*As of FY 2003 direct procurement	100%	*As of FY 2003 direct procurement		*As of FY 2003 direct procurement	100%

Future Acquisition	Selection	Goals
None.		

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 FY 2004 President's Budget: None.

INDEPENDENT REVIEWS

Review Types	Performer	Last Review Date	Next Review Date	Purpose
Senior Review	External panel	6/02	7/04	Consider mission extensions and funding levels for operating SEU spacecraft.
Working Group of Fed. Advisory Committee	Science Archives Working Group	10/03	4/04	Review continuing performance of missions ops and report to parent committee.

Theme: Structure and Evolution of the Universe
Operations

BUDGET

Budget Authority ($ millions)	FY 2003	FY 2004	FY 2005	Comments
FY2005 PRESBUD	8.4	10.3	4.3	
Chandra	3.8	4.2	4.3	
RXTE	1.8	1.3		
MAP	1.2			
GP-B		1.1		
SWIFT		3.0		
SWAS	0.6			
GALEX	0.9	0.7		
Changes since 2004 PRESBUD	-2.4			
Chandra		-0.1		
RXTE	-1.4			
MAP	-0.2			
GP-B	-2.0			
SWAS	+0.6			
GALEX	+0.7			
FY2004 PRESBUD	10.7	10.3		
Chandra	3.8	4.3		
RXTE	3.3	1.3		
MAP	1.4			
GP-B	2.0	1.1		
SWIFT		3.0		
GALEX	0.2	0.7		

Indicates changes since the previous year's President's Budget Submit
Indicates budget numbers in full cost.

Theme: Structure and Evolution of the Universe
Research

PURPOSE

Objectives	Performance Measures
5.10, 5.11, 5.12	5SEU4-12,14-15

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 Research & 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 Research 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.

Starting in FY 2005, the operations funding for GP-B, the Rossi X-ray Timing Explorer (RXTE), WMAP, Swift, and the Gamma ray Large Area Space Telescope (GLAST) will be combined with the Data Analysis funding for those missions (see Enterprise summary section for more information).

PROGRAM MANAGEMENT

NASA Headquarters is responsible for the SEU Research program. Enterprise official is Dr. Ed Weiler, Associate Administrator for Space Science at Headquarters. Theme Director and point of contact is Dr. 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 OSS. Data Analysis baselines are defined by the Program PCA or equivalent document.

Technical Specifications	FY 2005 President’s Budget	Change from Baseline
Building on the NASA Strategic Plan, the OSS Strategic Plan 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 roadmap activities conducted by the SEU Subcommittee. All selection processes and reviews of elements of the SEU research program use these strategic items as guideposts for selection and/or continuation. Proposals must relate to these strategic items.		

Schedule	FY 2005 President’s Budget	Change from Baseline
Beyond Einstein Foundation Science	Yearly in July	--
Balloon Program Research Opportunities In Space Science (ROSS)	Campaigns run all year	--
Data Analysis Senior Reviews	Every Two Years	--
R & A Research Opportunities In Space Science (ROSS)	Yearly in Feb.	--

ACQUISITION STRATEGY AND PERFORMING ORGANIZATIONS

The Research & 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. In FY 2003, direct procurement represented 100% of budget authority. Changes since FY 2004 President's Budget: None.

Theme: Structure and Evolution of the Universe

Research

Current Acquisition	Actual*	Selection Method	Actual*	Performer	Actual*
Cooperative Agreement	5%	Full & Open Competition	98%	Industry	4%
Cost Reimbursable	32%	Sole Source	2%	Government	2%
Fixed Price	1%			NASA Intramural	9%
Grants	49%		100%	University	76%
Other	13%			Non Profit	9%
*As of FY 2003 direct procurement	100%	*As of FY 2003 direct procurement		*As of FY 2003 direct procurement	100%

Future Acquisition	Selection	Goals
Beyond Einstein Foundation Science	Late 2004	100% Science Peer Review
Annual Chandra call for proposals	March 2004	100% Science Peer Review
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: Two missions in Data Analysis (XMM and INTEGRAL) involve agreements with the European Space Agency. Changes since FY 2004 President's Budget: None.

INDEPENDENT REVIEWS

Review Types	Performer	Last Review Date	Next Review Date	Purpose
Working Group of Fed. Advisory Committee	A&P Working Group	10/03	4/04	Review performance of research program and report findings to parent committee.

BUDGET

Budget Authority ($ millions)	FY 2003	FY 2004	FY 2005	Comments
FY2005 PRESBUD	140.9	187.5	210.0	
R&A	26.6	28.5	30.3	
Mission Operations & Data Analysis	96.3	76.4	88.3	
Balloons	18.0	27.1	24.3	
Other		55.5	67.1	
Changes since 2004 PRESBUD	-13.1	+0.9		
R&A	-0.4	-0.1		Rephase
Mission Operations & Data Analysis	+96.3	+76.4		Rephase
Balloons	+4.0	+1.8		Antarctica Infrastructure
Other		+55.5		
DA	-113.0	-132.7		
FY2004 PRESBUD	154.0	186.6		
R&A	27.0	28.6		
DA	113.0	132.7		
Balloons	14.0	25.3		

Indicates changes since the previous year's President's Budget Submit

Indicates budget numbers in full cost.

Technology and Advanced Concepts

PURPOSE

Objectives	Performance Measures
5.10, 5.11, 5.12	5SEU4-12

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. The SEU technology development program will support the Beyond Einstein missions -- the Laser Interferometer Space Antenna (LISA) and Constellation-X (Con-X). Beyond Einstein is critical to achieving two objectives in 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. Technology and Advanced Concepts also includes funding for the Extreme-Universe Space Observatory (EUSO), a new Explorer mission selected in FY 2003 and currently in pre-development. EUSO is led by ESA and will investigate radiations produced under the most extreme physical conditions in the universe. These are conditions beyond our present understanding, and they may be related to the early history of the Big Bang and the grand unification of the fundamental forces of nature.

Consistent with the SEU program needs, four technology areas which merit special attention have been identified, given their broad applicability across Enterprises. These areas are: advanced cryogenic systems, formation flying, high performance optics, and next generation detectors.

With regard to the challenges presented by the Beyond Einstein missions, 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; a disturbance reduction system consisting of micro-newton thrusters to keep the three spacecraft precisely centered; an interferometry system; pointing accuracy to less than 10 nano-radian; and a high power laser. Con-X is another example of how the Beyond Einstein program is pushing the frontiers of technological advancement. The mission will consist of 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 millikelvin (a fraction of a degree above absolute zero) by cryogenic coolers.

Due to reductions in near-term budgets for LISA and Con-X, NASA is currently reassessing launch dates. As a result of the reprioritized agency activities, the FY 2005 and outyear budgets for Con-X and LISA have been reduced. The impacts to these programs will be full assessed as part of the development of the FY 2006 budget. In addition, the Einstein Probes, medium-size missions, which were to have begun concept studies in FY 2004, have been indefinitely deferred.

PROGRAM MANAGEMENT

The Beyond Einstein program responsibility resides at Goddard Space Flight Center (GSFC). 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 Astronomy and Physics Division at NASA HQ.

TECHNICAL COMMITMENT

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

Schedule	FY 2005 President's Budget	Change from Baseline
LISA	TBD	no baseline established until confirmation
Con-X	TBD	no baseline established until confirmation

Technology and Advanced Concepts

Acquisition Strategy and Performing Organizations

The LISA Project Management Office is jointly managed by NASA (GSFC and the Jet Propulsion Laboratory) and European Space Agency, 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 FY 2003, direct procurement represented 100% of budget authority. Changes since FY 2004 President's Budget: None.

Current Acquisition	Actual*	Selection Method	Actual*	Performer	Actual*
Cooperative Agreement	8%	Full & Open Competition	69%	Industry	10%
Cost Reimbursable	24%	Sole Source	31%	Government	16%
Fixed Price	10%		100%	NASA Intramural	39%
Grants	0%			University	27%
Other	58%	Sci Peer Review	100%	Non Profit	8%
*As of FY 2003 direct procurement	100%	*As of FY 2003 direct procurement		*As of FY 2003 direct procurement	100%

Future Acquisition	Selection	Goals
Con-X Spect. X-ray Telescope flt mirror assembly dev. stdy	FY06	100% Full and Open Competition, 100% Fixed Price
LISA Phase A Study contracts	FY05	100% Full and Open Competition, 100% 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: LISA currently has a LOA with the European Space Agency (ESA). Changes since FY 2004 President's Budget: None.

Independent Reviews

Review Types	Performer	Last Review Date	Next Review Date	Purpose
Con-X / LISA Independent Implementation	TRIP	3/03		To ensure compliance with defined technical, cost, and schedule thresholds.
LISA Independent Implementation	IRT	6/03	9/04	To ensure compliance with defined technical, cost, and schedule thresholds.

Budget/Life Cycle Cost

Budget Authority ($ millions)	FY 2003	FY 2004	FY 2005	Comments
FY2005 PRESBUD	21.1	59.0	40.4	
CON-X	12.8	23.4	12.0	
LISA	7.3	25.1	19.0	
Other	1.0	10.5	9.4	
Changes since 2004 PRESBUD	-0.4	-1.9		
CON-X		-0.1		Rephase
LISA		-10.3		Rephase
Other	-0.4	+8.5		
FY2004 PRESBUD	21.5	60.9		
CON-X	12.8	23.5		
LISA	7.3	35.4		
Other	1.4	2.0		

Indicates changes since the previous year's President's Budget Submit

Indicates budget numbers in full cost.

Hubble Watches Light from Mysterious Erupting Star Reverberate Through Space - In January 2002, a dull star in an obscure constellation suddenly became 600,000 times more luminous than our Sun, temporarily making it the brightest star in our Milky Way galaxy. The mysterious star, called V838 Monocerotis, has long since faded back into obscurity. But observations by NASA's Hubble Space Telescope of a phenomenon called a "light echo" around the star have uncovered remarkable new features. These details promise to provide astronomers with at CAT-scan-like probe of the three-dimensional structure of shells and dust surrounding an aging star.

Astronomical Search for Origins

Major Events in FY 2005

- The Spitzer Space Telescope (formerly SIRTF - the Space Infrared Telescope Facility) will begin its second cycle of science proposals.
- The Stratospheric Observatory for Infrared Astronomy (SOFIA) will be delivered for final science testing.
- James Webb Space Telescope (JWST) will undergo its System Definition Review.

Theme: Astronomical Search for Origins

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 and thus directly support the President's new vision to explore the solar system as well as worlds beyond. As each mission makes radical advances in technology, innovations are fed forward, from one generation of missions to the next. In FY 2005, we will operate ongoing missions such as the Hubble Space Telescope (HST) and the Spitzer Space Telescope (SST, formerly 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).

Mission	Goals supported by this Theme	Objectives supporting these Goals
To 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.	5.8 Learn how galaxies, stars, and planetary systems form and evolve.
		5.9 Understand the diversity of worlds beyond our solar system and search for those that might harbor life.

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 that make 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 continue to 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

IMPLEMENTATION SCHEDULE

Theme Element	Schedule by Fiscal Year 02 03 04 05 06 07 08 09	Purpose
Spitzer Space Telescope (SST)		Study the formation of stars, galaxies, and planets via spectroscopy, high-sensitivity photometry and imaging.
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 as well as the origin and evolution of stars and planetary systems.
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.
Stratospheric Observatory for Infrared Astronomy (SOFIA)		Study the properties of interstellar space as well as planet and star formation.
Keck Interferometer		Characterize exo-zodiacal dust to support TPF design; direct detection of "hot Jupiters" and brown dwarfs; astronomic detection of planets.
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.
Terrestrial Planet Finder (TPF)		Find/characterize Earth-like planets around nearby stars.

Tech & Adv Concept Development Operations Research

No exceptions to NPG 7120.5B have been taken.

STATUS

- Both SIM and JWST successfully completed Confirmation Reviews to enter Phase B development.
- SOFIA telescope assembly was installed in the 747 aircraft.
- SIRTF (renamed the Spitzer Space Telescope), last of the Great Observatories, was launched in August 2003.
- HST discovered a 13-billion–year-old planet, the oldest known in the Milky Way.
- Keck Interferometer achieved its first scientific result: detection of a young star surrounded by dust in which planets may be forming.

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

PERFORMANCE MEASURES

Outcomes/Annual Performance Goals (APGs)	
Outcome 5.8.1	*Learn 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.*
5ASO4	Demonstrate James Webb Space Telescope (JWST) primary mirror technology readiness by testing a prototype in a flight-like environment.
5ASO5	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.
Outcome 5.8.2	*Understand how different galactic ecosystems of stars and gas formed and which ones might support the existence of planets and life.*
5ASO6	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.
Outcome 5.8.3	*Learn how gas and dust become stars and planets.*
5ASO7	Successfully demonstrate progress in learning how gas and dust become stars and planets. Progress towards achieving outcomes will be validated by external review.
Outcome 5.8.4	*Observe planetary systems around other stars and compare their architectures and evolution with our own.*
5ASO3	Demonstrate system-level instrument pointing precision consistent with SIM's flight system basic performance requirements, as specified in program plan.
5ASO8	Successfully demonstrate progress in observing planetary systems around other stars and comparing their architectures and evolution

Theme: Astronomical Search for Origins

Outcomes/Annual Performance Goals (APGs)	
	with our own. Progress towards achieving outcomes will be validated by external review.
Outcome 5.9.1	*Characterize the giant planets orbiting other stars.*
5ASO9	Successfully demonstrate progress in characterizing the giant planets orbiting other stars. Progress towards achieving outcomes will be validated by external review.
Outcome 5.9.2	*Find out how common Earth-like planets are and see if any might be habitable.*
5ASO2	Successfully complete the Kepler mission Preliminary Design Review (PDR).
5ASO10	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.
Outcome 5.9.3	*Trace the chemical pathways by which simple molecules and dust evolve into the organic molecules important for life.*
5ASO1	Deliver the SOFIA Airborne Observatory to Ames Research Center for final testing.
5ASO11	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.
Outcome 5.9.4	*Develop the tools and techniques to search for life on planets beyond our solar system.*
5ASO12	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.
Uniform Measures	
5ASO13	Complete all development projects within 110% of the cost and schedule baseline.
5ASO14	Deliver at least 90% of scheduled operating hours for all operations and research facilities.
5ASO15	At least 80%, by budget, of research projects will be peer-reviewed and competitively awarded.

INDEPENDENT REVIEWS

Review Types	**Performer**	**Last Review Date**	**Next Review Date**	**Purpose**
Subcommittee	ASO Subcommittee	10/03	2/04	Review science strategy, program implementation Strategy.
Nat'l Acad. of Sciences Advisory Council	Space Studies Board	7/00	7/10	Decadal Survey for Astronomy and Physics.
Federal Advisory Committee	NAC	12/03	3/04	Review science/program implementation strategies.
Federal Advisory Committee	SSAC	11/03	3/04	Review science/program implementation strategies.

BUDGET

Budget Authority ($ millions)	**FY 2003**	**FY 2004**	**Change**	**FY 2005**	**Comments**
Astronomical Search for Origins	**685.3**	**898.8**	**+168.0**	**1,066.8**	
Development	358.6	245.0	-88.1	156.9	
Hubble Space Telescope	140.7	139.8	-110.1	29.7	
SOFIA	46.6	54.4	-54.4		
Spitzer Space Telescope	148.3				
Kepler	23.0	50.8	+76.4	127.2	
Operations	7.2	24.4	+32.2	56.6	
Research	119.1	197.8	+34.5	232.3	
Technology and Advanced Concepts	200.5	431.6	+189.4	621.0	
James Webb Space Telescope	95.7	253.1	+65.0	318.1	
Technology and Advanced Concepts	104.8	178.5	+124.4	302.9	

Indicates changes since the previous year's President's Budget Submit

Indicates budget numbers in full cost.

Theme: Astronomical Search for Origins
Development: Hubble Space Telescope

PURPOSE

Objectives	Performance Measures
5.8	5ASO5-7,13

Since 1990, the Hubble Space Telescope (HST) 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. 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 has required instrument upgrades to keep the observatory at the forefront of astronomical research throughout its 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. These instruments should enable HST to continue to provide high quality astronomical data for several more years, after which the observatory will be decommissioned pending its controlled reentry into Earth's atmosphere using an automated spacecraft. The previously planned Servicing Mission SM4 has been cancelled due to safety considerations related to flying the Space Shuttle to a different orbit from that of the International Space Station (which could provide a safe haven in an emergency). Hubble development funding will now go to support the development of a robotic spacecraft that will be launched on an expendable launch vehicle, rendezvous with the observatory, and deorbit the Hubble Space Telescope safely after the end of its useful science life. In addition, modification and upkeep of ground operations systems continue.

Link to the Hubble Homepage for more information. http://hubble.gsfc.nasa.gov/index.html.

PROGRAM MANAGEMENT

GSFC is responsible for HST project management, including mission and science operations. The HST program is governed by the GSFC Program Management Council. The Agency Program Management Council has oversight responsibility for 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

Technical Specifications	FY 2005 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	FY 2005 President's Budget	Change from Baseline
Retrieval Mission	CY10	--

ACQUISITION STRATEGY AND PERFORMING ORGANIZATIONS

Changes since FY 2004 President's Budget: SM4 has been cancelled; deorbit mission to be carried out by an automated spacecraft. The HST program will require the acquisition of this module to deorbit the observatory safely at the end of its useful science life. The acquisition strategy and performing organizations are TBD. These changes will be reflected in NASA's Initial FY04 Operating Plan.

Current Acquisition	Actual*	Selection Method	Actual*	Performer	Actual*
Cooperative Agreement	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 FY03 direct procurement	100%	* as of FY03 direct procurement		* as of FY03 direct procurement	100%

Theme: Astronomical Search for Origins
Development: Hubble Space Telescope

Future Acquisition - Major	**Selection**	**Goals**
Automated spacecraft for HST deorbit.	TBD	TBD

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 FY 2004 President's Budget: None.

