COMMITTEE ON SCIENCE AND TECHNOLOGY
U.S. HOUSE OF REPRESENTATIVES

NASA's Fiscal Year 2011 Budget Request and Issues

Thursday, February 25, 2010

10:00 A.M. – 12:00 P.M.
2318 Rayburn House Office Building

Purpose:

On Thursday, February 25, 2010 at 10:00 am, the Committee on Science and Technology will hold a hearing on the National Aeronautics and Space Administration's (NASA) Fiscal Year (FY) 2011 Budget Request and Issues.

Witness:

Charles F. Bolden, Jr.
Administrator
National Aeronautics and Space Administration

BACKGROUND INFORMATION

Overview

The National Aeronautics and Space Administration (NASA), which was established in 1958, is the nation's primary civil space and aeronautics R&D agency. The estimated Civil Service Full-Time Equivalent (FTE) workforce level for FY 11 is 18,354. NASA has ten field Centers, including the Jet Propulsion Laboratory (JPL), a Federally Funded Research and Development Center (FFRDC). NASA conducts research and development activities in a wide range of disciplines including aeronautics, astrophysics, heliophysics, planetary science, Earth science and applications, human space flight, microgravity research, and technology development. NASA also operates a fleet of three Space Shuttles and is completing assembly of and operating/utilizing the International Space Station (ISS). NASA has also had a program underway to develop a new crew exploration vehicle and crew launch vehicle system to enable U.S. access to the ISS after the retirement of the Shuttle and to enable crewed missions beyond low Earth orbit, including working towards the goal of returning Americans to the Moon by 2020. NASA also maintains a space communications network that supports both NASA missions and other user requirements. As of fiscal year 2008, the most recent date for which complete data are available, about 83 percent of NASA's budget was for contracted work. In

addition, a number of NASA's scientific and human space flight activities involve collaboration with international participants.

The rollout of the President's FY 11 request for NASA included limited information, and the detailed budget justification document was not available to Congress until this past weekend. This hearing is intended to examine the key policy changes proposed in the budget request as well as issues raised by those changes. The Committee's Subcommittee on Space and Aeronautics plans to hold additional hearings to examine the Administration's request in more detail.

NASA Budgetary Information

NASA's proposed budget for FY 11 is $19 billion, an increase of 1.5 percent over the enacted FY 10 appropriation of $18.7 billion for NASA. Funding for NASA is projected to increase by an average of 2.5 percent per year from FY 12 through FY 15. Attachment 1 summarizes the FY 11 budget request and its five-year funding plan. Attachment 2 provides an overview on the extent to which the FY 11 budget proposal responds to the NASA Authorization Act of 2008 [P.L. 110-422]. It should be noted that in FY 09, the American Recovery and Reinvestment Act [P.L. 111-5] included $1 billion for NASA's Earth science, aeronautics, and exploration programs, cross-agency support, and Inspector General. Recovery Act funds are to be expended by September 30, 2010.

The structure of the accounts presented in the FY 11 budget request remains largely the same as in the FY 10 budget request with the exception of two changes. Pursuant to language in the Statement of Managers of the Consolidated Appropriations Act, 2010, the proposed NASA budget combines and organizes funding for repair or modification of NASA facilities, construction of new facilities, and managing of environmental clean-up from individual Directorates into a new account—Construction and Environmental Compliance and Restoration. In addition, the President's request for NASA adds a new advanced space technology initiative in an account with aeronautics research that is entitled, "Aeronautics and Space Research and Technology."

NASA and the Administration's Overall FY 2011 Budget Request

In the context of the overall Federal budget, NASA's average annual percentage of total budget authority from FY 1976 – FY2009 [which excludes the Apollo era], is 0.79 percent and the average annual percentage of total discretionary budget authority over the same time period is 2.05 percent. The percentage share of the budget devoted to NASA has declined from this average over the past ten years, and the FY 11 request for NASA would decrease NASA's share of total budgetary authority to 0.51 percent and its percentage of the total discretionary budget authority down to 1.50 percent. If one applies the 2.05 percent historical average to the total federal discretionary budget authority of $1.26 trillion in the Administration's FY 11 budget request, the result would be a NASA funding level in FY 11 of approximately $25.9 billion.

Key Changes and Initiatives from FY 10 Budget Proposal

Human Spaceflight

In its FY 10 Budget request, the Administration maintained the Congressionally-authorized policy of returning Americans to the Moon:

"*The Agency will create a new chapter of this legacy as it works to return Americans to the Moon by 2020 as part of a robust human and robotic space exploration program*."

The FY 11 request for NASA no longer maintains a return to the Moon as the next step in human spaceflight and exploration.

With regards to a post-Shuttle human launch system and commercial services for cargo and crew delivery to the International Space Station, the FY 10 budget request for NASA stated that "*Funds freed from the Shuttle's retirement will enable the Agency to support development of systems to deliver people and cargo to the International Space Station and the Moon. As part of this effort, NASA will stimulate private-sector development and demonstration of vehicles that may support the Agency's human crew and cargo space flight requirements*." In contrast, the FY 11 request for NASA "*funds NASA to contract with industry to provide astronaut transportation to the International Space Station as soon as possible, reducing the risk of relying solely on foreign crew transports for years to come*."

The FY 11 request for NASA proposes the following for NASA's human spaceflight activities:

- Cancels the Constellation Program and provides a total of $2.5 billion for FY 11 and FY 12 for close-out costs and contract termination;
- Initiates three new technology development lines within the Exploration Systems Mission Directorate focusing on:
    - Flagship Technology Demonstrations that have a stated goal of reducing costs and increasing capabilities for future exploration ($652 million in FY 11),
    - Heavy-lift and propulsion research and development ($559 million in FY 11), and
    - Robotic precursor missions described as being developed to identify potential locations for exploration and demonstrate technologies to increase safety ($125 million in FY 11);
- Invests $6 billion on the development of commercial human spaceflight over 5 years;
- Increases the Space Shuttle Program budget by $600 million in FY 11 to fund the safe completion of the Space Shuttle manifest into the first quarter of FY 11, if needed; and
- Provides an additional $429 million in FY 11 for "21st Century Space Launch Complex."

The FY 10 budget proposal stated that "*NASA will fly the Space Shuttle to complete the International Space Station …*" In addition, it said that "*NASA will continue to assemble and utilize the International Space Station, the permanently crewed facility orbiting Earth that enables the Agency to develop, test, and validate critical space exploration technologies and processes*." No mention was made of extending ISS operations. In its FY 11 request for NASA, the Administration proposes extending ISS operations and increasing utilization: "*The President's Budget provides funds to extend operations of the Space Station past its previously planned retirement date of 2016. …NASA will maximize return on this investment by deploying new research and test technologies in space and by making Space Station research capabilities available to educators and new researchers*."

Specifically, the FY 11 request for NASA's International Space Station Program includes:

- An increase of $463 million over the FY 10 enacted budget (and $231.6 million over the amount requested for the ISS in the President's FY 10 budget proposal) and an increase of $2 billion from FY 11- FY 14 as compared to the FY 10 budget request to be used for supporting the ISS National Laboratory and increasing Station capabilities, according to NASA's FY 11 budget overview materials.
- The FY 11 budget will cover the transportation costs to and from the ISS to support ISS research conducted by National Laboratory users. The previous plan was to require National Laboratory users to pay for their own transportation costs.

Science

The FY 11 request for NASA's Science Mission Directorate continues to make Earth science and climate change research a priority, following the emphasis placed on these areas in the Administration's FY 10 budget proposal. Key changes for NASA's Science programs include:

- A proposed increase of $300 million in FY 11 for Earth observations and climate satellites and research, largely for the reflight of the Orbiting Carbon Observatory (OCO), a scientific mission slated to monitor global carbon sources and sinks that was lost in a February 2009 launch failure;
- Requests funds to restart, in a cost-sharing arrangement with the Department of Energy (DOE), the production of plutonium-238 to support future exploration missions; and
- Initiates a high-priority solar probe mission.

Aeronautics

- Proposes increases of $73 million for FY 11 for aeronautics, which includes funding for NASA's Environmentally Responsible Aviation project.

Education

- Requests $20 million in FY 11 for new STEM education pilot projects.

Space Technology

- Requests $572 million in FY 11 to initiate a new agency-wide program to develop and test advanced space technologies.

PROGRAM AREAS

Human Space Flight

With its release of the FY 10 budget request for NASA, the Administration announced the establishment of an independent review of NASA's human space flight activities. In addition, the FY 10 budget request proposed a total cut of over $3 billion from NASA's Exploration Systems budget over five years, relative to the FY 2009 budget plan. The Administration indicated that an updated request would be forthcoming pending the outcome of the review. The Review of Human Spaceflight Plans Committee, chaired by retired Lockheed Martin executive Norman Augustine, delivered its final report in October 2009. The overarching conclusion of the review was that "*the U.S. human spaceflight program appears to be on an unsustainable trajectory*." The committee maintained that "*Meaningful exploration beyond low-Earth orbit is not viable under the FY 2010 budget guideline*" and that "*Meaningful human exploration is possible under a less-constrained budget, increasing annual expenditures by approximately $3 billion in real purchasing power above the FY 2010 guidance*." For FY 11, the President's request includes $4.3 billion for Exploration Systems, a reduction of $1.8 billion from the budget plan for Exploration in FY 11 that was included in the FY 10 budget request runout. The Administration's proposed plans for future human spaceflight activities were included as part of its FY 11 budget request for NASA. The FY 11 budget request includes limited details on the plans.

Constellation

As part of its request for Exploration, the Administration proposes to cancel the Constellation Program, which consists of the Ares I crew launch vehicle and Orion crew exploration vehicle, the Ares V heavy-lift launch vehicle, associated ground systems, and lunar systems. Constellation was the architecture established to deliver Americans to the ISS and later to the Moon and other destinations in the solar system following the retirement of the Space Shuttle. As of January 2010, NASA reported that it has spent a total of about $9 billion on Constellation. In the Statement of Managers accompanying the FY 10 Consolidated Appropriations Act, "*The conferees note that the Constellation program is the program for which funds have been authorized and appropriated over the last four years, and upon which the pending budget request is based. Accordingly, it is premature for the conferees to advocate or initiate significant changes to the current program absent a bona fide proposal from the Administration and subsequent*

assessment, consideration and enactment by Congress." The Statement of Managers also states that "*Funds are not provided herein to initiate any new program, project or activity, not otherwise contemplated within the budget request and approved by Congress, consistent with section 505 of this Act, unless otherwise approved by the Congress in a subsequent appropriations Act. Funds are also not provided herein to cancel, terminate or significantly modify contracts related to the spacecraft architecture of the current program, unless such changes or modifications have been considered in subsequent appropriations Acts*." Similar language was included in the Act itself.

The President's FY 11 request for NASA includes a total of $2.5 billion for FY 11 - FY 12 in "close-out costs" for Constellation and any additional costs for Shuttle transition. In its place, the President's request focuses on supporting the development of commercial capabilities to deliver crew to the ISS and on developing innovative, advanced technologies, among other proposed activities.