RISK MITIGATION

Top Risks	**Y**	**Overall**	**Y**	**Cost**	**Y**	**Schedule**	**Y**	**Probability**	**Impact**	**Mitigation Plan**
Propulsion Module Development								Medium	High	Under development

INDEPENDENT REVIEWS

Review Types	**Performer**	**Last Review Date**	**Next Review Date**	**Purpose**
Independent Implementation	IPAO/IRT	8/02	12/03	To ensure compliance with PCA-defined technical, cost and schedule thresholds.
Independent Science Review	HST-JWST Transition Panel	8/03	8/03	Review agency plans and to receive community input on the HST - JWST transition.

BUDGET/LIFE CYCLE COST

Budget Authority ($ millions)	**Prior**	**FY03**	**FY04**	**FY05**	**FY06**	**FY07**	**FY08**	**FY09**	**BTC**	**Total**	**Comments**
FY2005 PRESBUD		228.6	241.6	130.1	122.8	199.2	290.3	130.5	128.4		
Development		140.7	139.8	29.7	23.7	98.7	189.7	31.6	128.4		
Operations		4.8	8.7	6.9	7.1	7.3	8.0	8.1			
Data Analysis		83.1	93.1	93.5	92.0	93.2	92.6	90.8			
Changes since 2004 PRESBUD		+0.4	+2.7	-12.4	-25.1	+30.7	+71.2	+130.5	-324.2		
Development		+1.8	+3.4	-13.3	-20.0	+35.9	+79.7	+31.6	-47.5		SM4 cancelled; plan for robotic deorbit mission
Operations		-0.3	-0.1	-0.1	-0.2	-0.3	-0.1	+8.1	-16.8		
Data Analysis		-1.1	-0.6	+1.0	-4.8	-4.9	-8.3	+90.8	-259.9		Programmatic reduction
FY2004 PRESBUD		228.2	238.9	142.5	147.9	168.5	219.1		452.6		
Development		138.9	136.4	43.0	43.7	62.8	110.0		175.9		
Operations		5.1	8.8	7.0	7.3	7.6	8.1		16.8		
Data Analysis		84.2	93.7	92.5	96.8	98.1	100.9		259.9		

Indicates changes since the previous year's President's Budget Submit

Indicates budget numbers in full cost.

Theme: Astronomical Search for Origins
Development: SOFIA

PURPOSE

Objectives	Performance Measures
5.8, 5.9	5ASO7,11,13

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 is an astronomical observatory consisting of a 2.5 meter 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. 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 the 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	FY 2005 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 three years 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 5 years, up to 40 investigation teams per year.	--

Schedule	FY 2005 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 year after receipt by investigators	--
Observatory Operational Lifetime	20 years	--

Theme: Astronomical Search for Origins
Development: SOFIA

ACQUISITION STRATEGY AND 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 as the key subcontractor. Changes since FY 2004 President's Budget: United Airlines has dropped out of the partnership.

Current Acquisition	Actual*	Selection Method	Actual*	Performer	Actual*
Cooperative Agreement	0%	Full & Open Competition	100%	Industry	75%
Cost Reimbursable	83%	Sole Source	0%	Government	0%
Fixed Price	0%		100%	NASA Intramural	9%
Grants	0%			University	11%
Other	17%	Sci Peer Review	100%	Non Profit	5%
* as of FY03 direct procurement	100%	* as of FY03 direct procurement		* as of FY03 direct procurement	100%

Future Acquisition - Major	Selection	Goals
None - all major acquisitions are in place.		

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 FY 2004 President's Budget: None.

INDEPENDENT REVIEWS

Review Types	Performer	Last Review Date	Next Review Date	Purpose
Independent Annual Review	IRT	6/02	11/03	Assure compliance with PCA defined technical, cost and schedule parameters.

Theme: Astronomical Search for Origins
Development: SOFIA

BUDGET/LIFE CYCLE COST

Budget Authority ($millions)	Prior	FY03	FY04	FY05	FY06	FY07	FY08	FY09	BTC	Total	Comments
FY2005 PRESBUD	271.4	46.6	54.4	52.5	48.2	56.8	58.8	59.8		648.5	
Development	271.4	46.6	54.4							372.4	
Operations				33.4	28.3	37.7	39.1	40.1		178.6	
Data Analysis				19.1	19.9	19.1	19.7	19.7		97.5	
Changes since 2004 PRESBUD		-0.3	-0.3	+1.3	-7.1	-0.6	-0.9	+59.8		+51.9	
Development		-0.3	-0.3							-0.6	Reserves moved from Ops.
Operations				+0.5	-7.8	+0.2	-0.1	+40.1		+33.0	Added FY 09
Data Analysis				+0.7	+0.7	-0.7	-0.8	+19.7		+19.6	Added FY 09
FY2004 PRESBUD	271.4	46.9	54.7	51.2	55.3	57.4	59.7			596.6	
Development	271.4	46.9	54.7							373.0	
Operations				32.9	36.1	37.5	39.2			145.6	
Data Analysis				18.4	19.2	19.8	20.5			77.9	
Initial Baseline	271.4	38.0	38.9	40.1	41.3					429.7	
Development	234.8									234.8	
Operations	36.6	38.0	38.9	40.1	41.3					194.9	

Indicates changes since the previous year's President's Budget Submit
Indicates budget numbers in full cost.

Theme: Astronomical Search for Origins
Development: Kepler

PURPOSE

Objectives	Performance Measures
5.9	5ASO2,10,13

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 SST. 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 the Kepler Homepage for more information: http://www.kepler.arc.nasa.gov/

PROGRAM MANAGEMENT

Kepler is a project in the Discovery Program with project responsibility 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	FY 2005 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	FY 2005 President’s Budget	Baseline	Change from Baseline
System Readiness Review:	10/03	10/03	--
Preliminary Design Review:	10/04	10/04	--
Critical Design Review:	08/05	08/05	--
Launch:	10/07	10/07	--

ACQUISITION STRATEGY AND 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 FY 2004 President’s Budget: None.

Theme: Astronomical Search for Origins
Development: Kepler

Current Acquisition	Actual*	Selection Method	Actual*	Performer	Actual*
Cooperative Agreement	100%	Full & Open Competition	100%	Industry	95%
Cost Reimbursable	0%	Sole Source	0%	Government	0%
Fixed Price	0%		100%	NASA Intramural	5%
Grants	0%			University	0%
Other	0%	Sci Peer Review	100%	Non Profit	0%
* as of FY03 direct procurement	100%	* as of FY03 direct procurement		* as of FY03 direct procurement	100%

Future Acquisition - Major	Selection	Goals
None - all major acquisitions are in place.		

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 FY 2004 President's Budget: None.

Risk Mitigation

Top Risks	G	Overall	G	Cost	G	Schedule		Technical	Probability	Impact	Mitigation Plan

Independent Reviews

Review Types	Performer	Last Review Date	Next Review Date	Purpose
Confirmation Review	HQ/OSS		11/04	Approval to continue to Phase C/D.
Independent Assessment	Discovery Program Offics		10/04	Critical Design Review; ATLO (Pre-Environmental Review).

Budget/Life Cycle Cost

Budget Authority ($ millions)	Prior	FY03	FY04	FY05	FY06	FY07	FY08	FY09	BTC	Total	Comments
FY2005 PRESBUD	4.6	23.0	50.8	127.2	114.4	69.7	11.3	8.2	50.7	459.8	
Development	4.6	23.0	50.8	127.2	114.4	69.7				389.6	
Mission Operations & Data Analysis							11.3	8.2	50.7	70.2	
Changes since 2004 PRESBUD	+0.2	-2.5	-0.3	-6.4	+0.6	+7.6	-14.8	+8.2	+50.7	+43.4	
Development	+0.2	-2.5	-0.3	-6.4	+0.6	+7.6	-11.1			-11.7	MO&DA combined
Operations							-11.5			-11.5	
Mission Operations & Data Analysis							+11.3	+8.2	+50.7	+70.2	
Data Analysis							-3.6			-3.6	
FY2004 PRESBUD	4.3	25.5	51.1	133.6	113.8	62.1	26.1			416.4	
Development	4.3	25.5	51.1	133.6	113.8	62.1	11.1			401.4	
Operations							11.5			11.5	
Data Analysis							3.6			3.6	

Indicates changes since the previous year's President's Budget Submit
Indicates budget numbers in full cost.

Theme: Astronomical Search for Origins
OPERATIONS

PURPOSE

Objectives	Performance Measures
5.8, 5.9	5ASO5-12,14

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 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 Spitzer Space Telescope (SST, formerly SIRTF) was launched in August 2003, and will study the formation of stars, galaxies and planets via spectroscopy, high-sensitivity photometry and imaging.

Starting in FY 2005, the operations funding for the Far Ultraviolet Spectroscopic Explorer (FUSE), Kepler, and the Wide-field Infrared Survey Explorer (WISE) will be combined with the Data Analysis funding for those missions (see Enterprise summary section for more information).

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 Spitzer, 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. SST 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	FY 2005 President's Budget	Change from Baseline
All missions	All missions will meet Level I specifications as identified in the Program Plan.	--

Mission	Launch Date	Comments
Far Ultraviolet Spectroscopic Explorer	June 1999	Mission extended.
Hubble Space Telescope	April 1990	Mission extended.
Spitzer Space Telescope	August 2003	Prime mission through February 2006.

ACQUISITION STRATEGY AND 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. SST operations will be performed by the Jet Propulsion Laboratory. In FY03, direct procurement represented 100% of budget authority. Changes since FY 2004 President's Budget: None.

Current Acquisition	Actual*	Selection Method	Actual*	Performer	Actual*
Cooperative Agreement	0%	Full & Open Competition	100%	Industry	66%
Cost Reimbursable	100%	Sole Source	0%	Government	0%
Fixed Price	0%			NASA Intramural	0%
Grants	0%		100%	University	0%
Other	0%			Non Profit	34%
* as of FY03 direct procurement	100%	* as of FY03 direct procurement		* as of FY03 direct procurement	100%

Theme: Astronomical Search for Origins
OPERATIONS

Future Acquisition	Selection	Goals
Consolidated Space Operations Contract 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 FY 2004 President's Budget: None.

INDEPENDENT REVIEWS

Review Types	Performer	Last Review Date	Next Review Date	Purpose
Senior Review	External panel	6/02	7/04	To consider mission extensions and funding levels for operating ASO spacecraft

BUDGET

Budget Authority ($ millions)	FY 2003	FY 2004	FY 2005	Comments
FY2005 PRESBUD	7.2	24.4	56.6	
HST Operations	4.8	8.7	6.9	
SST Operations		14.2	16.3	
FUSE Operations	2.4	1.5		
Other			33.4	
Changes since 2004 PRESBUD	-2.6	-0.2		
HST Operations	-0.3	-0.1		
SST Operations	-3.2	-0.2		
FUSE Operations	+1.0			MO&DA combined
FY2004 PRESBUD	9.7	24.6		
HST Operations	5.1	8.8		
SST Operations	3.2	14.4		
FUSE Operations	1.4	1.5		

Indicates changes since the previous year's President's Budget Submit

Indicates budget numbers in full cost.

Theme: Astronomical Search for Origins
RESEARCH

PURPOSE

Objectives	Performance Measures
5.8, 5.9	5ASO5-12,14-15

The research program provides fundamental data analysis for operating ASO missions including HST, SST, 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 Research 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 Research 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.

Starting in FY 2005, the operations funding for the Far Ultraviolet Spectroscopic Explorer (FUSE), Kepler, and the Wide-field Infrared Survey Explorer (WISE) will be combined with the Data Analysis funding for those missions (see Enterprise summary section for more information).

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

Research baselines are consistent with those defined in individual Research Announcements released by OSS. Data Analysis baselines are defined by the program PCA or equivalent document.

Technical Specifications
The NASA Strategic Plan incorporates results of the Office of Space Science Strategic Planning process, which specifies goals, strategic objectives and research focus areas. The OSS Strategic Plan draws from the Astronomy and Physics Decadal Survey (NRC) and road mapping activities by the Astronomical Search for Origins Subcommittee of the Space Science Advisory Committee. All research proposals, selection processes and review of elements of the ASO research program use these strategic items as a guide.

Schedule	FY 2005 President's Budget	Change from Baseline
Data Analysis Senior Reviews	Every two years	--
R & A Research Opportunities In Space Science (ROSS)	Yearly in February	--

ACQUISITION STRATEGY AND PERFORMING ORGANIZATIONS

The Research and Analysis (R&A) and Data Analysis (DA) programs make awards following peer reviewed competitions under NASA Research Announcements (NRA), Announcements of Opportunity (AO) and Cooperative Agreement Notices (CAN). In FY 2003, direct procurement represented 100% of budget authority. Changes since FY 2004 President's Budget: None.

Current Acquisition	Actual*	Selection Method	Actual*	Performer	Actual*
Cooperative Agreement	1%	Full & Open Competition	98%	Industry	3%
Cost Reimbursable	32%	Sole Source	2%	Government	4%
Fixed Price	7%			NASA Intramural	7%
Grants	49%		100%	University	71%
Other	11%			Non Profit	15%
* as of FY03 direct procurement	100%	* as of FY03 direct procurement		* as of FY03 direct procurement	100%

Future Acquisition	Selection	Goals
Annual HST call for proposals	April 2004	100% Science Peer Review
Annual R&A research announcement	Late 2004	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 FY 2004 President's Budget: None.

INDEPENDENT REVIEWS

Review Types	Performer	Last Review Date	Next Review Date	Purpose
MO&DA Senior Review	Sr. Review committee	6/02	6/04	Recommend approval and funding level for extending science investigations.
R&A peer review	Peer review	7/03	7/04	To review ASO proposals responding to the annual R&A announcement.

BUDGET

Budget Authority ($ millions)	FY 2003	FY 2004	FY 2005	Comments
FY2005 PRESBUD	119.1	197.8	232.3	
ASO R&A	23.6	29.3	37.6	
ASO Mission Operations & Data Analysis	95.5	168.5	194.7	
Changes since 2004 PRESBUD	-29.3	-1.1		
ASO R&A	+0.2			
ASO Mission Operations & Data Analysis	+95.5	+168.5		Reflects MO&DA combination
ASO Data Analysis	-125.1	-169.7		
FY2004 PRESBUD	148.4	198.9		
ASO R&A	23.3	29.3		
ASO Data Analysis	125.1	169.7		

Indicates changes since the previous year's President's Budget Submit
Indicates budget numbers in full cost

Theme: Astronomical Search for Origins

Technology and Advanced Concepts

PURPOSE

Objectives	Performance Measures
5.8, 5.9	5ASO3,5-12

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 FY 2005 include 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). Technology and Advanced Concepts also includes funding for the Wide-field Infrared Survey Explorer (WISE), selected as a new Explorer in FY 2003 and currently in pre-development. 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). 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 the Jet Propulsion Laboratory (JPL) for the Navigator Program. The Agency Program Management Council (PMC) has governing responsibility for flight projects; at the time of Systems Requirements Review, 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.

Mission	Launch Date	Comments
Space Interferometry Mission (SIM)	Dec. 2009	--
Terrestrial Planet Finder (TPF)	TBD	--
Keck Interferometer	Operational through 2020	--

ACQUISITION STRATEGY AND PERFORMING ORGANIZATIONS

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, California Association for Research in Astronomy (CARA), Princeton University and others. Changes since FY 2004 President’s Budget: None.

Theme: Astronomical Search for Origins
Technology and Advanced Concepts

Current Acquisition	**Actual***	**Selection Method**	**Actual***	**Performer**	**Actual***
Cooperative Agreement	4%	Full & Open Competition	80%	Industry	12%
Cost Reimbursable	74%	Sole Source	20%	Government	0%
Fixed Price	4%		100%	NASA Intramural	16%
Grants	1%			University	64%
Other	17%			Non Profit	8%
* as of FY03 direct procurement	100%	* as of FY03 direct procurement		* as of FY03 direct procurement	100%

Future Acquisition	**Selection**	**Goals**
Space Interferometry Mission (SIM)	Late 2005	Full and 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: Memorandum of Understanding (MOU) exists between TPF and the European Space Agency's (ESA) Darwin mission. Changes since FY 2004 President's Budget: None.

INDEPENDENT REVIEWS

Review Types	**Performer**	**Last Review Date**	**Next Review Date**	**Purpose**
Independent Implementation Reviews	IRT/IPAO	8/03	11/03	To ensure compliance with defined technical, cost and schedule thresholds (PCAs, Roadmaps).

BUDGET

Budget Authority ($ millions)	**FY 2003**	**FY 2004**	**FY 2005**	**Comments**
FY2005 PRESBUD	104.8	178.5	302.9	
SIM	42.3	71.4	155.1	
TPF	34.4	43.9	52.5	
Keck	10.4	9.7	12.4	
Other	17.7	53.5	82.9	
Changes since 2004 PRESBUD	-52.7	+21.9		
SIM	+2.8	-8.4		
TPF	+14.7	-0.3		
Keck	+1.1	-0.1		
Other	-4.0	+30.8		
Starlight	-67.3			
FY2004 PRESBUD	157.5	156.6		
SIM	39.5	79.8		
TPF	19.7	44.2		
Starlight	67.3			
Keck	9.3	9.8		
Other	21.7	22.7		

Indicates changes since the previous year's President's Budget Submit
Indicates budget numbers in full cost.

Theme: Astronomical Search for Origins
Technology and Advanced Concepts: James Webb Space Telescope

PURPOSE

Objectives	Performance Measures
5.8	5ASO4-7

The James Webb Space Telescope (JWST) is the planned successor to the Hubble Space Telescope (HST), extending the discoveries made by HST into the infrared, where the highly redshifted early universe must be observed, where cool objects like protostars and protoplanetary disks emit strongly, and where dust obscures shorter wavelengths. Taking full advantage of technological advancements in lightweight deployable optics and infrared detectors, JWST will be the only facility capable of observing predicted first light objects (protogalaxies, supernovae, and black holes) at redshifts out to 20, when the universe was just 180 million years old.

OVERVIEW

JWST will be deployed with a segmented mirror and actuators to adjust the optical system, carrying three instruments and a fine guidance camera with science capabilities. These instruments will provide imaging, spectroscopy, and coronagraph, all optimized for ultimate sensitivity due to the faintness of the first light objects. JWST will be launched to orbit around Lagrange point L2, the gravitational balance point in which it will move around both Sun and Earth once per year with minimal fuel consumption. While in orbit, a multi-membrane shield will protect the telescope from radiation.

The JWST science program will address the questions: How did we get here?, Are we alone? To answer these questions, JWST research will explore four themes: First Light, Assembly of Galaxies, Origins of Stars and Planetary Systems, and Planetary Systems and the Origins of Life.

Following selection of a prime contractor (Northrop Grumman Space Technology), the JWST project underwent a major replan led by NASA and NGST, involving our international partners (the European and Canadian Space Agencies), the instrument teams, and the Space Telescope Science Institute (STScI). Significant outcomes from this effort included baselining the mirror area at 25 square meters, maintaining all original science instruments, and scheduling launch for August 2011. JWST has now received confirmation to proceed to the preliminary design phase of development (Phase B).

PROGRAM MANAGEMENT

Program responsibility for JWST has been delegated to Goddard Space Flight Center. The Agency Program Management Council (PMC) has oversight responsibility for the project. Enterprise Official is Dr. Ed Weiler, Associate Administrator Space Science at NASA HQ. Theme Director and point of contact id Dr. Anne Kinney, Director of Astronomy and Physics at NASA HQ. This project is in full compliance with NPG7120.5B.

TECHNICAL COMMITMENT

Project technical baseline is defined by the Formulation Authorization Document (FAD).

Mission	Launch Date	Comments
James Webb Space Telescope (JWST)	Aug. 2011	--

ACQUISITION STRATEGY AND PERFORMING ORGANIZATIONS

The observatory prime contractor is Northrop Grumman Space Technology, teamed with Ball, Kodak and Alliant Techsystems; the instrument complement is being provided under an Announcement of Opportunity. The Space Telescope Science Institute is the contractor for science and operations.

Current Acquisition	Actual*	Selection Method	Actual*	Performer	Actual*
Cooperative Agreement	0%	Full & Open Competition	80%	Industry	50%
Cost Reimbursable	100%	Sole Source	20%	Government	0%
Fixed Price	0%		100%	NASA Intramural	0%
Grants	0%			University	50%
Other	0%	Sci Peer Review	100%	Non Profit	0%
* as of FY03 direct procurement	100%	* as of FY03 direct procurement		* as of FY03 direct procurement	100%

Future Acquisition	Selection	Goals
None -- major acquisitions are in place.		

Theme: Astronomical Search for Origins
Technology and Advanced Concepts: James Webb Space Telescope

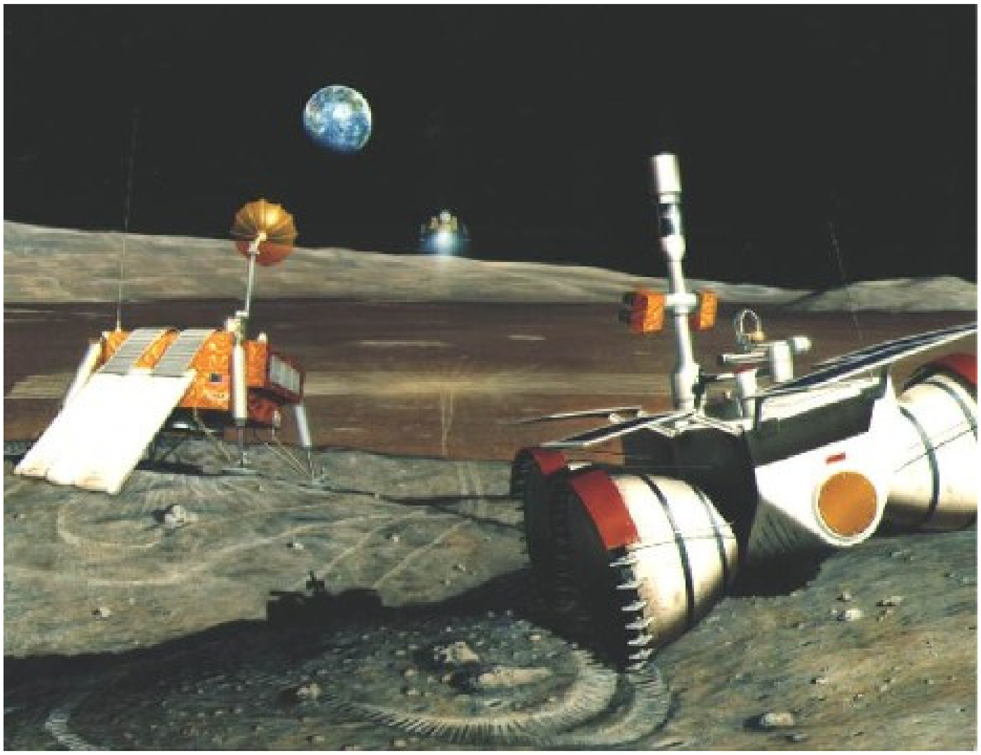
AGREEMENTS

In work.

BUDGET

Budget Authority ($ millions)	FY 2003	FY 2004	FY 2005	Comments
FY2005 PRESBUD	95.7	253.1	318.1	
James Webb Space Telescope	95.7	253.1	318.1	
Changes since 2004 PRESBUD	-30.6	-1.5		
James Webb Space Telescope	-30.6	-1.5		
FY2004 PRESBUD	126.3	254.6		
James Webb Space Telescope	126.3	254.6		

Indicates changes since the previous year's President's Budget Submit
Indicates budget numbers in full cost.



NASA begins its lunar testbed program with robotic missions that perform orbital reconnaissance and demonstrate capabilities for sustainable solar system exploration.

Lunar Exploration

MAJOR EVENTS IN FY 2005

Lunar Exploration will be established as a new Theme for FY 2005, in response to the President's Vision for U.S. Space Exploration. Major activities for FY 2005 will be developed prior to the start of FY 2005.

Theme: Lunar Exploration

OVERVIEW

The Lunar Exploration (LE) Theme will undertake lunar exploration activities that enable sustained human and robotic exploration of Mars and other bodies across the solar system. These activities will be used to further science, and to develop and test new approaches, technologies, and systems, including use of lunar and other space resources, to support sustained human space exploration to Mars and other destinations.

As the Theme responsible for preliminary demonstration and operation of systems to be employed in future human-robotic exploration, the LE Theme will develop precursor lunar missions in response to mission and technology requirements defined by the Exploration Systems Enterprise. These requirements will be derived from the planetary surface exploration architecture defined by Exploration Systems. LE Theme missions will infuse the technologies and test the operations modes that NASA will employ in human and robotic solar system exploration. To the extent that NASA's exploration architectures will assign functions to both humans and robots based on their respective capabilities and characteristics, robotic lunar missions will test systems that support human and robotic architectural elements.

The specific number, frequency, duration, sizes and types of lunar missions and systems NASA ultimately deploys will be determined based on: the capabilities requiring demonstration on or near the Moon; the operational concepts being considered for future human and robotic exploration of Mars and other solar system destinations; and the research results from ongoing robotic missions to Mars and other solar system destinations. The Lunar Exploration Theme will develop and conduct a robotic lunar orbital mission, launching by 2008, and a robotic lunar surface mission, launching by 2009, to test system capabilities, gather engineering data for future systems development, identify in situ resources, characterize the operating environment at the lunar surface, and address lunar science priorities, such as uncovering geological records of our early solar system. These precursor missions will lay a foundation for a human mission to the Moon, launching between 2015 and 2020, that will test humans and robots as integrated elements of the architecture that will be used to explore Mars and the solar system in the years to come.

Missions	Goals supported by this Theme	Objectives supporting those Goals
To Understand and Protect our Home Planet	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 Through robotic and human lunar missions, demonstrate capabilities for safe, affordable, effective and sustainable human-robotic solar system exploration.

RELEVANCE

In direct support of the President's new vision of future space exploration, the LE Theme will manage the operation and demonstration of new capabilities for safe, affordable, effective, and sustainable future human-robotic solar system exploration. The Lunar Exploration Theme will formulate and develop missions that meet requirements determined by the Exploration Systems Enterprise. These mission requirements will be derived from a planetary surface exploration architecture that assigns functions to humans and robots based on their respective capabilities and characteristics, and will ensure that elements of this architecture are tested on the lunar surface. Science objectives associated with Mars and solar system exploration will drive the requirements for the architecture and systems to be tested in lunar human-robotic missions, and these testbed missions will also address lunar science priorities.

Education and Public Benefits
Human and robotic missions to the Moon will provide an operational environment to demonstrate exploration capabilities as precursors for human missions to Mars or other destinations, testing human-scale exploration systems, such as surface power, habitation and life support, and planetary mobility. In addition to laying a foundation for inspiring future exploration missions, the Lunar Exploration Theme missions will provide opportunities for academic and student engagement in scientific research and operations.

IMPLEMENTATION

The managerial structure for the Lunar Exploration theme is not yet determined. The exact scope and phasing of missions are also not yet determined, but will include a robotic lunar orbital mission launching by 2008 and a robotic lunar surface mission launching by 2009. Lunar Exploration Theme investments and project plans will ensure cost-effective and timely development of technologies and demonstration of capabilities, in preparation for launch of a human lunar surface mission between 2015 and 2020.

The NASA Enterprise official is Dr. Edward Weiler, Associate Administrator for Space Science. Acting Theme director and point of contact is Mr. Orlando Figueroa, Director of the Solar System Exploration Division and the Mars Exploration program at Headquarters. The acting Program Executive Officer is Mr. David Lavery, Program Executive Officer for Solar System Exploration.

The programs within the Lunar Exploration Theme will be managed to be compliant with NPG 7120.5B.

Theme: Lunar Exploration

STATUS

The Lunar Exploration Theme is a full new start in 2005, but will be organizing management structures, executing preliminary reviews and design studies, and conducting other initializing activities in 2004.

PERFORMANCE MEASURES

Outcomes/Annual Performance Goals (APGs)	
Outcome 5.13.1	*Develop capability to conduct robotic lunar test bed missions by 2008 and human lunar missions as early as 2015 that demonstrate preferred exploration systems and architectural approaches to enable human-robotic exploration across the solar system.*
5LE1	Identify and define preferred human-robotic exploration systems concepts and architectural approaches for validation through lunar missions.
5LE2	Identify candidate architectures and systems approaches that can be developed and demonstrated through lunar missions to enable a safe, affordable and effective campaign of human-robotic Mars exploration.
Outcome 5.13.2	*Conduct robotic missions, in lunar orbit and on the lunar surface, to acquire engineering and environmental data by 2015 required to prepare for human-robotic lunar missions.*
5LE3	Establish a baseline plan and Level 1 requirements to utilize the robotic lunar orbiter(s) and robotic lunar surface mission(s) to collect key engineering data and validate environmental characteristics and effects that might affect later robotics, astronauts and supporting systems.
5LE4	Identify candidate scientific research and discovery opportunities that could be pursued effectively during robotic lunar missions.
Outcome 5.13.3	*By 2020, establish through lunar surface missions the building block capabilities to support safe, affordable and effective long-duration human presence beyond low Earth orbit (LEO) as a stepping-stone to sustained human-robotic exploration and discovery beyond the Moon.*
5LE5	Establish a viable investment portfolio for development of human support systems, including human/machine extravehicular activity (EVA) systems, locally autonomous medical systems and needed improvements in human performance and productivity beyond low Earth orbit (LEO).
Outcome 5.13.4	*By 2015, demonstrate new human-robotic space operations capabilities employing advanced in-space infrastructures, including space assembly, maintenance and servicing, and logistics concepts.*
5LE6	Identify preferred approaches for development and demonstration during lunar missions to enable transformational space operations capabilities.
5LE7	Conduct reviews with international and U.S. government partners, to determine common capability requirements and opportunities for collaboration.
Uniform Measures	
5LE8	The Theme will distribute at least 80% of its allocated procurement funding to competitively awarded contracts.

INDEPENDENT REVIEWS

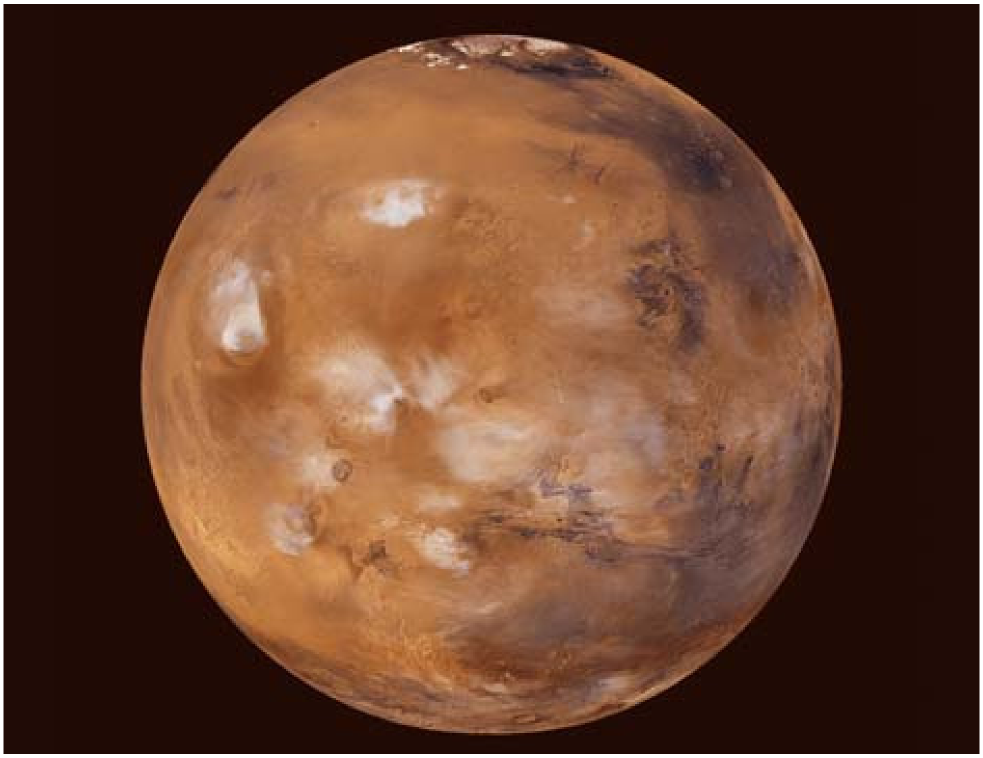
Review Types	Performer	Last Review Date	Next Review Date	Purpose
Presidential Commission	Aldridge Commission		Feb-Jun 2004	Assess implementation approaches to President's Vision for U.S. Space Exploration

BUDGET

Budget Authority ($ millions)	FY 2003	FY 2004	Change	FY 2005	Comments
Lunar Exploration			**+70.0**	**70.0**	
Technology and Advanced Concepts			+70.0	70.0	
Lunar Exploration			+70.0	70.0	

Indicates changes since the previous year's President's Budget Submit

Indicates budget numbers in full cost.



Mars is the target of NASA's most intensive scientific exploration of another planetary body since the Apollo Program, and the first waypoint in the search for extraterrestrial life. The Mars Exploration Program is designed to build on the success of the Mars Global Surveyor and Mars Odyssey missions, as well as that of the Mars Exploration Rovers. The first of the twin robotic geologists landed safely on Mars on January 3, 2004, and has begun to explore Gusev Crater, a site where liquid water may once have been present. More information can be found at "http://marsprogram.jpl.nasa.gov/index.html".

Mars Exploration

Major Events in FY 2005

- The Mars Reconnaissance Orbiter (MRO) will launch in August 2005. MRO will observe the atmosphere, surface, and subsurface of Mars in unprecedented detail.
- Development of the 2007 Mars Scout mission will continue. This mission, the first in the competitively selected Mars Scout Program, is called Phoenix, and will land in and explore the ice-rich terrain of the high northern latitudes of Mars.

Theme: Mars Exploration

OVERVIEW

The Mars Exploration program is a science- and exploration-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 program seeks to characterize the habitability of Mars and determine whether it was ever or still is inhabited by forms of life. The discoveries made by the Mars Exploration effort will help pave the way for eventual human missions to the Red Planet.

NASA is aggressively pursuing the search for water and life at Mars using robotic explorers. The Spirit and Opportunity rovers are the newest in a series of research missions planned to explore Mars through 2010. By the end of this decade, three rovers, a lander, and two orbiters will have visited the planet. NASA will augment this program and prepare for the next decade of Mars research missions by investing in key capabilities to enable advanced robotic missions, such as returning geological samples from Mars or drilling under the surface of Mars. This suite of technologies will enable NASA to rapidly respond to discoveries this decade and pursue the search for water and life at Mars wherever it may lead next decade.

Starting in 2011, NASA will also launch the first in a series of human precursor missions to Mars. These robotic testbeds will demonstrate technologies such as improved aerodynamic entry, Mars orbital rendezvous and docking, high precision landing, and resource extraction and utilization, that can greatly enhance future robotic capabilities and are key to enabling future human Mars missions. These missions will also obtain critical data for future human missions on chemical hazards, resource locations, and research sites and may prepare resources and sites in anticipation of human landings.

The FY 2005 budget request will enable NASA to operate existing assets at Mars (Mars Global Surveyor and Mars Odyssey); to provide science and operational support for the Mars Express and ASPERA-3 projects; to continue the development of the 2005 Mars Reconnaissance Orbiter mission; to initiate the development of the Phoenix Scout mission (2007 launch); and to continue the invest in Education and Public Outreach (E&PO), technology, research and analysis, and advanced studies for future missions.