Some of the issues and questions raised by the proposal include the following:

- *In discussing the potential to use commercial services to transport crew to low-Earth orbit, the Augustine Committee report stated that "there are simply too many risks at the present time not to have a viable fallback option for risk mitigation." However, in proposing a major investment in the development of commercial crew capability, the FY 11 request does not include a fallback option. What is the rationale for the decision not to include a government-led crew transport system development program as a "fallback option"?*

- *The FY 11 budget request does not propose a concrete plan or mission for human exploration beyond low-Earth orbit or development of a heavy-lift launcher to enable such exploration. Therefore, in proposing commercial crew services for low-Earth orbit, the Administration in essence relinquishes U.S. government capability to send humans into space after the Shuttle is retired for the foreseeable future. What would be the implications of relinquishing the U.S. government capability to launch humans into low-Earth for the maintenance of specialized technical skills, facilities, industrial base capabilities, national security, global competitiveness, and geopolitical standing? To what extent were these issues considered in formulating the proposal to pursue commercial crew services?*

- *With the retirement of the Space Shuttle and the cancellation of all of the Constellation contracts occurring at the same time under the Administration's proposal, and the inevitable gap that will occur in the awarding of any new contracts for alternative activities due to the time required for such contracts to be developed, competed, and negotiated, what will the impact be on the aerospace workforce that had been working on Shuttle and Constellation? How many workers will be affected, and to what extent was disruption to the workforce considered in the formulation of the Administration's human space flight plans?*

- *What is the plan for the disposition of facilities constructed to support and develop the Constellation Program?*

- *What implications does the proposed cancellation of Constellation have for other Federal agencies, such as the Department of Defense's (DOD) space industrial base? To what extent were the Administration's plans for NASA's human space flight program vetted with other agencies such as DOD before a decision was made?*

Commercial Crew and Cargo

The request includes a total of $812 million in FY 11 and a total of about $6 billion for FY 11 – FY 15 for commercial space flight as part of NASA's Exploration Systems Mission Directorate funding. The total includes a request of $500 million in FY 11 for fostering the development of commercial companies to deliver crew to the ISS and proposes $312 million in FY 11 for "additional incentives" for NASA's existing Commercial Orbital Transportation Services (COTS) program, which is supporting commercial development of vehicles to deliver cargo to the ISS. According to NASA, no decisions have been made on whether NASA would use a Space Act Agreement or other mechanism to implement a commercial crew program. In addition, according to NASA officials, no decisions have been made on the cost-sharing, if any, that commercial companies would be required to contribute to a commercial crew development program; the level of safety requirements they would be expected to meet; or the level of non-government market the commercial business plans would be expected to support. NASA also is unable to provide at this time a timetable for when NASA would have a demonstrated capability from potential commercial providers that would allow the agency to actually procure commercial crew services to low-Earth orbit.

To provide the full scope of NASA's current and proposed support for commercial spaceflight activities, NASA's Space Operations Mission Directorate awarded Commercial Resupply Service (CRS) contracts in December 2008 valued at a total of about $3.5 billion to provide commercial cargo services to the International Space Station. The awards were made to Space Exploration Technologies (SpaceX) and Orbital Sciences Corporation in advance of any demonstrated capability by the companies to actually deliver cargo to the ISS. In addition, NASA plans to support a Commercial Reusable Suborbital Research (CRuSR) project to "*competitively secure flight services for experimental payloads supporting NASA's objectives in science, technology and education*" according to NASA's Fiscal Year 2011 Budget Estimates book. At present, no commercial reusable suborbital launch vehicle services are in existence. NASA plans to support commercial spaceflight as part of its Facilitated Access to the Space Environment for Technology Development and Training (FAST) project, which "*provides opportunities for emerging technologies to be tested in the space environment thereby increasing their maturity and the potential for their use in NASA programs and in commercial applications*" according to NASA's Fiscal Year 2011 Budget Estimates book. "*The FAST project promotes the growth of emerging commercial space services by employing competitively selected private reduced gravity flight services*."

Some of the issues and questions raised by the commercial crew and cargo proposals include the following:

- *How was the estimate of $6 billion for development of commercial crew derived?*
- *What is the basis for cost savings assumed to be accrued from commercial crew services?*
- *What contingencies are in place should a commercial crew provider's business fail and shut down?*
- *On what basis does NASA estimate that commercial crew services will be available by 2016?*
- *What is the basis for proposing a $312 million "incentive" for the COTS program, given that the companies involved already have the incentive of a total of $3.5 billion for the follow-on contract? How will the proposed funding be used?*
- *Who assumes the liability for astronauts or researchers transported on commercial crew vehicles?*
- *In the absence of an alternative government system, what recourse will the government have if commercial crew vehicles are unable to attain the safety standard set by NASA?*
- *In the absence of an alternative government system, how will the pricing of the commercial crew transport services be set and enforced?*
- *How many jobs is NASA assuming will be created by the proposal to seek commercial crew services to support the ISS? What is the basis of those assumptions?*

Advanced Technology Development

The FY 11 budget request initiates three technology and R&D programs in the Exploration Systems Mission Directorate.

- Exploration Technology and Demonstrations Program
  The President's request proposes $652 million in FY 11 and a total of $7.8 billion to fund an "Exploration Technology and Demonstrations" program. The program will support Flagship Technology Demonstrations, projects at the level of $400 million to $1 billion over less than 5 years to demonstrate technologies such as in-orbit propellant transfer and storage, inflatable modules, and closed-loop life support systems, among other activities. The proposed program will also support an Enabling Technology Development Program to consist of smaller and shorter duration projects at the level of $100 million or less. Those projects are expected to be competitively selected and will demonstrate key technologies such as in-situ resource utilization and advanced in-space propulsion. NASA has indicated that it is developing a plan for the program. There are no details on how the projects would be prioritized or selected and what NASA would expect as "deliverables" for these projects. In addition, it is not clear at what point NASA would expect to have the capabilities in hand, based on the technology development programs, to

make a determination on a target, mission, plan and architecture for a human exploration mission beyond low-Earth orbit.