Missions	Goals supported by this Theme	Objectives supporting these Goals
To 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.	5.3 Understand the current state and evolution of the atmosphere, surface, and interior of Mars.
		5.4 Determine if life exists or has ever existed on Mars.
		5.5 Develop an understanding of Mars in support of future human exploration.

RELEVANCE

The Mars Exploration program will characterize another silicate planet, which, like Earth, bears an atmosphere, and will investigate the variability of its climate in the context of understanding habitability. This work will provide a quantitative basis for interplanetary comparative climatology.

Mars Exploration seeks to understand the "habitability of a silicate planet" and to develop predictive models that pertain to sustainability and habitats. 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 climatological and geological records on Mars may be relevant to the earliest history and origin of life on Earth. The program 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 into 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 and predict the environmental evolution and habitability of planet Earth.

NASA's Mars Exploration program 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 other than on 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 eventually by humans. The program represents one of the U.S. government's strongest efforts to inspire future generations of scientists, engineers, and explorers.

Education and Public Benefits
Public benefits from the Mars Exploration program 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-terrestrial 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.

Theme: Mars Exploration

IMPLEMENTATION

The Mars Exploration program 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 Contact is Mr. Orlando Figueroa, director of the Mars Exploration program at HQ. This theme is in full compliance with NPG7120.5B.

IMPLEMENTATION SCHEDULE

Theme Element	Schedule by Fiscal Year 95 96 97 98 99 00 01 02 03 04 05 06 07 08 09 10	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 evidence of water in the subsurface layers 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 (Phoenix)		Openly competed mission flight opportunity for the science community
2009 Mars Science Laboratory		Nuclear powered mobile analytical laboratory at high priority site
2009 Mars Telesat Orbiter		High data rate telecomm capability to support Mars missions

Tech & Adv Concept   Development   Operations   Research

No exceptions to NPG 7120.5B have been taken.

STATUS

The Mars Exploration program accomplished the following this past year: - Mars Global Surveyor continues its second science mission extension; - Odyssey continues to collect data, with all instruments fully operational; - 2003 Mars Exploration Rovers were successfully launched, Spirit on 10 June and Opportunity on 7 July of 2003; - Delivered to ESA the Mars Express instruments (Radar Sounder [MARSIS] Antenna and Transmitter and RF subsystems), launched successfully in June 2003; - Mars Reconnaissance Orbiter completed its formulation phase successfully; - Selected the 2007 Mars Scout Mission (Phoenix) from 4 selected for definition study phase; - Released Mars Instrument Development Program (MIDP) NRA; selection in late September 2003 for award; and - Released Mars Fundamental Research Program NRA.

By February of 2004, the Mars Exploration program will have: - Landed one rover on Mars (this was accomplished on January 3, 2004, with the successful landing of the Spirit rover); - Selected a Phase A design concept for the 2009 MSL; - Selected a baseline concept design for the Optical Communication Technology demonstration.

The program received an EFFECTIVE rating using the 2003 Performance Assessment Rating Tool (PART).

Theme: Mars Exploration

PERFORMANCE MEASURES

Outcomes/Annual Performance Goals (APGs)	
Outcome 5.3.1	*Characterize the present climate of Mars and determine how it has evolved over time.*
5MEP5	Successfully complete the Mission Concept Review and PMSR for the 2009 Mars Telesat Orbiter (NOTE: this APG supports all MEP research focus areas).
5MEP7	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.
Outcome 5.3.2	*Understand the history and behavior of water and other volatiles on Mars.*
5MEP1	Successfully complete Assembly, Test, and Launch Operations (ATLO) for the Mars Reconnaissance Orbiter mission.
5MEP2	Successfully launch the Mars Reconnaissance Orbiter.
5MEP8	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.
Outcome 5.3.3	*Understand the chemistry, mineralogy, and chronology of Martian materials.*
5MEP9	Successfully demonstrate progress in studying the chemistry, mineralogy, and chronology of Martian materials. Progress towards achieving outcomes will be validated by external review.
Outcome 5.3.4	*Determine the characteristics and dynamics of the interior of Mars.*
5MEP10	Successfully demonstrate progress in determining the characteristics and dynamics of the interior of Mars. Progress towards achieving outcomes will be validated by external review.
Outcome 5.4.1	*Understand the character and extent of prebiotic chemistry on Mars.*
5MEP4	Successfully complete the Preliminary Mission System Review (PMSR) for the 2009 Mars Science Laboratory (MSL) Mission.
5MEP6	Successfully complete Preliminary Design Review (PDR) for Laser Communication Demonstration (NOTE: this APG supports all MEP research focus areas).
5MEP11	Successfully demonstrate progress in investigating the character and extent of prebiotic chemistry on Mars. Progress towards achieving outcomes will be validated by external review.
Outcome 5.4.2	*Search for chemical and biological signatures of past and present life on Mars.*
5MEP3	Complete science instrument selections for the 2009 Mars Science Laboratory (MSL).
5MEP12	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.
Outcome 5.5.1	*Identify and understand the hazards that the Martian environment will present to human explorers.*
5MEP13	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.
Outcome 5.5.2	*Inventory and characterize Martian resources of potential benefit to human exploration of Mars.*
5MEP14	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.
Uniform Measures	
5MEP15	Complete all development projects within 110% of the cost and schedule baseline.
5MEP16	Deliver at least 90% of scheduled operating hours for all operations and research facilities.
5MEP17	At least 80%, by budget, of research projects will be peer-reviewed and competitively awarded.

INDEPENDENT REVIEWS

Review Types	Performer	Last Review Date	Next Review Date	Purpose
MPIAT Report	Mars Program Independent Assessment Team	3/00		Analyze successes and failures of recent Mars and deep space missions.
Program Advisory Group (MEPAG)	Peer Review	9/03	6/04	Refine and evaluate the scientific objectives and research focus areas.
Solar System Roadmap	National Academy of Sciences	7/03	12/06	Assess effectiveness of program goals and implementation strategy.
Space Science Strategic Plan	National Academy of Sciences	7/03	12/06	Assess effectiveness of program goals and implementation strategy.

Theme: Mars Exploration

BUDGET

Budget Authority ($ millions)	FY 2003	FY 2004	Change	FY 2005	Comments
Mars Exploration	**500.4**	**595.1**	**+95.8**	**690.9**	
Development	303.5	182.4	-78.2	104.2	
2003 Mars Exploration Rovers	151.5				
2005 Mars Reconnaissance Orbiter (MRO)	146.9	182.4	-78.2	104.2	
Small Development Projects	5.2				
Operations	26.2	44.5	-34.6	9.9	
Research	27.7	63.5	-2.3	61.2	
Technology	142.9	304.7	+210.9	515.6	Supports new space exploration vision

Indicates changes since the previous year's President's Budget Submit

Indicates budget numbers in full cost.

Theme: Mars Exploration
Development: 2005 Mars Reconnaissance Orbiter (MRO)

PURPOSE

Objectives	Performance Measures
5.3	5MEP1-2,8,15

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 will 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 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	FY 2005 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 at beginning of mission	--
Raw Data Volume	26 Tbits	--
Mapping Targeted Imaging	30cm/pixel ground sampling monochromatic imaging; < 40m/pixel ground sampling for mineralogical mapping	--
Imaging Capability	<7.5 m/pixel ground sampling context imaging from 300 km altitude.	--
Primary science orbit (PSO)	255 X 320 km	--

Schedule	FY 2005 President's Budget	Change from Baseline
Instruments selection	Nov-01	--
Mission Preliminary Design Review	Jul-02	--
NAR	Jul-02	--
Mission Critical Design Review	3Q/FY03	--
Start spacecraft-level integration and testing	3Q/FY04	--
Launch	4Q/FY05	--
Ship to launch site	3Q/FY05	--

Theme: Mars Exploration
Development: 2005 Mars Reconnaissance Orbiter (MRO)

ACQUISITION STRATEGY AND 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 2003, direct procurement represented 100% of budget authority. Changes since FY 2004 President's Budget: None.

Current Acquisition	Actual*	Selection Method	Actual*	Performer	Actual*
Cooperative Agreement	0%	Full & Open Competition	84%	Industry	54%
Cost Reimbursable	99%	Sole Source	16%	Government	0%
Fixed Price	1%		100%	NASA Intramural	0%
Grants	0%			University	46%
Other	0%	Sci Peer Review	34%	Non Profit	0%
* as of FY03 direct procurement	100%	* as of FY03 direct procurement		* as of FY03 direct procurement	100%

Future Acquisition - Major	Selection	Goals
None - all major acquisitions are in place.		

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 2004 President's Budget: None.

INDEPENDENT REVIEWS

Review Types	Performer	Last Review Date	Next Review Date	Purpose
Independent Annual Review	IPAO	7/03	7/03	Evaluates project readiness for implementation.
Project ATLO Readiness Review	IPAO & JPL		4/04	Assess readiness of major systems (Science, Flight, Mission Ops) to enter ATLO.
Mission Readiness Review	IPAO & JPL		7/05	Assess the readiness of the project for launch.

Theme: Mars Exploration

Development: 2005 Mars Reconnaissance Orbiter (MRO)

BUDGET/LIFE CYCLE COST

Budget Authority ($ millions)	Prior	FY03	FY04	FY05	FY06	FY07	FY08	FY09	BTC	Total	Comments
FY2005 PRESBUD	70.0	146.9	182.4	109.9	46.4	47.6	38.9	23.9	11.8	677.8	
Development	70.0	146.9	182.4	104.2						503.5	
Operations				4.2	24.1	23.7	17.8	11.6	11.8	93.2	
Data Analysis				1.5	22.3	23.9	21.1	12.3		81.1	
Changes since 2004 PRESBUD		+3.4	-1.1	+0.8	+12.7	+9.8	+7.8	+23.9	-26.4	+30.9	
Development		+3.4	-1.1	+0.7						+3.0	JPL burden increased (FY03) and full cost adjustments
Operations				+0.1	+1.5	+3.3	+1.7	+11.6	-18.8	-0.6	Full cost adjustments; MO&DA realignment
Data Analysis				+0.1	+11.2	+6.5	+6.1	+12.3		+28.5	Increased to reflect grass-root estimate and Independent team recommendation
FY2004 PRESBUD	70.0	143.5	183.5	109.1	33.7	37.8	31.1		38.2	646.9	
Development	70.0	143.5	183.5	103.5						500.5	
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	
Initial Baseline	70.0	147.8	175.4	103.4	32.8	36.7	30.3		36.1	632.5	
Pre-Dev	70.0									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 changes since the previous year's President's Budget Submit

Indicates budget numbers in full cost.

Theme: Mars Exploration
Development: Small Development Projects

PURPOSE

Objectives	Performance Measures
5.3	5MEP7-8,15

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 the European Space Agency (ESA) Mars Express mission. The objective of the Mars Express mission is to understand the fate of the Martian water supply; understanding this objective is crucial in resolving the mystery of whether life ever existed on Mars.

OVERVIEW

NASA is participating in a mission managed by the European Space Agency (ESA) and Agenzia Spaziale Italiana (ASI) called Mars Express, which is exploring the atmosphere and surface from polar orbit. The spacecraft will carry a science payload with some heritage from European instruments lost on the ill-fated Russian Mars 96 mission, as well as a communications relay to support lander missions. NASA's involvement with the mission includes a joint development of the radar instrument with ASI; support to U.S. science co-investigators; coordination of radio relay systems ensuring various spacecraft operate with each other; a hardware contribution to the energetic neutral atoms analyzer instrument; and the provision of backup tracking support during critical mission phases by NASA's Deep Space Network. NASA's contributions also include the development and data analysis for the Swedish ASPERA-3 experiment, which will study the interaction between solar wind and the Martian atmosphere. ASPERA-3 was selected and is funded as a Discovery Program Mission of Opportunity.

Link to Jet Propulsion Laboratory Mars website: http://marsprogram.jpl.nasa.gov/.

PROGRAM MANAGEMENT

The Mars Express and ASPERA-3 projects are delegated to the Jet Propulsion Laboratory (JPL). The Agency Program Management Council (PMC) has Mars Express and ASPERA-3 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

The baseline for Mars Express is based on the Mars Exploration program's Program Commitment Agreement (PCA); baseline for ASPERA-3 is based on the Discovery PCA.

Technical Specifications	FY 2005 President's Budget	Change from Baseline
Mars Express & ASPERA-3 Launch	June 2003	--
Mars Express & ASPERA-3 Launch Vehicle	Soyuz Fregat Launcher, from Baikonur in Kazakhstan	--
Mars Express & ASPERA-3 Mission Life	One Martian year (687 Earth days)	--

Schedule	FY 2005 President's Budget	Change from Baseline
Mars Express & ASPERA-3 launch	Jun-03	--
Mars Express & ASPERA-3 Mars orbit insertion	Dec-03	--

ACQUISITION STRATEGY AND 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. ASI is responsible for the digital electronic subsystem, subsystem integration, and delivery. The Principal Investigator for ASPERA-3 is at Southwest Research Institute (SwRI), and is responsible for the development and operation. In FY 2003, direct procurement represented 100% of budget authority. Changes since FY 2004 President's Budget: Deleted NetLander (U.S.-provided experiment package was selected under full and open competition as Mission of Opportunity under Discovery Program).

Theme: Mars Exploration
Development: Small Development Projects

Current Acquisition	Actual*	Selection Method	Actual*	Performer	Actual*
Cooperative Agreement	0%	Full & Open Competition	83%	Industry	11%
Cost Reimbursable	48%	Sole Source	17%	Government	0%
Fixed Price	52%		100%	NASA Intramural	1%
Grants	0%			University	86%
Other	0%	Sci Peer Review	39%	Non Profit	2%
*As of FY03 direct procurement	100%	*As of FY03 direct procurement		*As of FY03 direct procurement	100%

Future Acquisition - Major	Selection	Goals
None - all major acquisitions are in place.		

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. Changes since FY 2004 President's Budget: Cancelled and deleted funding for the U.S.-provided experiment package on NetLander, CNES 2007 Premier Mission.

Independent Reviews

Review Types	Performer	Last Review Date	Next Review Date	Purpose
Mars Express - Project Confirmation	JPL	9/00		Phase C/D Development
Mars Express - MARSIS Peer Review/	JPL	2/02		Flight Hardware delivery
Mars Express - Critical Design Review	ESA	4/02		Transition from design to build

Budget/Life Cycle Cost

Budget Authority ($ millions)	Prior	FY03	FY04	FY05	FY06	FY07	FY08	FY09	BTC	Total	Comments
FY2005 PRESBUD	23.3	5.2								28.5	
Mars Express	17.3	3.0								20.3	
ASPERA-3	3.6	0.5								4.1	
NetLander	2.4	1.7								4.2	
Changes since 2004 PRESBUD	-0.1	-3.9	-10.3	-8.1	-4.4	-2.3	-2.5			-31.6	
Mars Express		-0.4								-0.4	Underrun
NetLander		-3.5	-10.3	-8.1	-4.4	-2.3	-2.5			-31.1	Mission cancelled due to CNES cancellation of the 2007 Mars Premier mission
FY2004 PRESBUD	23.4	9.1	10.3	8.1	4.4	2.3	2.5			60.1	
Mars Express	17.3	3.4								20.7	
ASPERA-3	3.6	0.5								4.1	
NetLander	2.5	5.2	10.3	8.1	4.4	2.3	2.5			35.3	
Initial Baseline	16.3	5.2	8.3	5.3	4.6	0.3				40.0	
Mars Express	12.8	4.6	7.6	4.5	3.9					33.4	Lifecycle; 9/00
ASPERA-3	3.5	0.6	0.7	0.8	0.7	0.3				6.6	Lifecycle; 11/99

Indicates changes since the previous year's President's Budget Submit
Indicates budget numbers in full cost.

Theme: Mars Exploration
Operations

PURPOSE

Objectives	**Performance Measures**
5.3, 5.4, 5.5	5MEP7-14,16

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

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 has provided measurement of potential Mars Exploration Rovers (MER) landing sites, and will 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 (Spirit and Opportunity), launched on June 10 and July 7, 2003, respectively, is to learn the history of ancient water and its role in the geology and climate of Mars. Each of the rovers will act as a robotic field geologist, equipped to read the geologic record at its landing site and learn what the conditions were when the rocks and soils were formed. Each rover can travel up to 1 km across the Martian landscape measuring the chemical character of the soils, rocks, and previously inaccessible interiors of rocks where unaltered materials may lie. - Mars Multi-Mission Operations (MMO) supports the development and operations for all Mars projects. MMO's 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	**FY 2005 President's Budget**	**Change from Baseline**
Mars Global Surveyor (MGS) Extended Science (E2)	Continue through 9/04 (3rd extension through 2006)	Additive to the original baseline
2001 Mars Odyssey Primary Science (E1)	917 Days (E1 through 9/06)	Addition to the original baseline
2001 Mars Odyssey Prime Mission - Relay Support	2/02 through 8/04	--
2003 Mars Exploration Rovers (MER) - Mission Life	90 sols (Martian days) for each rover	--
2003 Mars Exploration Rovers (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	--
MRO end of nominal life	December 31, 2010	--

Mission	**Launch Date**	**Comments**
Mars Global Surveyor	Nov. 1996	Mission Extended.
Mars Odyssey	April 2001	Prime mission through Sept. 2004.
Mars Express	June 2003	Prime mission through Sept. 2005.
ASPERA-3	June 2003	Prime mission through Sept. 2006.
Mars Exploration Rover – Spirit	June 2003	Prime mission through April 2004.
Mars Exploration Rover - Opportunity	July 2003	Prime mission through April 2004.
Mars Reconnaissance Orbiter	Aug. 2005	Prime mission through Sept. 2009.
Mars Multi-Mission Operations	Ongoing	Ongoing.

Theme: Mars Exploration

Operations

ACQUISITION STRATEGY AND 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 were selected and procured following an open Announcement of Opportunity (AO), were integrated onto the rovers at JPL. Both the Mars Global Surveyor (MGS) 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 2003, direct procurement represented 100% of budget authority. Changes since FY 2004 President's Budget: None.

Current Acquisition	Actual*	Selection Method	Actual*	Performer	Actual*
Cooperative Agreement	0%	Full & Open Competition	65%	Industry	3%
Cost Reimbursable	100%	Sole Source	35%	Government	0%
Fixed Price	0%			NASA Intramural	0%
Grants	0%		100%	University	97%
Other	0%			Non Profit	0%
*As of FY03 direct procurement	100%	*As of FY03 direct procurement		*As of FY03 direct procurement	100%

Future Acquisition	Selection	Goals
All major acquisitions are in place.		

AGREEMENTS

Internal: Program is not dependent on activities outside of the control of the Space Science Associate Administrator. External: Mars Express & ASPERA-3 (both in Data Analysis) involve agreements with the European Space Agency (ESA) and the Italian Space Agency (ASI). Changes since FY 2004 President's Budget: None.

INDEPENDENT REVIEWS

Review Types	Performer	Last Review Date	Next Review Date	Purpose
Senior Review (MGS)	HQ	1/99	1/04	Determine the feasibility of MGS science.
Mars Odyssey- Red Team Review (Odyssey)	JPL	1/00		Assess mission design and launch readiness.
Mars Odyssey- Odyssey High Gain Antenna	JPL	1/02		Assess readiness for antenna deployment.

Theme: Mars Exploration
Operations

BUDGET

Budget Authority ($ millions)	FY 2003	FY 2004	FY 2005	Comments
FY2005 PRESBUD	26.2	44.5	9.9	
Mars Global Surveyor	6.0	4.4		
2001 Mars Odyssey	10.5	9.9		
2003 Mars Exploration Rovers (MER)	5.9	26.4	1.6	
2005 Mars Reconnaissance Orbiter (MRO)			4.2	
Mars Multi-Mission Operations	3.9	3.8	4.1	
Changes since 2004 PRESBUD	+0.2	-0.3		
2001 Mars Odyssey	-0.1	-0.1		Full cost adjustments
2003 Mars Exploration Rovers (MER)		-0.1		Full cost adjustments; MO&DA realignment
Mars Multi-Mission Operations	+0.4			Full cost adjustments
FY2004 PRESBUD	26.0	44.8		
Mars Global Surveyor	6.0	4.4		
2001 Mars Odyssey	10.6	10.0		
2003 Mars Exploration Rovers (MER)	5.9	26.5		
Mars Multi-Mission Operations	3.5	3.8		

Indicates changes since the previous year's President's Budget Submit
Indicates budget numbers in full cost.

Theme: Mars Exploration
Research

PURPOSE

Objectives	Performance Measures
5.3, 5.4, 5.5	5MEP7-14,16-17

The objectives of the Mars research program, which includes Research & Analysis (R&A) and Data Analysis (DA), are to utilize flight mission data to develop a predictive understanding of Mars as a system, and 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.

The Mars Global Surveyor (MGS) has been conducting science mapping operations around Mars since March 1999. The spacecraft, now in its second extended mission, has served as a communications relay satellite during the entry, descent, and landing phase of the Mars Exploration Rovers (MER). MGS has discovered evidence of a 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 Mars Odyssey orbiter has already discovered high (80% 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, one of its instruments has observed mineralogical diversity at sub-km scales, suggesting greater compositional heterogeneity than previously thought.

The science goal of the 2003 Mars Exploration Rovers (Spirit and Opportunity), launched on June 10 and July 7, 2003, respectively, is to learn the history of ancient water and its role in the geology and climate of Mars.

Data Analysis: This program currently includes ASPERA-3 and Mars Express, part of a European Space Agency (ESA)/Italian Space Agency mission 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 Mars Exploration program's Program Commitment Agreement (PCA).

Technical Specifications	FY 2005 President's Budget	Change from Baseline
		None

The Mars research and analysis program solicits investigations using competitive, peer review, and is guided by priorities developed by groups which include the NRC's Space Studies Board COMPLEX, the Mars Exploration Program Analysis Group, and the Solar System Decadal Survey (NRC). All science data 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	FY 2005 President's Budget	Baseline	Change from Baseline
Mars Fundamental Sci.	Proposal Mar-2003, panel Jun-2003, award Sep-2003	--	--
Mars Data Analysis	Proposal Aug-2003, panel Nov-2003, award Dec-2003	--	--
ROSS NRA	An announcement is released annually via the Research Opportunities in Space Science (ROSS) NRA.	Jan-03	Release annually

Theme: Mars Exploration
Research

ACQUISITION STRATEGY AND 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 2004 President's Budget: None.

Current Acquisition	Actual*	Selection Method	Actual*	Performer	Actual*
Cooperative Agreement	3%	Full & Open Competition	100%	Industry	6%
Cost Reimbursable	63%	Sole Source	0%	Government	7%
Fixed Price	1%			NASA Intramural	2%
Grants	24%		100%	University	79%
Other	9%			Non Profit	6%
*As of FY 2003 direct procurement	100%	*As of FY 2003 direct procurement		*As of FY 2003 direct procurement	100%

Future Acquisition	Selection	Goals
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: Mars Express and ASPERA-3 involve agreements with the European Space Agency (ESA) and the Italian Space Agency (ASI). Changes since FY 2004 President's Budget: None.

INDEPENDENT REVIEWS

Review Types	Performer	Last Review Date	Next Review Date	Purpose
MO&DA Senior Review	Sr. Review committee		7/04	To review extending mission beyond its primary science phase.
R&A peer review	peer review committee	7/03	7/04	Review Mars proposals in response to R&A announcement.

Theme: Mars Exploration
Research

BUDGET

Budget Authority ($ millions)	FY 2003	FY 2004	FY 2005	Comments
FY2005 PRESBUD	27.7	63.5	61.2	
Mars Global Surveyor (MGS)	4.9	2.4		
2001 Mars Odyssey	10.7	10.9	4.2	
2003 Mars Exploration Rovers (MER)	3.6	25.1	10.3	
Mars Express	1.0	4.6	4.3	
ASPERA-3		0.8	0.8	
2005 Mars Reconnaissance Orbiter (MRO)			1.5	
Future Mars Data Analysis	7.6	12.1	32.4	
Mars Exploration Program Research and Analysis		7.6	7.7	
Changes since 2004 PRESBUD	+2.3	+7.3		
2001 Mars Odyssey	+0.9	-0.1		Full cost adjustments
2003 Mars Exploration Rovers (MER)	+1.3	-0.1		Full cost adjustments; MO& DA realignment
Mars Express	+0.2			Full cost adjustments
Future Mars Data Analysis	-0.1	-0.1		Full cost adjustments; added funds for Odyssey science ext (FY05)
Mars Exploration Program Research and Analysis		+7.6		Transferred from SSE theme
FY2004 PRESBUD	25.5	56.2		
Mars Global Surveyor (MGS)	4.9	2.4		
2001 Mars Odyssey	9.8	11.0		
2003 Mars Exploration Rovers (MER)	2.3	25.2		
Mars Express	0.8	4.6		
ASPERA-3		0.8		
Future Mars Data Analysis	7.7	12.2		

Indicates changes since the previous year's President's Budget Submit
Indicates budget numbers in full cost.

Theme: Mars Exploration
Technology and Advanced Concepts

PURPOSE

Objectives	Performance Measures
5.3, 5.4, 5.5	5MEP3-14

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 future investigations. 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 among 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 includes a competitively selected PI-led mission (Mars Scouts) patterned after the Discovery program, and similarly capped at $325M (FY 2003 dollars). In August 2003 the first Scout mission called Phoenix was selected for launch in 2007 to land in the ice rich terrains of the high northern latitudes. The 2009 opportunity will include a roving long-range, long-duration science laboratory, with unprecedented instrument capability for surface analysis to measure geochemistry and biological processes of materials potentially linked with ancient life and climate. The roving science laboratory will also demonstrate precision landing, operational autonomy, and innovative approaches to deliver increased mass to the surface. The 2009 Mars Telecommunications Satellite will be multi-band (X, Ka, UHF) and will be located at an optimal orbit to maximize coverage of orbital, sub-orbital, and surface assets on Mars. The telesat will also include an operational demonstration of optical telecommunications technologies, which will significantly increase the communication data rate and improve the cost per bite of data returned. 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, autonomy, sample acquisition, handling and processing, and Mars proximity telecommunications. 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. Base technologies also address longer-term, higher-risk, high-payoff technologies that may enable new types of missions. NASA will augment this program and prepare for the next decade of Mars research missions by investing in key capabilities to enable advanced robotic missions, such as returning geological samples from Mars or drilling under the surface of Mars. This suite of technologies will enable NASA to rapidly respond to discoveries this decade and pursue the search for water and life at Mars wherever it may lead next decade.

Starting in 2011, NASA will also launch the first in a series of human precursor missions to Mars. These robotic testbeds will demonstrate technologies such as improved aerodynamic entry, Mars orbital rendezvous and docking, high precision landing, and resource extraction and utilization, that can greatly enhance future robotic capabilities and are key to enabling future human Mars missions. These missions will also obtain critical data for future human missions on chemical hazards, resource locations, and research sites and may prepare resources and sites in anticipation of human landings.

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.

TECHNICAL COMMITMENT

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

Schedule/Mission	FY 2005 President's Budget	Change from Baseline
2007 Phoenix	Mars Scout mission; will land in ice-rich terrain in high northern latitudes.	New selection in 2003.
2009 Mars Science Laboratory	12 months flight time; 5-6 course corrections; lander performs direct entry with altimetry performed in terminal descent; 450-600 kg rover; 500 sol lifetime; 10km mobility.	n/a; no established baseline until confirmation
2009 U.S. Telecom Orbiter	1-year cruise; 6 years on orbit; Electra UHF and X-band link and gimbaled camera.	n/a; no established baseline until confirmation

Acquisition Strategy and Performing Organizations

NASA has set a goal of openly competing from 65-75% of budgeted dollars in the Mars Exploration program, depending on whether a given mission is performed in-house at a NASA Center or out-of-house at a contractor facility. 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, FY 2003 dollars. - 2009 Mars Science Laboratory - Hybrid JPL in-house and industry. - 2009 U.S. Telecom mission - fully competed. Will include Government Furnished Equipment (GFE) developed under other contracts/tasks managed by JPL. - Optical Communication Technology Demonstration will be led by the Goddard Space Flight Center (GSFC) with the Jet Propulsion Lab and MIT Lincoln Lab as partnhers. In FY 2003, direct procurement represented 100% of budget authority. Changes since FY 2004 President's Budget: Includes Optical Communication Technology Demonstration, transferred from the Solar System Theme.

Current Acquisition	Actual*	Selection Method	Actual*	Performer	Actual*
Cooperative Agreement	0%	Full & Open Competition	52%	Industry	11%
Cost Reimbursable	48%	Sole Source	48%	Government	1%
Fixed Price	52%		100%	NASA Intramural	0%
Grants	0%			University	86%
Other	0%			Non Profit	2%
*As of FY 2003 direct procurement	100%	*As of FY 2003 direct procurement		*As of FY 2003 direct procurement	100%

Future Acquisition	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 for Space Science. External: Department of Energy for Multi-Mission Radioisotope Thermoelectric Generators (MMRTG). Changes since FY 2004 President's Budget: Deleted U.S. contribution toward 2007 Centre National d'Etudes Spatiales Orbiter; deleted 2007 Agenzia Spaziale Italiana (ASI) Orbiter and 2009 ASI/Synthetic Aperture Radar; added 2009 U.S. Telecom.

Independent Reviews

Review Types	Performer	Last Review Date	Next Review Date	Purpose
2007 Mars Scout Non-Advocate Review	IPAO		7/04	Assess readiness for implementation.
2009 MSL Non-Advocate Review	IPAO		6/05	Assess readiness for implementation.
2009 U.S. Telecom Non-Advocate Review	IPAO		1/06	Assess readiness for implementation.
Scout Step 1 Proposal Review	LaRC/TMCO		9/03	Select 3-4 mission concepts.
Scout Step 2 Concept Study Review	LaRC/TMCO		3/03	Select Scout flight mission.
Technology 3-year review	External Review Board	9/02	10/03	Assess content, quality and relevance of technology investments.

Theme: Mars Exploration

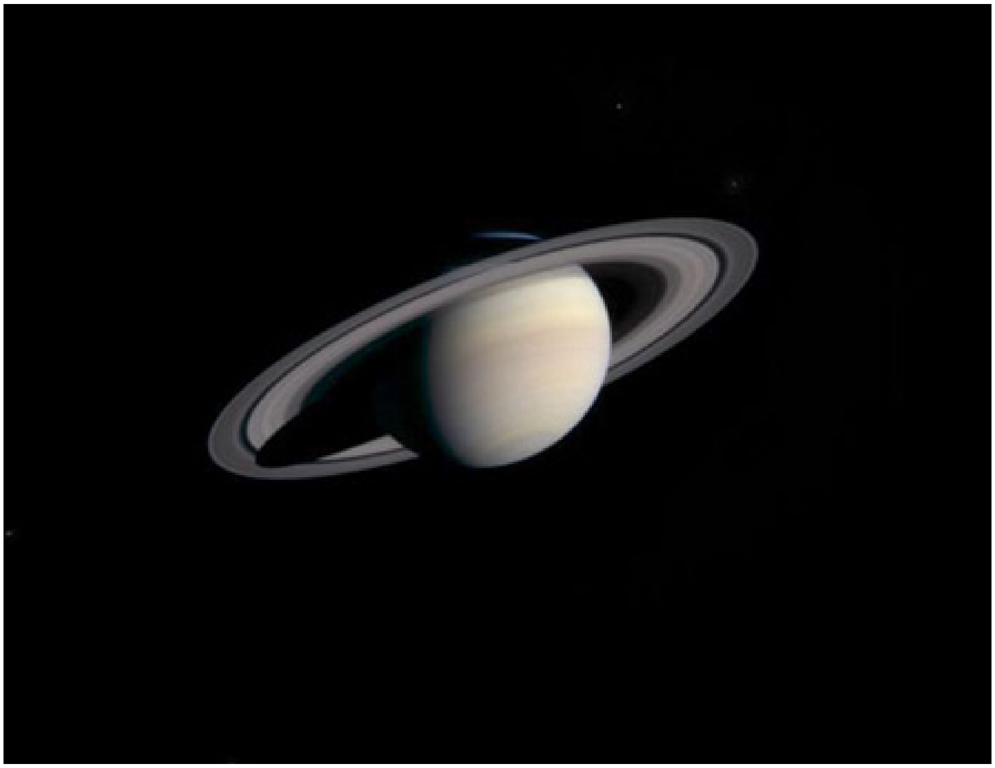
Technology and Advanced Concepts

BUDGET

Budget Authority ($ millions)	FY 2003	FY 2004	FY 2005	Comments
FY2005 PRESBUD	142.9	304.7	515.6	
Optical Comm		31.0	55.8	
2007 Scout Mission	8.8	28.9	102.8	
2009 MSL	60.6	117.3	174.6	
2009 US Telesat	4.2	9.2	25.1	
Mars Technology	28.7	36.1	20.2	
JPL Discrete CoF	1.4	15.5	11.5	
Mars Program Plans & Architecture and Other	39.1	66.7	125.6	Supports new exploration vision
Changes since 2004 PRESBUD	-34.6	+29.3		
Optical Comm		+31.0		Transferred from SSE Theme
2007 Scout Mission	+1.7	-0.2		Deleted Mission of Opportunity (MoO)
2009 MSL	+39.0	-0.7		Increased MMRTG budget consistent with contract award
2009 US Telesat	+4.2	-0.1		Rephased funding profile
Mars Technology	-21.3	-0.2		
JPL Discrete CoF	-15.1	-0.1		Deferred Flt Project Building to 2005
Mars Program Plans & Architecture and Other	+39.1	+66.7		
2007 CNES Orbiter	-19.4	-14.1		
FY2004 PRESBUD	177.5	275.4		
2007 CNES Orbiter	19.4	14.1		
2007 Scout Mission	7.1	29.1		
2009 MSL	21.6	118.0		
2009 US Telesat		9.3		
Mars Technology	50.0	36.3		
JPL Discrete CoF	16.5	15.6		
2007 Scout Mission	62.9	52.9		

Indicates changes since the previous year's President's Budget Submit

Indicates budget numbers in full cost.



Cassini, a robotic spacecraft launched in 1997 by NASA, is close enough now to resolve many rings and moons of its destination planet: Saturn. The spacecraft has now closed to within a single Earth-Sun separation from the ringed giant. In November 2003, Cassini snapped the contrast-enhanced color composite pictured above. Many features of Saturn's rings and cloud-tops now show considerable detail. When arriving at Saturn in July 2004, the Cassini orbiter will begin to circle and study the Saturnian system. Several months later, a probe named Huygens will separate and attempt to land on the surface of Titan.

Solar System Exploration

Major Events in FY 2005

- Deep Impact will launch in December 2004. The spacecraft will release a small (820 lbs.) Impactor directly into the path of comet Tempel 1 in July 2005. The resulting collision is expected to produce a small impact crater on the surface of the comet's nucleus, enabling scientists to investigate the composition of the comet's interior.
- Onboard the Cassini orbiter is a 703-pound scientific probe called Huygens that will be released in December 2004, beginning a 22-day coast phase toward Titan, Saturn's largest moon; Huygens will reach Titan's surface in January 2005.

Theme: Solar System Exploration

OVERVIEW

The exploration of the solar system is a major component of the President's vision of NASA's future. Our cosmic "neighborhood" will first be scouted by robotic trailblazers pursuing answers to key questions about the diverse environments of the planets, comets, asteroids, and other bodies in our solar system. Eventually, they will be followed by human explorers who will create a sustained presence throughout the solar system.