- Heavy-Lift and Propulsion Technology
  The proposed FY 11 budget for NASA's Exploration programs includes $559 million in FY 11 and $3.1 billion for the FY 11 – FY 15 period to support space launch propulsion technology research and development. NASA indicates that it intends to develop a new RD-180 class hydrocarbon rocket engine with funds from this account, but it has not yet articulated the requirement for such an engine. The projects may involve intra-governmental, commercial, academic and international partnerships.

- Exploration Precursor Robotic Missions
  The budget proposal requests $125 million in FY 11 and $3 billion over FY11 – FY 15 to develop and deploy robotic precursor missions to locations such as the Moon, Mars and its moons, Lagrange points and nearby asteroids. It is unclear how the missions, e.g., to Lagrange points, would differ from previous robotic spacecraft missions, or what the urgency of those missions would be in the absence of a timetable for human missions to those locations. According to NASA budget materials, the program will support missions costing $800 million or less.

Several issues and questions raised by the Exploration Technology and Development program proposals include the following:

- *What was the basis for the budget numbers proposed for these programs?*
- *What are the goals and milestones for technology development?*
- *In the absence of an overarching vision and concrete mission, how will these technologies be applied?*
- *In the absence of an overarching vision and concrete mission, what is the risk that technology development funds will be used to support other objectives?*
- *What are the requirements against which advanced technology developments will be conducted and what are the metrics to measure progress?*
- *NASA budget materials indicate that part of the purpose of these technology programs is to reduce the costs and increase the capabilities of space activities. How does NASA plan to establish metrics for the cost reductions to be accrued and the enhanced capabilities to be achieved? What are the criteria for success?*
- *The former robotic precursor program was conceived with lunar exploration in mind. How will the funding for the program be prioritized given the wide range of potential activities it will undertake?*
- *There is scientific interest in all of the potential targets the robotic precursor missions might explore. What is the role of the Science Mission Directorate (SMD) in this activity? To what extent will this program leverage SMD's long-term experience in robotics and the potential target areas listed?*
- *One proposed activity for the robotic precursor program is to land a robot on the Moon that can be remotely operated and that can transmit near real-time video*

from the Moon. What would be the justification for such a project when the Google Lunar X Prize, which is a private activity, has nearly identical objectives?

- *As NASA seeks to broaden its technology development programs and include participation, to some extent, from international partners, what are the challenges? To what extent will information security and International Traffic in Arms Regulations (ITAR) pose issues for the programs and how will NASA address those challenges?*

Space Shuttle

The proposed FY 11 budget request includes approximately $989 million for the Space Shuttle Program, an increase of about $600 million over that requested in FY 10 for the FY 11 Shuttle Program. The increases support the completion of the Shuttle manifest into the first quarter of FY 11, if necessary. If the manifest is completed by the end of FY 10, NASA indicates that it will work with the Administration and Congress to prioritize use of the additional funds. Once the flights are completed, NASA will augment its work on transition and retirement of the Shuttle.

Under the Constellation Program, NASA was in the process of leveraging workforce synergies between Shuttle and Constellation and planned to transfer many Shuttle civil servants to Constellation. With the proposed shift in NASA's direction, the Shuttle Program will evaluate whether some of the Shuttle workforce could be tasked to new initiatives, including technology demonstration programs.

Some issues and questions related to the Shuttle Program include the following:

- *The 2009 Annual Report of the Aerospace Safety Advisory Panel notes that* "Successful workforce transition depends heavily on a decision being made about NASA's direction." *What steps is NASA taking to ensure the workforce remains focused on safely flying out the Shuttle manifest at a time when the proposed direction for NASA in the FY 11 request largely eliminates a government follow-on to the Shuttle and does not include funding for work on a heavy-lift launcher?*
- *The Augustine Committee noted the importance of maintaining critical workforce skills and capabilities such as the design and manufacturing of solid propellant motors. To what extent does NASA's proposed redirection affect those critical skill areas and what, if any, plans does NASA have to address this issue? To what extent is NASA identifying other skills used in the Shuttle and Constellation programs that should be preserved as critical national capabilities?*
- *How much time can lapse before the U.S. cannot access the critical skills needed to develop and operate a heavy-life vehicle?*
- *How will decisions be made on the disposition of Shuttle orbiters to external institutions? What are the criteria for those decisions?*

International Space Station

As part of its FY11 budget proposal for NASA, the Administration supports the extension and utilization of the ISS: "*The President's Budget provides funds to extend operations of the Space Station past its previously planned retirement date of 2016…NASA will maximize return on this investment by deploying new research and test technologies in space and by making Space Station research capabilities available to educators and new researchers*." To support the extension and increased utilization of the ISS, the Administration requests approximately $2.8 billion for the ISS in FY 11, an increase of about $463 million over that enacted in FY 10 and an increase of about $230 million from that projected for FY 11 in the FY 10 budget submission. The Augustine Committee, among other external advisory bodies, noted the importance of extending ISS operations and utilization. In addition, the NASA Authorization Act of 2008 directed NASA to "*take all necessary steps to ensure that International Space Station remains a viable and productive facility… through at least 2020.*" According to NASA officials, the decision to extend ISS operations is critical to the agency's ability to plan for utilizing the ISS National Laboratory, decision making and planning with international partners, and working to plan for future cargo transportation needs.