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
To 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 impact hazards to Earth from space.
To 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.	5.1 Learn how the solar system originated and evolved to its current diverse state.
		5.2 Understand how life begins and evolves and determine the characteristics of the solar system that led to the origin of life.

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. 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.

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 Orlando Figueroa, Director of the Solar System Exploration Division at Headquarters. This theme is in full compliance with NPG 7120.5B.

Theme: Solar System Exploration

IMPLEMENTATION SCHEDULE

Theme Element	Schedule by Fiscal Year 02 03 04 05 06 07 08 09	Purpose
New Horizons		Scientific investigation of the planet Pluto and its moon Charon.
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 Churyumov-Gerasimenko.
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.

Tech & Adv Concept   Development   Operations   Research

No exceptions to NPG 7120.5B have been taken.

STATUS

SSE accomplished the following this past year: - Stardust completed a close flyby of the main belt asteroid Annefrank on November 2, 2002. - Launch of joint NASA-ISAS (Japan's Institute of Space and Astronautical Science) mission MUSES-C on May 9, 2003. - Galileo reached the end of its mission on September 21, 2003 after nearly fourteen years in operation studying Jupiter and two of its moons, Europa and Io. The program received an EFFECTIVE rating using the 2003 Performance Assessment Rating Tool (PART).

PERFORMANCE MEASURES

Outcomes/Annual Performance Goals (APGs)	
Outcome 1.4.1	*By 2008, inventory at least 90 percent of asteroids and comets larger than 1 km in diameter that could come near Earth.*
5SSE5	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.
Outcome 1.4.2	*Determine the physical characteristics of comets and asteroids relevant to any threat they may pose to Earth.*
5SSE1	Successfully launch Deep Impact.
5SSE6	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.
Outcome 5.1.1	*Understand the initial stages of planet and satellite formation.*
5SSE2	Complete integration and testing for New Horizons/Pluto.
5SSE4	Release a NASA Research Announcement (NRA) for In Space Power and Propulsion technology development activities (NOTE: this APG could potentially support multiple SSE research focus areas).
5SSE7	Successfully demonstrate progress in understanding the initial stages of planet and satellite formation. Progress towards achieving outcomes will be validated by external review.
Outcome 5.1.2	*Understand the processes that determine the characteristics of bodies in our solar system and how these processes operate and interact.*
5SSE8	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.
Outcome 5.1.3	*Understand why the terrestrial planets are so different from one another.*
5SSE9	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.
Outcome 5.1.4	*Learn what our solar system can tell us about extra-solar planetary systems.*

Theme: Solar System Exploration

Outcomes/Annual Performance Goals (APGs)	
5SSE10	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 5.2.1	*Determine the nature, history, and distribution of volatile and organic compounds in the solar system.*
5SSE3	Select the next New Frontiers mission (NOTE: this APG could potentially support multiple SSE research focus areas).
5SSE11	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.
Outcome 5.2.2	*Identify the habitable zones in the solar system.*
5SSE12	Successfully demonstrate progress in identifying the habitable zones in the solar system. Progress towards achieving outcomes will be validated by external review.
Outcome 5.2.3	*Identify the sources of simple chemicals that contribute to pre-biotic evolution and the emergence of life.*
5SSE13	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.
Outcome 5.2.4	*Study Earth's geologic and biologic records to determine the historical relationship between Earth and its biosphere.*
5SSE14	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.
Uniform Measures	
5SSE15	Complete all development projects within 110% of the cost and schedule baseline.
5SSE16	Deliver at least 90% of scheduled operating hours for all operations and research facilities.
5SSE17	At least 80%, by budget, of research projects will be peer-reviewed and competitively awarded.

INDEPENDENT REVIEWS

Review Types	Performer	Last Review Date	Next Review Date	Purpose
NASA Advisory Council	NAC	12/03	3/04	Review science strategy, program implementation strategy
Nat'l Academy Advisory Council	SScAC	8/03	3/04	Review science strategy, program implementation strategy
Nat'l Academy Advisory Council	SSE Sub-Committee	10/03	2/04	Review science strategy, program implementation strategy
Nat'l Academy of Sciences	COMPLEX	11/03	3/04	Advises on long-term scientific strategies for solar system exploration
Nat'l Academy of Sciences	Space Studies Board	11/03	3/04	Effectiveness and quality of the program

BUDGET

Budget Authority ($ millions)	FY 2003	FY 2004	Change	FY 2005	Comments
Solar System Exploration	**1,039.1**	**1,315.9**	**-128.9**	**1,187.0**	--
Development	308.3	292.4	-82.7	209.7	--
MESSENGER	86.7	37.8	-37.8		--
Deep Impact	57.7	12.9	-3.4	9.5	--
Dawn	36.3	124.9	-40.5	84.4	--
Small Development Projects	3.9				--
New Horizons (Pluto)	123.6	116.8	-1.0	115.8	--
Operations	298.9	308.2	-31.2	277.0	--
Research	258.5	323.7	+42.9	366.6	--
Technology and Advanced Concepts	173.5	391.6	-57.9	333.7	--

Indicates changes since the previous year's President's Budget Submit

Indicates budget numbers in full cost.

Theme: Solar System Exploration
Development: MESSENGER

PURPOSE

Objectives	Performance Measures
5.1	5SSE9,15

The MErcury Surface, Space ENvironment, GEochemistry and Ranging (MESSENGER) project will determine: (1) the chemical composition of Mercury's surface; (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 Orlando Figueroa, 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	FY 2005 President’s Budget	Change from Baseline
Launch Vehicle:	Delta II	--
Operational capability:	MESSENGER's 12 months in orbit cover 2 Mercurial solar days. (The Mercurial 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)	--

Schedule	FY 2005 President’s Budget	Change from Baseline
Start of formulation	Dec-99	--
Start of implementation	Jul-01	--
Critical Design Review	Mar-02	--
Launch	Mar-04 (launch delayed – TBD)	--
Venus flybys	June 2004 and March 2006	--
Mercury flybys	July 2007 and April 2008	--
End of Data Analysis/archive	Apr-11	--
End of orbital data collection	Apr-10	--
Enter Mercury orbit	Apr-09	--

ACQUISITION STRATEGY AND PERFORMING ORGANIZATIONS

Carnegie Institute of Washington, under contract to NASA, provides the Principal Investigator (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. Composite Optics, Inc. provides the structure and Gencorp Aerojet provides the propulsion system. The payload is provided by JHU/APL, NASA/Goddard Space Flight Center, 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. Changes since FY 2004 Pres. Budget: None.

Current Acquisition	Actual*	Selection Method	Actual*	Performer	Actual*
Cooperative Agreement	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%			Non Profit	0%
* as of FY03 direct procurement	100%	* as of FY03 direct procurement		* as of FY03 direct procurement	100%

Future Acquisition - Major	Selection	Goals
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 FY 2004 President's Budget: None.

Risk Mitigation

Risk Date: 8/11/2003

Top Risks	R	Overall	R	Cost	R	Schedule	Y	Technical	Probability	Impact	Mitigation Plan
R	Launch postponement to May 2004								High	High	Reserves identified

Independent Reviews

Review Types	Performer	Last Review Date	Next Review Date	Purpose
Independent Assessment	Discovery Program Office	9/03	1/04	Critical Design Review; Pre-Environmental Review

Theme: Solar System Exploration
Development: MESSENGER

BUDGET/LIFE CYCLE COST

Budget Authority ($ millions)	Prior	FY03	FY04	FY05	FY06	FY07	FY08	FY09	BTC	Total	Comments
FY2005 PRESBUD	160.4	86.7	42.3	7.7	8.2	9.4	11.5	16.3	15.8	358.3	--
Development	160.4	86.7	37.8							284.9	--
Operations			3.0							3.0	--
Mission Operations & Data Analysis			1.5	7.7	8.2	9.4	11.5	16.3	15.8	70.4	--
Changes since 2004 PRESBUD	-0.1	+18.7	-0.2	+0.3	+0.5	+0.4	+0.4	+16.3	-15.6	+20.6	--
Development	-0.1	+18.7	-0.2							+18.4	--
Operations				-4.3	-4.4	-4.4	-5.5		-14.2	-32.9	--
Mission Operations & Data Analysis			+1.5	+7.7	+8.2	+9.4	+11.5	+16.3	+15.8	+70.4	MO&DA combined
Data Analysis			-1.5	-3.1	-3.4	-4.6	-5.6		-17.2	-35.3	--
FY2004 PRESBUD	160.5	68.0	42.5	7.4	7.7	9.0	11.1		31.4	337.7	--
Development	160.5	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	--
Initial Baseline	157.4	68.0	39.1	7.1	7.5	8.7			42.2	330.0	--
Development	157.4	68.0	34.7							260.1	--
Operations			2.9	4.1	4.2	4.2			19.5	34.9	--
Data Analysis			1.5	3.0	3.3	4.5			22.7	35.0	--

Indicates changes since the previous year's President's Budget Submit
Indicates budget numbers in full cost.

Theme: Solar System Exploration
Development: Deep Impact

PURPOSE

Objectives	Performance Measures
1.4, 5.1	5SSE1,6-7,15

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 (NEO) 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 composition 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 Jet Propulsion Laboratory 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 Orlando Figueroa, 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	FY 2005 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	FY 2005 President's Budget	Change from Baseline
Start of Formulation	Nov-99	--
Start of Implementation	Jun-01	--
Critical Design Review	Jan-02	--
Launch	Jan-04 (launch delayed to Dec-04)	--
Encounter	Jul-05	--
End of DA/Archive	Apr-06	--
End of Mission	Aug-05	--

Theme: Solar System Exploration
Development: Deep Impact

ACQUISITION STRATEGY AND PERFORMING ORGANIZATIONS

University of Maryland provides the PI and the science team for the overall science inputs to the mission design. The Jet Propulsion Laboratory 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 FY 2004 President's Budget: None.

Current Acquisition	Actual*	Selection Method	Actual*	Performer	Actual*
Cooperative Agreement	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 FY03 direct procurement	100%	* as of FY03 direct procurement		* as of FY03 direct procurement	100%

Future Acquisition - Major	Selection	Goals
None - all major contracts are in place		

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 FY 2004 President's Budget: None.

RISK MITIGATION

Risk Date: 1/21/04

Top Risks	Y	Overall	R	Cost	G	Schedule	Y	Technical	Probability	Impact	Mitigation Plan

INDEPENDENT REVIEWS

Review Types	Performer	Last Review Date	Next Review Date	Purpose
Independent Assessment	Discovery PO	8/03	3/04	CDR Review; Baseline Confirmation/Risk Review; Envir. Test Readiness Review

Theme: Solar System Exploration
Development: Deep Impact

BUDGET/LIFE CYCLE COST

Budget Authority ($ millions)	Prior	FY03	FY04	FY05	FY06	FY07	FY08	FY09	BTC	Total	Comments
FY2005 PRESBUD	187.7	57.7	21.6	17.0	2.6					286.6	
Development	187.7	57.7	12.9	9.5						267.8	
Operations			6.9							6.9	
Mission Operations & Data Analysis			1.8	7.5	2.6					11.9	
Changes since 2004 PRESBUD		-1.4	-0.1	+5.7	+0.6					+4.7	
Development		-1.4	-0.1	+9.5						+8.0	
Operations				-8.3	-0.4					-8.8	
Mission Operations & Data Analysis			+1.8	+7.5	+2.6					+11.9	MO&DA combined
Data Analysis			-1.8	-3.0	-1.6					-6.4	
FY2004 PRESBUD	187.8	59.1	21.7	11.3	2.0					281.9	
Development	187.8	59.1	13.0							259.8	
Operations			6.9	8.3	0.4					15.7	
Data Analysis			1.8	3.0	1.6					6.4	
Initial Baseline	182.1	59.1	21.0	11.1	2.0					275.3	
Development	182.1	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	

Indicates changes since the previous year's President's Budget Submit
Indicates budget numbers in full cost.

Theme: Solar System Exploration
Development: Dawn

PURPOSE

Objectives	Performance Measures
5.1	5SSE8,15

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 examining 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, magnetometry, 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 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 ion 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 Orlando Figueroa, 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 the delta Confirmation Review, to be held 2/6/04.

Technical Specifications	FY 2005 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 altitude, 11 months	--
Ceres:	Orbit at 890 and 140 km altitude, 11 months	--

Schedule	FY 2005 President's Budget	Baseline	Change from Baseline
Start of Formulation	Sep 02	--	--
Preliminary Design Review	Oct 03	Aug 03	+ 2 months
Critical Design Review	May 04	Apr 04	+ 1 month
Launch	May 06	--	--
Vesta Encounter	Jul 10	--	--
Ceres Encounter	Aug 14	--	--
End of Mission & Data Archiving	Jul 16	--	--

ACQUISITION STRATEGY AND 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

Aerospace Center is responsible for the framing camera, and the Italian Space Agency is responsible for the mapping spectrometer. Changes since FY 2004 President's Budget: None.

Current Acquisition	Actual*	Selection Method	Actual*	Performer	Actual*
Cooperative Agreement	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 FY03 direct procurement	100%	* as of FY03 direct procurement		* as of FY03 direct procurement	100%

Future Acquisition - Major	Selection	Goals
None - all major acquisitions are in place.		

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 have not been signed. Changes since FY 2004 President's Budget: Letters of Agreement have been developed.

Risk Mitigation

Risk Date: 7/18/2003

Top Risks	Y	Overall	R	Cost	Y	Schedule	Y	Technical	Probability	Impact	Mitigation Plan

Independent Reviews

Review Types	Performer	Last Review Date	Next Review Date	Purpose
Independent Asses.	Discovery Program Office		5/04	CDR Review; Pre-Environmental Review

Budget/ Life Cycle Cost

Budget Authority ($ millions)	Prior	FY03	FY04	FY05	FY06	FY07	FY08	FY09	BTC	Total	Comments
FY2005 PRESBUD	1.4	36.3	124.9	84.4	43.8	6.1	6.4	6.7	56.3	366.4	
Development	1.4	36.3	124.9	84.4	42.8					289.8	
Mission Operations & Data Analysis					1.0	6.1	6.4	6.7	56.3	76.5	
Changes since 2004 PRESBUD			-0.8	+0.9	+2.9	-0.1	-0.1	+6.7	-33.3	-23.9	
Development			-0.8	+0.9	+2.9					+3.0	
Operations					-1.0	-5.1	-5.2		-44.9	-56.3	
Mission Operations & Data Analysis					+1.0	+6.1	+6.4	+6.7	+56.3	+76.5	MO&DA combined
Data Analysis						-1.1	-1.3		-44.7	-47.1	
FY2004 PRESBUD	1.4	36.3	125.7	83.5	40.9	6.2	6.5		89.6	390.2	
Development	1.4	36.3	125.7	83.5	39.9					286.8	
Operations					1.0	5.1	5.2		44.9	56.3	
Data Analysis						1.1	1.3		44.7	47.1	

Indicates changes since the previous year's President's Budget Submit

Indicates budget numbers in full cost.

Theme: Solar System Exploration
Development: New Horizons (Pluto)

PURPOSE

Objectives	Performance Measures
5.1	5SSE2,7,15

The New Horizons Pluto mission will conduct a reconnaissance of Pluto and its moon Charon. The mission objectives are to: a) Characterize the global geology and morphology of Pluto and Charon; b) Map the surface composition of Pluto and Charon; and c) Characterize the neutral atmosphere of Pluto and its escape rate.

OVERVIEW

New Horizons will complete the reconnaissance of the planets by making the first-ever flyby of the Pluto-Charon system. Understanding these worlds is fundamental to understanding the origin and evolution of the outer solar system. New Horizons will seek to answer key scientific questions regarding the surfaces, atmospheres, interiors, and space environments of Pluto and Charon using imaging, visible and infrared spectral mapping, ultraviolet spectroscopy, radio science, and in situ plasma sensors. The mission also features an active Jupiter-system flyby to exercise the spacecraft and instruments, a bonus that will enable us to review new findings about Jupiter and its major satellites. NEW HORIZONS Homepage: http://pluto.jhuapl.edu/mission.htm

PROGRAM MANAGEMENT

Project responsibility for New Horizons, the first mission under the New Frontiers program, is delegated to the Principal Investigator (PI) at Southwest Research Institute (SwRI). The Johns Hopkins University/Applied Physics Laboratory (JHU/APL) has project management responsibility. Enterprise Official is Ed Weiler, Associate Administrator for Space Science at Headquarters. Theme director and point of contact is Orlando Figueroa, director of the Solar System Exploration Division at Headquarters. This program is in full compliance with NPG 7120.5B.

TECHNICAL COMMITMENT

The baseline for New Horizons is detailed in the Program Level I requirements

Technical Specifications	FY 2005 President's Budget	Change from Baseline
Launch Mass	465 kg	--
Power at Pluto	228 watts	--
Launch Vehicle	Atlas V 551	--
Communications	X-band, 2.1-meter high gain antenna	--
Payload	LongRange Reconnaissance Imager, Exploration RemoteSensing Instrument, SolarWind Analyzer for PAM, Energetic Particle Spectrometer Science Investigation, Radio Science Experiment, Student Dust Counter	--
Data Rate	768 bps to 70-meter antenna	--

Schedule	FY 2005 President's Budget	Change from Baseline
Critical Design Review	Oct-03	--
Flight Readiness Review	Dec-05	--
Launch	Jan-06	--
Jupiter Flyby/Gravity Assist	Mar-07	--
Pluto-Charon Encounter	Jul-15	--
End of Mission	Jan-20	--

ACQUISITION STRATEGY AND PERFORMING ORGANIZATIONS

Current Acquisition	Actual*	Selection Method	Actual*	Performer	Actual*
Cooperative Agreement	0%	Full & Open Competition	100%	Industry	44%
Cost Reimbursable	100%	Sole Source	0%	Government	7%
Fixed Price	0%		100%	NASA Intramural	2%
Grants	0%			University	47%
Other	0%			Non Profit	0%
*As of FY 2003 direct procurement	100%	*As of FY 2003 direct procurement		*As of FY 2003 direct procurement	100%

Theme: Solar System Exploration
Development: New Horizons (Pluto)

Future Acquisition - Major	Selection	Goals
None -- all major contracts are in place.		