The NASA Authorization Act of 2005 designated the ISS a National Laboratory for use by the private sector and other Federal entities. According to NASA, up to 50 percent of ISS research capability may be available to support non-NASA users. NASA has engaged in National Laboratory partnerships with the National Institutes of Health and the Department of Agriculture. NASA has also entered into Space Act Agreements with private companies. Research that is ongoing or planned as part of the National Laboratory includes vaccine development, telemedicine, environmental testing among other research areas. Many of the systems and research being demonstrated are intended to have significant ground-based applications. The President's FY 11 request includes funding to pay for the transportation costs required to support National Laboratory user research on the ISS. This proposal represents a departure from the FY 10 plan, which was to require ISS National Lab users to cover their own transportation costs for accessing the ISS.

Several issues and questions related to the future of the ISS include the following:

- *What are the implications and contingencies for ISS utilization should the availability of commercial cargo transportation services be delayed considerably?*
- *How will internal NASA users – Exploration, Science, Space Operations – determine their own priorities?*
- *The NASA Authorization Act of 2008 directed NASA to "identify the organization to be responsible for managing United States research on the International Space Station..." A recent Government Accountability Office (GAO) report, "International Space Station: Significant Challenges May Limit On-orbit Research" also noted that other large research institutions include a research*

management entity. What are NASA's plans for a research management organization?

- *Who or what organization will determine the priorities for National Laboratory research conducted on the ISS as well as who gets access to available transportation capacity?*
- *The GAO also noted that "NASA's staff members in ISS fundamental science research areas have been decentralized or reassigned, limiting its capability to provide user support." What are NASA's plans for rejuvenating interest in ISS fundamental science research areas?*
- *In comparing NASA ISS with other major research laboratories and institutes, GAO found NASA's outreach to potential users limited. What are NASA's plans to enhance user outreach?*
- *Other issues relate to NASA's reliance on commercial cargo transportation service, e.g., to what extent do cargo providers understand user requirements and are they planning to meet them?*

21st Century Space Launch Complex

The President's proposal for FY 11 includes $429 million in FY 11 and a total of about $2.1 billion from FY 11- FY 15 for a 21st Century Space Launch Complex at Cape Canaveral [run by the USAF] and Cape Kennedy. To date, NASA has provided only limited details on what might be involved, the goals included in overview budget materials include increasing the operational efficiency of the Center and reducing launch costs for NASA and other launch site users, including commercial cargo service providers.

- *What was the process used to identify infrastructure at Cape Canaveral as a priority as opposed to another NASA facility?*
- *To the extent that funds are used to reduce launch costs for commercial cargo service providers, will those providers reduce their planned prices to carry government cargo or otherwise share in the cost of the improvements?*
- *What is the basis of the estimate of $429 million in FY 11 and $2 billion total to support the modernization?*
- *What is the basis of the requirement for the 21st Century Launch Complex in the wake of the proposed cancellation of the Ares launch vehicle programs?*
- *To what extent, if at all, has this proposed initiative been coordinated with DOD?*
- *What assumptions is NASA making about the outcomes from this project in terms of efficiency, throughput, cost savings, etc.?*
- *What are the priorities for spending the $429 million within the FY 11 year?*
- *What is the target completion date, and would there be any potential disruption or risk to ongoing launch services during the upgrade?*
- *When will detailed plans be available for this project?*
- *Why is this project not included in NASA's facilities and maintenance budget line and prioritized against other NASA facilities needs?*

Earth Science

The President's budget for FY 11 requests $1.8 billion for Earth science research, applications, Earth observing missions, education and outreach, and technology development, an increase of about $380 million over the FY 10 enacted budget. The run-out for FY 11- FY 14 proposed in the budget represents an increase of about $1.8 billion as compared to the FY 10 request's runout. According to the Budget of the U.S. Government Fiscal Year 2011, the budget proposal for Earth science "*accelerates the development of new satellites the National Research Council recommended as Earth Science priorities*" thereby continuing support for Earth science missions provided in the FY 10 request. The Administration's proposal also "*supports several research satellites currently in development, a campaign to monitor changes in polar ice sheets, and enhancements to climate models. In addition, the Budget provides funds for NASA to develop and fly a replacement for the Orbiting Carbon Observatory, a mission designed to identify global carbon sources and sinks that was lost when its launch vehicle failed in 2009*."

The FY 10 appropriation for NASA provided $15 million to continue studies of the second pair of Earth Science decadal survey missions—the Climate Absolute Radiance and Refractivity Observatory (CLARREO) and the Deformation, Ecosystem Structure, and Dynamics of the Ice (DESDnyl) mission to be implemented. Of the 15 missions recommended for implementation by NASA, two missions—the Soil Moisture Active-Passive (SMAP) and the Ice Satellite II (ICESat)—have entered the formulation phase, CLARREO and DESDnyl are in the concept study phase.

Other Earth Science Program Areas

The proposed FY 11 budget request includes increases through FY 14 for Earth Science technology to provide new and enhanced capabilities and measurements, for example, while the Multi-Mission Operations line remains essentially flat. Over the FY 11 – FY 15 budget horizon, the budget plan includes modest increases for NASA's Applied Sciences program involving the development of decision support tools that apply the research results of NASA's Earth science missions to support other Federal agency and institutional missions in the areas of climate, ecosystems, agriculture, water, disaster management and other areas that benefit society. How or to what extent NASA will use the Applied Sciences Program for decision support for stakeholders, especially in the area of climate change, is a potential issue to explore in the hearing.