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 New Horizon's team members) on which the project depends for mission success. Changes since FY 2004 President's Budget: None.

RISK MITIGATION

Risk Date:8/8/2003

Top Risks	R	Overall	Y	Cost	R	Schedule	Y	Technical	Probability	Impact	Mitigation Plan

INDEPENDENT REVIEWS

Review Types	Performer	Last Review Date	Next Review Date	Purpose
Independent Assessment	New Frontiers PO	10/03	12/05	Critical Design Review; Flight Readiness Review

BUDGET/ LIFE CYCLE COST

Budget Authority ($ millions)	Prior	FY03	FY04	FY05	FY06	FY07	FY08	FY09	BTC	Total	Comments
FY2005 PRESBUD	30.7	123.6	116.8	115.8	84.4	19.0	8.4	5.9	114.6	619.2	
Development	30.7	123.6	116.8	115.8	84.4	19.0	8.4	5.9	114.6	619.2	
Changes since 2004 PRESBUD	+30.7	+123.6	+116.8	+115.8	+84.4	+19.0	+8.4	+5.9	+114.6	+619.2	Moved from formulation into development
Development	+30.7	+123.6	+116.8	+115.8	+84.4	+19.0	+8.4	+5.9	+114.6	+619.2	
FY2004 PRESBUD.											

Indicates changes since the previous year's President's Budget Submit

Indicates budget numbers in full cost.

Theme: Solar System Exploration
Development: Small Development Projects

PURPOSE

Objectives	Performance Measures
5.2	5SSE11,15

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 navigational 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	FY 2005 President's Budget	Change from Baseline
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	FY 2005 President's Budget	Baseline	Change from Baseline
Rosetta Launch	Not earlier than 02/26/04	01/2003	Thirteen months

ACQUISITION STRATEGY AND 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 FY 2004 President's Budget: none.

Current Acquisition	Actual*	Selection Method	Actual*	Performer	Actual*
Cooperative Agreement	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 FY 2003 direct procurement	100%	*As of FY 2003 direct procurement		*As of FY 2003 direct procurement	100%

Future Acquisition - Major	Selection	Goals
None - all major acquisitions are in place		

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 FY 2004 Pres. Budget: None.

Theme: Solar System Exploration
Development: Small Development Projects

INDEPENDENT REVIEWS

Review Types	Performer	Last Review Date	Next Review Date	Purpose
N/A (European Space Agency-led project)	N/A			N/A

BUDGET/ LIFE CYCLE COST

Budget Authority ($ millions)	Prior	FY03	FY04	FY05	FY06	FY07	FY08	FY09	BTC	Total	Comments
FY2005 PRESBUD	35.3	3.9								39.2	
Rosetta	35.3	3.9								39.2	
Changes since 2004 PRESBUD	-5.8	+3.0								-2.8	
Rosetta	-5.8	+3.0								-2.8	
FY2004 PRESBUD	41.1	0.9								42.0	
Rosetta	41.1	0.9								42.0	

Indicates changes since the previous year's President's Budget Submit
Indicates budget numbers in full cost.

Theme: Solar System Exploration
Operations

PURPOSE

Objectives	Performance Measures
1.4, 5.1, 5.2	5SSE5-14,16

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. Starting in FY 2005, the operations funding for Stardust, Genesis, MESSENGER, Deep Impact, and Dawn will be combined with the Data Analysis funding for those missions (see Enterprise summary section for more information).

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 Orlando Figueroa, director of the Solar System Exploration Division at Headquarters. SSE mission operations are managed by the Jet Propulsion Laboratory, with the exception of MESSENGER and New Horizons, which are managed by the Johns Hopkins University's Applied 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	FY 2005 President's Budget	Change from Baseline
All missions	will meet Level I specifications as identified in each mission's respective program plan.	None

Mission	Launch Date	Comment
Cassini	Oct. 1997	Arrives at Saturn in July 2004.
Stardust	Feb. 1999	Prime mission through Jan. 2006.
Genesis	Aug. 2001	Prime mission though Sept. 2004.
Deep Impact	Jan. 2004	Launch delayed to Dec. 2004; comet encounter July 2005.
MESSENGER	March 2004	Launch delayed (TBD).

ACQUISITION STRATEGY AND PERFORMING ORGANIZATIONS

The Cassini mission is an international endeavor with the Jet Propulsion Laboratory, European Space Agency and Italian Space Agency. Prime contractors for Discovery missions are selected by the Principal Investigator (PI) of each mission. In FY 2003, direct procurement represented 100% of budget authority. Changes since FY 2004 President's Budget: None.

Current Acquisition	Actual*	Selection Method	Actual*	Performer	Actual*
Cooperative Agreement	0%	Full & Open Competition	15%	Industry	5%
Cost Reimbursable	100%	Sole Source	85%	Government	0%
Fixed Price	0%			NASA Intramural	0%
Grants	0%		100%	University	95%
Other	0%	Sci Peer Review	%	Non Profit	0%
*As of FY 2003 direct procurement	100%	*As of FY 2003 direct procurement		*As of FY 2003 direct procurement	100%

Future Acquisition	Selection	Goals
CSOC recompetition	Late 2003	100% Full & Open Competition

Theme: Solar System Exploration

Operations

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 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 FY 2004 President's Budget: None.

INDEPENDENT REVIEWS

Review Types	Performer	Last Review Date	Next Review Date	Purpose
Independent Annual Review	Independent Review Team	9/03	5/04	Validate performance of Discovery program against PCAs
Independent Implementation 2	Independent Review Team	8/03	12/04	DSMS - progress and risk assessment

BUDGET

Budget Authority ($ millions)	FY 2003	FY 2004	FY 2005	Comments
FY2005 PRESBUD	298.9	308.2	277.0	
Stardust	4.7	5.3		
Genesis	8.1	8.2		
Messenger		3.0		
Deep Impact		6.9		
Cassini	31.3	30.1	16.3	
DSN expansion	15.2	0.7		
DSMS	239.6	254.0	260.7	
Changes since 2004 PRESBUD	-11.7	-1.7		MO&DA combined
Stardust	+0.1			
Genesis	+0.9			
Cassini	-0.2	-0.2		
DSN expansion	-0.1			
DSMS	-10.0	-1.5		
Contour	-2.4			
FY2004 PRESBUD	310.6	309.9		
Stardust	4.6	5.3		
Genesis	7.2	8.2		
Contour	2.4			
Messenger		3.0		
Deep Impact		6.9		
Cassini	31.5	30.3		
DSN expansion	15.3	0.7		
DSMS	249.6	255.5		

Indicates changes since the previous year's President's Budget Submit

Indicates budget numbers in full cost.

Theme: Solar System Exploration
Research

PURPOSE

Objectives	Performance Measures
1.4, 5.1, 5.2	5SSE5-14,16-17

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 Research 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 research 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. Starting in FY 2005, the operations funding for Stardust, Genesis, MESSENGER, Deep Impact, and Dawn will be combined with the Data Analysis funding for those missions (see Enterprise summary section for more information).

For more information, go to: http://spacescience.nasa.gov/missions/index.htm; http://research.hq.nasa.gov/code_s/code_s.cfm; and 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 Orlando Figueroa, director of the Solar System Exploration Division at Headquarters. This program is in full compliance with NPG7120.5B.

TECHNICAL COMMITMENT

Content of SSE R&A and DA is defined in each individual mission PCA or NASA Research Announcement.

Technical Specifications
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 & reviews of the elements of the SSE research program use these strategic items as guide posts for selection and/or continuation. Research proposals must relate to these strategic items.

Schedule	FY 2005 President's Budget	Change from Baseline
Data Analysis Senior Reviews	Every Two Years	--
R & A Research Opportunities In Space Science (ROSS)	Yearly in Feb.	--

ACQUISITION STRATEGY AND 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 2003, direct procurement represented 100% of budget authority. Changes since FY 2004 President's Budget: None.

Current Acquisition	Actual*	Selection Method	Actual *	Performer	Actual*
Cooperative Agreement	12%	Full & Open Competition	98%	Industry	6%
Cost Reimbursable	48%	Sole Source	2%	Government	5%
Fixed Price	1%			NASA Intramural	5%
Grants	30%		100%	University	73%
Other	9%			Non Profit	11%
*As of FY 2003 direct procurement	100%	*As of FY 2003 direct procurement		*As of FY 2003 direct procurement	100%

Theme: Solar System Exploration
Research

Future Acquisition	Selection	Goals
Annual R&A research announcement	late 2004	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 FY 2004 President's Budget: None.

INDEPENDENT REVIEWS

Review Types	Performer	Last Review Date	Next Review Date	Purpose
MO&DA Senior Review	Sr. Review Committee	8/03	8/04	Recommend approval and funding level for extending science investigations.
R&A peer review	peer review committee	8/03	8/04	To review SSE proposals responding to the annual R&A announcement.

BUDGET

Budget Authority ($ millions)	FY 2003	FY 2004	FY 2005	Comments
FY2005 PRESBUD	258.5	323.7	366.6	
Cassini Data Analysis	38.4	44.8	64.7	
Miscellaneous MO&DA	25.7	32.1	54.4	
SSE R&A	194.4	246.8	247.5	
Changes since 2004 PRESBUD	+3.8	+2.1		Combined MO&DA
Cassini Data Analysis	+5.2	-0.3		
Miscellaneous MO&DA	+25.7	+32.1		
SSE R&A	+1.5	+2.5		
Miscellaneous DA	-28.6	-32.3		
FY2004 PRESBUD	254.7	321.6		
Cassini Data Analysis	33.2	45.1		
Miscellaneous DA	28.6	32.3		
SSE R&A	192.9	244.3		

Indicates changes since the previous year's President's Budget Submit

Indicates budget numbers in full cost.

Theme: Solar System Exploration
Technology and Advanced Concepts

PURPOSE

Objectives	Performance Measures
1.4, 5.1, 5.2	5SSE3-14

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 and techniques that enable greater mission flexibility, improved radioisotope power systems, advanced communications systems, and advanced avionics capabilities.

OVERVIEW

The Solar System Exploration Theme's Technology and Advanced Concepts program boasts a variety of efforts designed to push the state of the art in planetary exploration. The goal of the In-Space Power and Propulsion (ISPP) program is to develop alternative, more efficient power and propulsion systems. The ISPP will include the radioisotope power systems (RPS) work and some of the electric propulsion efforts that had previously been part of Project Prometheus, the nuclear systems program. While most of Project Prometheus will now be part of NASA's new Exploration Systems Enterprise, the Space Science Enterprise will retain not only the RPS and electric propulsion work, but also the fundamental science component of the Jupiter Icy Moons Orbiter (JIMO) and instrument technology development for that mission. The Solar System Exploration Technology and Advanced Concepts effort also supports the selection of future Discovery and New Frontiers missions, and the development of communications and avionics technologies.

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/

PROGRAM MANAGEMENT

Enterprise Official is Ed Weiler, Associate Administrator for Space Science at Headquarters. Theme director and point of contact is Orlando Figueroa, director of the Solar System Exploration Division at Headquarters. 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		FY05 Budget Submit							Change from Baseline
		FY03	FY04	FY05	FY06	FY07	FY08	FY09	
In-Space Power and Propulsion (excluding electric propulsion)	TRL	3	4	4	5	5	5	5	--
	$M	43.20	61.60	82.7	87.1	90.2	93.7	96.2	--
In-Space Power and Propulsion: Radioisotope Power Systems - Stirling Radioisotope Generator	TRL	7	7	7	7	7	8	8	--
	$M	20	27						--
In-Space Power and Propulsion: Radioisotope Power Systems - NRAs for Concepts	TRL	3	3	3	3	3	3	3	--
	$M	3	4						--
In-Space Power and Propulsion: Radioisotope Power Systems - NRAs for Breadboards	TRL	5	5	5	5	5	5	5	--
	$M	12	12						--

Schedule	FY 2005 President's Budget	Change from Baseline
New Frontiers 2 - AO Release	Oct. 2003	--
New Frontiers 2 - Proposals Due	Feb. 2004	--
Discovery 11 - AO Release	Feb. 2004	--
Discovery 11 - Proposals Due	May 2004	--
New Frontiers 2 - Concept Study Selection	July 2004	--

Theme: Solar System Exploration

Technology and Advanced Concepts

Schedule	FY 2005 President's Budget	Change from Baseline
Discovery 11 - Concept Study Selection	Oct. 2004	--
New Frontiers 2 - Downselect	May 2005	--
Discovery 11 - Downselect	June 2005	--
NRA Selections for RPS Concepts	1st Qtr. FY06	--
NRA Selections for RPS Breadboards	1st Qtr. FY06	--
Discovery 12 - AO Release	Aug. 2006	--
New Frontiers 3 - AO Release	Oct. 2006	--
Discovery 12 - Proposals Due	Nov. 2006	--
New Frontiers 3 - Proposals Due	March 2007	--
Discovery 12 - Concept Study Selection	April 2007	--
New Frontiers 3 - Concept Study Selection	Aug. 2007	--
Discovery 12 - Downselect	Dec. 2007	--
New Frontiers 3 - Downselect	June 2008	--
NRA Selections for RPS Concepts	1st Qtr. FY09	--
NRA Selections for RPS Breadboards	1st Qtr. FY09	--
Discovery 13 - AO Release	Feb. 2009	--
Discovery 13 - Proposals Due	July 2009	--

ACQUISITION STRATEGY AND PERFORMING ORGANIZATIONS

Major acquisitions in FY 2003 included a selection for the Next Generation Ion Engine for the ISPP program. In FY 2003, direct procurement represented 100% of budget authority. Changes since FY 2004 President's Budget: none.

Current Acquisition	Actual*	Selection Method	Actual*	Performer	Actual *
Cooperative Agreement	0%	Full & Open Competition	74%	Industry	12%
Cost Reimbursable	79%	Sole Source	26%	Government	15%
Fixed Price	2%		100%	NASA Intramural	0%
Grants	0%			University	62%
Other	19%			Non Profit	11%
*As of FY 2003 direct procurement	100%	*As of FY 2003 direct procurement		*As of FY 2003 direct procurement	100%

Future Acquisition	Selection	Goals
New Frontiers 2	May 2005	100% Full & Open Competition
Discovery 11	June 2005	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. NASA is currently working on a Memorandum of Agreement with the Department of Energy regarding nuclear systems work. Changes since FY 2004 President's Budget: None.

INDEPENDENT REVIEWS

Review Types	Performer	Last Review Date	Next Review Date	Purpose
ISPP: Independent Technology Assessment	SSE Subcomm. Tech. Assessment	7/03	7/04	Evaluate and prioritize ISPP technologies

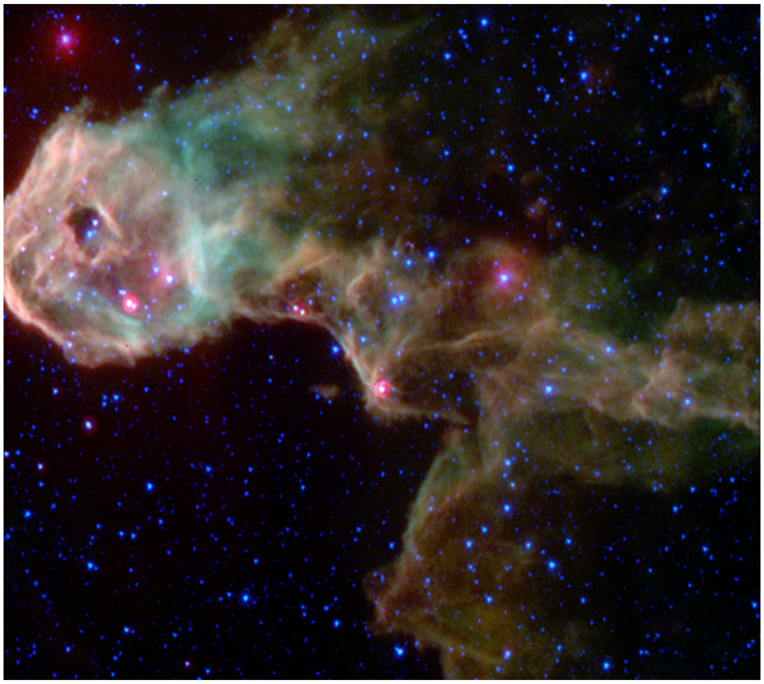
Theme: Solar System Exploration
Technology and Advanced Concepts

BUDGET

Budget Authority ($ millions)	FY 2003	FY 2004	FY 2005	Comments
FY2005 PRESBUD	173.5	391.6	333.7	
In-Space Power and Propulsion Program (ISPP)	86.9	76.5	163.6	ISPP Includes Radioisotope Power Systems work (previously included with Project Prometheus)
X-2000	15.0			
Future Discovery Pre-Development	6.6	34.1	48.7	
Future New Frontiers		12.6	100.7	
Other	8.8	10.7	8.2	
Project Prometheus	56.1	257.7		Reflects transfer of Project Prometheus to Exploration Systems Enterprise
Jupiter Icy Moons Orbiter Payload			12.5	
Changes since 2004 PRESBUD	-72.6	-158.8		Pluto was moved in its entirety to Development
In-Space Power and Propulsion Program	+24.4	+1.5		
X-2000	-15.0	-10.9		
Future Discovery Pre-Development	-6.5	+10.1		
Future New Frontiers	-15.0	-117.6		
Other	+8.8	+10.7		
Project Prometheus	+56.1	+257.7		
Optical Communications		-31.2		Transferred to Mars Exploration Theme
Nuclear Power	-79.0	-55.7		
Nuclear Propulsion	-46.5	-130.9		
JIMO		-92.6		
FY2004 PRESBUD	246.1	550.4		
In-Space Power and Propulsion Program	62.5	75.0		
Optical Communications		31.2		
X-2000	30.0	10.9		
Future Discovery Pre-Development	13.1	24.0		
Future New Frontiers	15.0	130.2		
Nuclear Power	79.0	55.7		
Nuclear Propulsion	46.5	130.9		
JIMO		92.6		

Indicates changes since the previous year's President's Budget Submit

Indicates budget numbers in full cost.

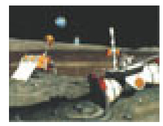


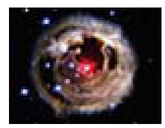
NASA's Spitzer Space Telescope (SST), launched in August 2003, has captured a glowing stellar nursery within a dark globule that is opaque to visible light. Located at a distance of 2,450 light years from Earth, the globule is a condensation of dense gas that is being compressed by the wind and radiation from a nearby massive star. Within the globule, newly discovered protostars are easily discernable as the bright red-tinted objects. This composite image is a product of SST's highly sensitive infrared camera multiband imaging photometer. More information can be found at: http://spacescience.nasa.gov/.

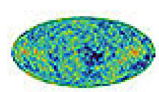
THEMES

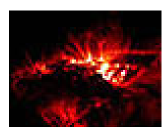

Solar System Exploration


Mars Exploration


Lunar Exploration


Astronomical Search for Origins


Structure and Evolution of the Universe


Sun-Earth Connection

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, evidence about how the Sun affects Earth, 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.

Enterprise: Space Science

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?

Now, in support of the President's new vision of space exploration, orbiting observatories and planetary probes will be joined by human explorers in seeking answers to these questions. Robotic scouts will blaze the trail, reconnoitering the planets, moons, asteroids, and comets of the solar system in advance of human expeditions, as observatories monitor the sun and its effects on its planetary retinue. The Space Science Enterprise will work with the new Exploration Systems Enterprise to develop and deploy new technologies, first on automated spacecraft and then on human missions.

FY 2003 Accomplishments

The Spitzer Space Telescope (SST, formerly the Space Infrared Telescope Facility), the fourth and final Great Observatory, was launched and began science operations. Spitzer is the largest infrared telescope ever launched into space. Its highly sensitive instruments allow us to peer into regions of space that are hidden from optical telescopes. Many areas of space are filled with vast, dense clouds of gas and dust that block our view. Infrared light, however, can penetrate these clouds, allowing us to see into regions of star formation, the centers of galaxies, and newly forming planetary systems.

The Wilkinson Microwave Anisotropy Probe (WMAP) provided some of the most important scientific results in modern astronomy. The WMAP science team constructed the first detailed full-sky map of the oldest light in the universe. WMAP data have determined the age of the universe to an unprecedented level of accuracy: 13.7 billion years. These data have also shown that the first stars ignited 200 million years after the Big Bang, provided new evidence that the universe is expanding at an increasing rate, and determined that the universe is composed of 4% conventional matter, 23% cold dark matter, and 73% dark energy.

"Spirit" and "Opportunity," the twin Mars Exploration Rovers, were successfully launched in the summer of 2003. On January 3, 2004, Spirit landed safely on Mars and has since begun to explore the planet; Opportunity followed on January 25. The rovers, working as robotic field geologists, will examine two sites offering a balance of favorable conditions for safe landings and interesting science: Gusev Crater and Meridiani Planum. At both sites the rovers will examine rocks and soils that could hold clues to the wet environments of Mars' past. Scientists will assess the data to determine whether those environments may have been conducive to life.

Additional FY 2003 accomplishments include the successful launch of the Galaxy Evolution Explorer (GALEX), an orbiting space telescope that will observe galaxies in ultraviolet light across 10 billion years of cosmic history; the confirmation of the oldest known planet by the Hubble Space Telescope; and the detection of regions of magnetic field concentration (which lead to sunspots) on the far side of the Sun by the Solar and Heliospheric Observatory through a new technique called helioseismology. Since sunspots are sites of catastrophic solar activity that sometimes affect the Earth, this new technique allows for early detection of events that may interfere with power and communications systems.

On September 21, 2003, the Galileo spacecraft plunged into Jupiter's atmosphere, ending an historic mission that circled the solar system's largest planet 34 times. Galileo was the first mission to measure Jupiter's atmosphere with a descent probe and the first to conduct long-term observations of the Jovian system from orbit. The spacecraft was purposely put on a collision course with Jupiter to eliminate any chance of an unwanted impact between the spacecraft and Jupiter's moon Europa, which Galileo discovered is likely to have a liquid subsurface ocean.

Theme Distribution

Budget Authority ($ in millions)	FY 2003	FY 2004	FY 2005
Solar System Exploration	1,039.1	1,315.9	1,187.0
Mars Exploration	500.4	595.1	690.9
Lunar Exploration	0.0	0.0	70.0
Astronomical Search for Origins	685.3	898.8	1,066.8
Structure and Evolution of the Universe	402.0	406.0	377.7
Sun-Earth Connection	479.7	755.4	745.9
Institutional Support	424.1	--	--
Total	3,530.6	3,971.2	4,138.3

Note: For all formats, the FY 2003 column reflects the FY 2003 Congressional Operating Plan, dated 9/04/03. The FY 2004 column reflects the FY 2004 Conference committee report. The FY 2005 column represents the FY 2005 President's Budget Submit.

Indicates budget numbers in full cost

Solar System Exploration

This theme seeks to understand how our own solar system formed and evolved, and whether there might be life in the solar system beyond Earth. In support of the President's new vision of space exploration, the robotic spacecraft dedicated to answering these questions will serve as trailblazers for the future human exploration of the solar system. 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 2005 include:

Overall Budget

FY 2005 request is $1,187 million, a $129 million or 10 percent decrease from the likely enacted FY 2004 budget:

- $210 million for three missions in development: the Dawn mission to orbit two asteroids, the Deep Impact mission to probe below the surface of a comet, and the New Horizons mission to Pluto and the Kuiper Belt.
- $164 million for an In-Space Power and Propulsion program, which includes an effort to develop a new radioisotope power system to enable greatly extended mission lifetimes.
- $75 million for Astrobiology research to improve the ability to find and identify life on other planets.
- $261 million for operation of the Deep Space Management System.
- A decrease of $438 million from the transfer of most elements of Project Prometheus to the new Exploration Systems Enterprise.

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 will be critical for future human exploration. The FY 2005 program includes multiple efforts to build upon the recent success of the Mars Exploration Rover program.

Overall Budget

FY 2005 request is $691 million, a $96 million or 16 percent increase over the likely enacted FY 2004 budget:

- $104 million for development of 2005 Mars Reconnaissance Orbiter, an orbiter that will map Martian surface features as small as a basketball (20-30 cm).
- $103 million for the 2007 Scout Mission, called Phoenix, a competitively selected mission to land on the Martian plains and analyze surface and subsurface samples of water and ice.
- $175 million for 2009 Mars Science Laboratory, 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.
- $25 million for the 2009 Mars Telesat Orbiter (MTO), a multi-band (X-, Ka-, and UHF band) spacecraft that will provide communications relay support for assets at Mars. MTO will also provide entry, descent, and landing (EDL), and Mars orbit insertion (MOI) support for the 2009 Mars Science Laboratory.
- $56 million for an optical communication technology demonstration, which will help develop technology to increase communication data rate and improve the cost-per-bit of data returned. This technology will be demonstrated on the 2009 MTO.
- An increase of $63 million in FY 2005 ($1,311 million over five years, a 192% increase) to prepare for the next decade of Mars research missions by investing in key capabilities to enable advanced robotic missions, such as returning geological samples form Mars or drilling under the surface of the planet. In the next decade, NASA will launch precursor missions to Mars to test new technologies that will be key to enabling future human missions. These robotic flights will obtain critical data for human missions on chemical hazards, resource locations, and research sites, and they may prepare resources and sites in anticipation of human landings.

Lunar Exploration

The Lunar Exploration (LE) Theme will undertake lunar exploration activities that enable sustained human and robotic exploration of Mars and other bodies in the solar system, through the development of new approaches, technologies, and systems. The major focus of the LE Theme will be demonstrating capabilities to conduct sustained research on Mars as well as deeper and more advanced explorations of our solar system. The specifics of lunar missions and systems will be driven by the requirements of future human and robotic explorations of Mars and other solar system destinations, as well as by research results from ongoing robotic missions to Mars and other bodies in the solar system. Lunar missions will also pursue scientific investigations on the Moon, such as uncovering geological records of our early solar system. Robotic lunar missions will begin in 2008, with human lunar missions following as early as 2015.

OVERALL BUDGET

FY 2005 request is $70.0 million (full cost).

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 of life that might be detectable from Earth. 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 2005 include:

OVERALL BUDGET

- FY 2005 request is $1,067 million, a $168 million or 19 percent increase over the likely enacted FY 2004 budget:
- $37 million for Hubble Space Telescope operations, as well as funding for a robotic mission to safely deorbit the telescope when it ends operations.
- $318 million for development of James Webb Space Telescope planned for launch about 2010 and promising to build on the legacy of Hubble Space Telescope.
- $155 million for development of Space Interferometry Mission planned for launch in late 2009 to detect planets around other stars.

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. Highlights for FY 2005 include:

OVERALL BUDGET

- FY 2005 request is $378 million, a $28 million or 7 percent decrease from the likely enacted FY 2004 budget:
- $103 million for development of Gamma-ray Large Area Space Telescope (GLAST), a mission to study high-energy objects like black holes.
- $31 million for continued technology development for two missions: Laser Interferometer Space Antenna (LISA) and Constellation-X. 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. As a result of the reprioritized agency activities, the budgets for Con-X and LISA have been reduced; impacts to these programs and their launch dates will be fully assessed as part of the development of the FY 2006 budget.

Sun-Earth Connection

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 2005 include:

OVERALL BUDGET

- FY 2005 request is $746 million, a $10 million or 1 percent decrease from the likely enacted FY 2004 budget:
- $232 million for development of STEREO and Solar Dynamics Observatory.
- $47 million for future flight missions in the Living With a Star program.

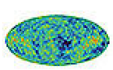
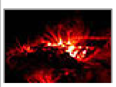
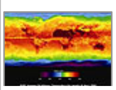
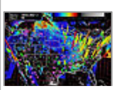
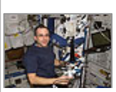
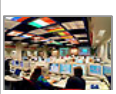
A Note on Mission Operations and Data Analysis

In a flight project, the work covered under Mission Operations (MO) and Data Analysis (DA) includes: communicating with the spacecraft; control center and flight operations team activities; controlling spacecraft orbit and attitude; level-0 data processing; project management and administration; science planning (including commanding individual instruments mounted on the spacecraft); spacecraft and instrument engineering; science data processing, validation, distribution, and archiving; science data analysis; the publication and presentation of science results; and the conduct of education and public outreach activities.

Beginning in FY 2005, the Space Science Enterprise will combine the MO budget lines of many of its flight projects with their counterpart DA lines. This will be done, in part, because many of the activities noted above could be considered either MO or DA (e.g. project management and administration, science planning/instrument commanding, instrument engineering, level-0 processing). In addition, since the project science team usually manages both MO and DA activities, tracking them as though they were separate lines of work is inefficient, and affords managers less flexibility in allocating resources where they are most needed during the operational phase of a mission.

Certain missions with extended cruise phases (where operations can be readily distinguished from data analysis) and/or significant operations funding will retain their current MO lines. Examples of space science missions that will continue to use their MO lines include: all Mars Exploration missions; all Great Observatories (i.e. Hubble Space Telescope, Chandra X-Ray Observatory, and Spitzer Space Telescope); the airborne Stratospheric Observatory For Infrared Astronomy (SOFIA); and “strategic” planetary missions (e.g. Cassini and New Horizons). In addition, funding for Multimission Operations, including the Deep Space Network, will be retained in MO. Please note that in the case of all other missions, the combination of MO and DA funding constitutes a zero-sum action that will not affect the missions’ lifecycle costs.

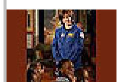
Appropriation Summary: Exploration, Science, and Aeronautics

Millions of Dollars	FY 2003 Op Plan 9/04/03	FY 2004 Conference Report	FY 2005 President's Budget
SPACE SCIENCE	**3,530.6**	**3,971.2**	**4,138.3**
 **Solar System Exploration**	1,039.1	1,315.9	1,187.0
 **Mars Exploration**	500.4	595.1	690.9
 **Lunar Exploration**	—	—	70.0
 **Astronomical Search for Origins**	685.3	898.8	1,066.8
 **Structure and Evolution of the Universe**	402.0	406.0	377.7
 **Sun-Earth Connection**	479.7	755.4	745.9
Institutional Support	424.1	—	—
EARTH SCIENCE	**1,716.8**	**1,613.2**	**1,485.4**
 **Earth System Science**	1,304.1	1,522.4	1,408.5
 **Earth Science Applications**	78.0	90.8	76.9
Institutional Support	334.7	—	—
BIOLOGICAL AND PHYSICAL RESEARCH	**882.6**	**985.2**	**1,048.6**
 **Biological Sciences Research**	268.6	368.0	491.5
 **Physical Sciences Research**	241.4	357.2	300.1
 **Research Partnerships and Flight Support**	170.0	260.0	257.0
Institutional Support	202.6	—	—

Note: For all formats, the FY 2003 column reflects the FY 2003 Congressional Operating Plan dated 9/04/03 (not in full cost). The FY 2004 column reflects the Conference Report in full cost. FY 2005 column is in full cost.

Indicates budget numbers in full cost.

Appropriation Summary: Exploration, Science, and Aeronautics

Millions of Dollars	FY 2003 Op Plan 9/04/03	FY 2004 Conference Report	FY 2005 President's Budget
AERONAUTICS	**1,004.4**	**1,034.3**	**919.2**
 **Aeronautics Technology**	599.1	1,034.3	919.2
Institutional Support	405.3	—	—
EDUCATION PROGRAMS	**198.6**	**226.3**	**168.5**
 **Education Programs**	198.6	226.3	168.5
TOTAL APPROPRIATION	**7,333.0**	**7,830.2**	**7,760.0**

Note: For all formats, the FY 2003 column reflects the FY 2003 Congressional Operating Plan dated 9/04/03 (not in full cost). The FY 2004 column reflects the Conference Report in full cost. FY 2005 column is in full cost.

Indicates budget numbers in full cost.

Overview

On January 14, 2004, President Bush established a new vision for U.S. space exploration that is bold and forward-thinking yet practical and responsible – one that seeks answers to longstanding questions of importance to science and society; develops revolutionary technologies and capabilities for the future; and genuinely inspires our nation, the world, and the next generation, while maintaining good stewardship of taxpayer dollars. The President's vision is documented in *A Renewed Spirit of Discovery, The President's Vision for U.S. Space Exploration*. To support the vision, NASA is simultaneously releasing the FY 2005 Congressional budget justification, the *FY 2005 Budget Estimates*, and another document, *The Vision for Space Exploration*, that links NASA's programs plans and the FY 2005 Budget request to the exploration vision. The material below provides a summary of both documents.

NASA's FY 2005 Budget request aligns with the goals set forth in *The President's Vision for U.S. Space Exploration* and provides a robust yet responsible five-year budget plan for achieving these goals. The programs supported by this budget will yield remarkable new scientific insights, stimulate American innovation, and inspire young and old alike, while supporting the Administration's goal of cutting the budget deficit in half within the next five years.

Policy Goals

The fundamental goal of the new exploration vision is to advance U.S. scientific, security, and economic interests through a robust space exploration program. In support of this goal, NASA, in cooperation with its partners in other Federal agencies, academia, the private sector, and the international community, will:

- Implement a sustained and affordable human and robotic program to explore the solar system and beyond;
- Extend human presence across the solar system, starting with a human return to the Moon by the year 2020, in preparation for human exploration of Mars and other destinations;
- Develop the innovative technologies, knowledge, and infrastructures both to explore and to support decisions about destinations for human exploration; and
- Promote international and commercial participation in exploration to further U.S. scientific, security, and economic interests.

Guiding Principles for Exploration

NASA does not undertake exploration merely for the sake of adventure, however exciting that may be. In pursuit of the exploration vision, NASA has identified six guiding principles:

Pursue Compelling Questions – Exploration of the solar system and beyond will be guided by compelling questions of scientific and societal importance. NASA exploration programs will seek profound answers to questions about the origins of our solar system, whether life exists beyond Earth, and how we could live on other worlds.

Across Multiple Worlds – NASA will make progress across a broad front of destinations, starting with a return to the Moon to enable future human exploration of Mars and other worlds. Consistent with recent discoveries, NASA will focus on possible habitable environments on Mars, the moons of Jupiter, and in other solar systems. Where advantageous, NASA will also make use of destinations like the Moon and near-Earth asteroids to test and demonstrate new exploration capabilities.

Employ Human and Robotic Capabilities – NASA will send human and robotic explorers as partners, leveraging the capabilities of each where most useful. Robotic explorers will visit new worlds first, to obtain scientific data, assess risks to our astronauts, demonstrate breakthrough technologies, identify space resources, and send tantalizing imagery back to Earth. Human explorers will follow to conduct in-depth research, direct and upgrade advanced robotic explorers, prepare space resources, and demonstrate new exploration capabilities.

For Sustainable Exploration – NASA will pursue breakthrough technologies, investigate lunar and other space resources, and align ongoing programs to develop sustainable, affordable, and flexible solar system exploration strategies.

Use the Moon as a Testing Ground For Mars and Beyond – Under this new Vision, the first robotic missions will be sent to the Moon as early as 2008 and the first human missions as early as 2015 to test new approaches, systems and operations for sustainable human and robotic missions to Mars and beyond.

Starting Now – NASA will pursue this Vision as our highest priority. Consistent with the FY 2005 Budget, NASA will immediately begin to realign programs and organization, demonstrate new technical capabilities, and undertake new robotic precursor missions to the Moon and Mars before the end of the decade.