National Polar-orbiting Operational Environmental Satellite System

In addition, the Administration's FY 11 budget proposes a major restructuring of the National Polar-orbiting Operational Environmental Satellite System (NPOESS) which was structured as an integrated tri-agency program to meet civil and military requirements for environmental data. The restructuring will involve dissolving the NASA-National Oceanic and Atmospheric Administration (NOAA)-DOD tri-agency Integrated Program Office and relegating responsibilities for portions of the program to

NOAA/NASA and DOD. The three agencies will continue to coordinate their roles in environmental satellite observations. NOAA and NASA would have responsibility for the afternoon orbit of the program in what is called the Joint Polar Satellite System. DOD would have responsibility for the early morning orbit and existing European and DOD assets would be expected to continue providing other coverage. NOAA would exercise its ongoing relationship with NASA to procure instruments and spacecraft bus elements. The NASA budget request for FY 11 does not include any budget impacts as a result of this restructuring, however the changes are expected to have implications for NASA as it assumes procurement responsibility for significant elements of the former NPOESS program.

Key Issues for Earth Science include the following:

- *In FY 10 the Administration requested increases of more than $1.2 billion over the FY 09 – FY 13 period, including Recovery Act funds, for "accelerating" Earth Science Decadal Survey and foundational Earth science missions. Where are we now and how much acceleration has been accomplished as a result of these investments? How much "acceleration" is the United States buying with the proposed FY 11 increases for decadal survey missions?*
- *To what extent are Decadal survey missions reflecting the scope of science identified in the Decadal survey and to what extent are measurements being included? Who has the "say" in determining the scope (which affects cost) of the Decadal survey missions?*
- *To what extent are the "foundational missions" making adequate progress toward meeting launch readiness dates?*
- *What are the implications of funding the OCO reflight for the plans for implementing Decadal survey missions? To what extent are groups discussing and planning to demonstrate the use of OCO data for verifying potential climate agreements that may be negotiated in the future?*
- *Does NASA plan to participate in NOAA's Climate Services initiative and if so, how? To what extent, if at all, will NASA's Applied Sciences program be involved?*
- *What are the implications of the NPOESS restructuring for NASA? Will NASA have sufficient acquisitions staff in place to manage the significant contracts for instruments and spacecraft buses that NASA will handle on behalf of NOAA?*

Space Science

The President's FY 11 budget requests $3.2 billion (not including Earth science) to fund NASA's space science programs, including Heliophysics, which seeks to understand the Sun and how it affects the Earth and the solar system; Planetary Science, which seeks to answer questions about the origin and evolution of the solar system and the prospects for life beyond Earth; and Astrophysics, which seeks answers to questions about the origin, structure, evolution and future of the universe and to search for Earth-like planets. The

FY 11 budget request for space science represents a decrease of about $44 million below the amount requested for space science in FY 10, and a reduction of about $171 million for FY 11- FY 14 from the projections in the FY 10 budget proposal. Over the FY 11-FY 14 period, the Astrophysics budget is increased by about $111 million, the Planetary Science program is reduced by approximately $57 million, and the Heliophysics budget decreases by about $225 million, as compared to the FY 10 budget projection for FY 11-FY 14. The FY 11 proposal also requests funds to move forward on the Solar Probe Plus mission, a high priority mission recommended in the National Research Council's decadal survey on solar and space physics.

During 2009, NASA's space science program launched Kepler, a mission to search for Earth-sized planets near distant stars, the Wide-field Infrared Survey Explorer (WISE), which will scan the sky in the infrared spectrum and also detect asteroids, the Lunar Reconnaissance Mission, which is mapping the lunar surface, the Lunar Observation and Sensor Satellite (LCROSS) that impacted a crater and confirmed the presence of water in the permanently shadowed crater. NASA also completed the fifth human servicing mission of the Hubble observatory since its launch in 1990.

The FY 11 budget proposal for NASA proposes to restart U.S. production of plutonium 238, which is needed to support power sources for deep space missions and other exploration activities. The U.S. ceased production of the Pu-238 material decades ago and has lately been purchasing the material from Russia. The availability of future Russian supplies, however, is highly uncertain. NASA's budget information does not include details on the roles and responsibilities of NASA and DOE or how much is being requested for NASA to support restarting Pu-238 production.

Key issues for space science include:

- *The availability and cost of launch vehicles are major factors in planning, designing and budgeting for space science missions. The cost of launch vehicles appears to be rising, the major medium-class workhorse-- the Delta II-- is no longer available for future missions, and excess ballistic missiles whose engines are used for a family of launchers are in limited supply. What are the implications of this situation for NASA's science program? What is NASA doing to address this situation?*
- *To what extent will the FY 11 budget plan give NASA flexibility to budget for new missions, especially those to be recommended in the NRC's astronomy and astrophysics and planetary science decadal surveys?*
- *The 2008 NASA Authorization Act directed the Administrator to "establish an intra-Directorate long-term technology development program for space and Earth science…for the development of new technology." The FY 11 request for NASA proposes new initiatives and major investments of several billion dollars for advanced technology, however, none of the new initiatives specifically responds to the Congressional direction. What is the rationale for not establishing an intra-Directorate technology program in SMD?*

- *In recent years, some of NASA's science missions have experienced considerable cost growth and schedule delays. To what extent, if any, has SMD considered any new approaches in types of spacecraft, instruments, or mission planning to help address issues related to cost growth?*
- *How, if at all, does SMD plan to participate in the Space Technology program? What types of technology developments would SMD see as candidates for the program? What does SMD believe will be its contributions to the Agency's emphasis on innovation?*
- *What, if any, implications does the proposed extension of the ISS have for SMD? What potential opportunities for science does the ISS extension make possible?*
- *What role, if any, does SMD envision playing in the precursor robotic program?*
- *What are the implications, if any, of the proposed cancellation of Constellation on SMD?*
- *What are the implications for SMD, if any, of the President's proposal to rely on commercial crew and cargo services to LEO?*
- *How much will NASA spend on plutonium-238 restart and what will it be used for? What are the roles, responsibilities, and cost-sharing between NASA and DOE for restarting plutonium 238? How sustainable is the funding over the out-years?*
- *The FY 11 request includes increases to detect asteroids that could pose hazards to Earth. How will those increases be used and to what extent will this funding help make progress on the congressional direction to detect, track, catalogue, and characterize 90% of near-earth objects 140 meters in diameter or larger?*

Aeronautics Research and Space Technology

For FY 11, NASA is requesting $1.51 billion for aeronautics and space research and technology of which about $580 million is requested for aeronautics and $572 million for a Space Technology budget line.

Aeronautics Research

NASA's aeronautics program has and continues to conduct fundamental and systems-level research to enable technical capabilities and economic benefits for the aviation industry and the nation. The goals of the program are 1) to carry-out advanced, cutting-edge research that will yield benefits for the aeronautics community and 2) to develop the concepts and enabling technologies that involve systems-level approaches.

The FY 11 proposal increases aeronautics by $73 million over the FY 10 enacted budget and by $300 million over the FY 11- FY 14 period as compared to the FY 10 budget projections.

The additional budget for aeronautics will support new initiatives that would augment NASA's contribution to the Next Generation Air Transportation System (NextGen). NextGen is a joint effort between the Federal Aviation Administration (FAA), NASA,

DOD, Department of Homeland Security and Department of Commerce that will transform the entire national air transportation system, gradually allowing aircraft to safely fly more closely, reduce delays, and provide benefits for the environment and the economy through reductions in carbon emissions, fuel consumption, and noise. Specifically the FY 11 proposal includes:

- An increase of $20 million to initiate a grants program as part of NASA's environmentally responsible aviation program,
- An increase of $20 million to support work on verifying and validating software-based systems, and
- An increase of $30 million to support issues related to incorporating unmanned aircraft systems in the national airspace.

Issues for Aeronautics Research include:

- *Is NASA's research and development program able to address important issues related to aviation's impact on the environment, e.g., noise, emissions, and energy consumption, under current funding levels?*
- *How effectively is NASA's aeronautics research and development program supporting the nation's NextGen initiative?*
- *How can NASA work more effectively with industry, universities and colleges to carry out a meaningful aeronautics research and development program?*

Space Technology Program

The FY 11 request proposes a new Space Technology Program, which is bookept under a programmatic line now called Aeronautics and Space Research and Technology. The request includes $572 million in FY 11, an amount that is projected to increase to over $1 billion in FY 12 and remain at that level through FY 15. In addition, the Space Technology Program aims to strengthen U.S. leadership in various research areas, and foster the development of future-oriented, long-term capabilities. The program will include the Innovative Partnerships Program (IPP), which was formally located within the Cross-Agency Support program. The Space Technology Program will expand partnerships with academia, industry, other Federal agencies and international institutions.

The establishment of a Space Technology Program responds to recent NRC reports, as well as the Augustine Committee report, that have called for reinvigorating NASA's role in advanced technology. The Subcommittee on Space and Aeronautics held a hearing to examine the results of NRC reviews and other issues regarding advanced technology development at NASA. The FY 11 budget request for the Space Technology Program does not include details on how NASA plans to implement the program, including what the milestones, criteria for success, and measures of progress will be.

Issues for Space Technology include:

- *What is the basis for the amount being requested for this program?*
- *To what extent does the absence of an overarching mission such as returning humans to the Moon affect the urgency, focus, and criteria for success for the space technology program?*
- *The FY 11 request provides several hundreds of millions of dollars (excluding the Innovative Partnership Program funding) in new money to be spent within the first year of the program's life. How realistic is it to assume that a new program in its first year of existence will be able to properly set priorities and goals, establish solicitations, vet the solicitations, and make selections in a manner that will efficiently and effectively spend those dollars?*
- *What plans and safeguards are needed to effectively double the size of the program after the first year?*
- *How are priorities for the projects to be established?*
- *Will all of the funding be competed and, if not, what proportion will be spent at NASA Centers?*
- *How is NASA defining "game-changing innovations"?*
- *NASA notes that the program seeks to increase the capability and affordability of space activities. In this regard, what is a reasonable contribution to expect from the projects this program will fund?*
- *To what extent has NASA considered whether cost-sharing or financial contributions will be part of the partnerships with commercial, other Federal agencies, or external institutions that it will be pursuing to conduct advanced technology development activities?*

Space Communications

The President's FY 11 budget requests $485 million for Space Communications and Navigation, about $54 million less than the amount projected for FY 11 in the FY 10 request and $32 million less than the enacted FY 10 budget. NASA has largely completed acquisitions to replenish aging Tracking and Data Relay Satellite (TDRS) spacecraft, which are used to support communications and tracking for the International Space Station (ISS), Space and Earth science missions, as well as other Federal government agencies. During the next year, NASA will determine whether or not it will procure an additional two TDRS spacecraft.

The FY 11 budget request includes plans for NASA's Space Communications and Navigation program to begin procuring 34 meter antennas as upgrades to the three 70 meter antennas that comprise the Deep Space Network (DSN). The DSN supports continuous communications to spacecraft in orbit. The DSN is 40 years old, many of its subsystems are obsolete, and the GAO has raised concerns about its fragility and continuing ability to service a mounting workload. The 34 meter antennas will be linked as an array. The Program's goal is to complete the 34 meter upgrades to the DSN by 2025. The existing DSN 70 meter dish located in Goldstone, CA includes a radar

capability that is critical for characterizing near-Earth objects and accurately determining their orbits. According to NASA officials, the requirements for the new 34 meter antenna array include the radar capability.

Issues for Space Communications include:

- *In light of proposed changes to NASA's exploration strategy which add robotic precursor missions, are NASA's long-range plans for modernizing its space network adequate to handle the higher workload?*
- *What is NASA doing to alleviate the aging of the infrastructure supporting the Deep Space Network?*

Education

The President's budget requests $145.8 million in FY 11 to support NASA's Education program. The request represents a reduction of about $38 million from the FY 10 enacted budget. The most notable change in the FY 11 request is the focus on using NASA's education programs to encourage innovation, including innovative approaches in STEM teaching and education through the use of NASA resources and content. As part of this theme, the President proposes a budget of $20 million in FY 11 to support the Summer of Innovation, a pilot project being launched in FY 10 to target at least 100,000 underperforming middle school students and to reach 5,000 STEM educators over the summer vacation and during other opportunities. The funds will be competed and managed through the Space Grant consortia.

In FY 10, NASA plans to introduce as a pilot project the redesign of the Explorer Schools project, which works with selected schools to deliver NASA content to middle and high school students, to provide professional development, and to increase student engagement and proficiency in STEM areas. The NASA Authorization Act of 2008 directed a review of the Explorer Schools project. The redesigned Explorer Schools project will be "*open to all secondary schools and will utilize current technologies in the delivery of opportunities and experiences to meet the needs of today's learning and learners,*" according to NASA's Fiscal Year FY 2011 Budget Estimates book. The President's FY 11 request proposes about $8 million each year for the FY 11 – FY 15 budget horizon.

In addition to the programs included in NASA's Office of Education, the Science Mission Directorate, the Aeronautics Mission Directorate, the Exploration Systems Mission Directorate, and the Space Operations Mission Directorate as well as the NASA Centers all fund educational projects. The Office of Education coordinates education activities across the NASA and its Centers.

Issues and questions related to the Education program include the following:

- *What will NASA tell students and America's youth about what it is doing and where it is going? How important is their response?*

- *What is the increase for the Summer of Innovation actually supporting and is there sufficient lead-time for NASA and institutions to effectively initiate the pilot project for the Summer of 2010?*
- *How will the results of the 2010 Summer of Innovation pilot projects guide spending decisions for the $20 million requested in FY 11?*
- *What are the implications of the proposed cancellation of the Constellation Program for NASA on its education programs and the ability to inspire youth to pursue STEM or space-related education and careers?*
- *Some of NASA's educational programs, projects, and student competitions directly reflect the goals of returning humans to the Moon, developing a new crew launch and exploration vehicle to get there, and potentially creating a lunar infrastructure. Does NASA have any plans to alter those projects to reflect the Agency's new direction?*
- *Students' decisions on education, studies, and potential careers, even in the pre-college years, may be shaped by their perceptions of long-term, concrete programs that will support them should they pursue a particular path. The President's FY 11 plans for human spaceflight do not specify a target, a timeline, or a particular program for human exploration beyond low-Earth orbit. Does this pose any risk of losing America's best and brightest students to other technical and scientific fields?*
- *NASA has long used visits to Shuttle launches as a means to inspire students and Americans in support of the nation's space program. What, if anything, will replace this unique opportunity for outreach?*

NASA Infrastructure: Construction and Environmental Compliance and Restoration

NASA's institutional investments are intended to ensure that facilities and field installations can meet the agency's mission requirements in a safe, secure and environmentally sound manner.

According to NASA's Fiscal Year 2011 Estimates book, "*Construction and Environmental Compliance and Restoration (CECR) provides for design and execution of discrete and minor revitalization construction of facilities projects, facility demolition projects, and environmental compliance and restoration activities.*

The Construction of Facilities (CoF) program ensures that the facilities critical to achieving NASA's space and aeronautics programs are the right size and type, and that they are safe, secure, environmentally sound, and operated efficiently and effectively. It also ensures that NASA installations conform to requirements and initiatives for the protection of the environment and human health.

The purpose of NASA's Environmental Compliance and Restoration (ECR) program is to clean up chemicals released to the environment from past activities. Cleanups are prioritized by NASA to ensure that the highest priority liabilities are addressed first in

order to protect human health and the environment and preserve natural resources for future missions."

NASA is requesting $397.3 million in FY 11 for Construction and Environmental Compliance and Restoration. Of that amount, about $335 million is for construction of facilities which provides for the construction, repair, rehabilitation, and modification of basic infrastructure and institutional facilities. Replacement and renewal projects replacing old, inefficient, and deteriorated buildings with energy efficient buildings will reduce utility usage. The remaining $62.1 million requested for FY 11 is for environmental compliance and restoration which provides the personnel, services, and activities necessary to complete the cleanup of hazardous materials and wastes that have been released to the surface or groundwater at NASA installations. These activities are mandated under a variety of federal and state environmental laws and regulations, as well as legally enforceable orders and agreements.

NASA has recently undergone a comprehensive review of its facilities and is developing plans to reduce and renew these critical assets. It is worth noting that NASA's estimate of backlogged facilities and maintenance requirements totals about $2 billion. So while projected budget requests for construction and facilities rise from FY 12 ($316.3 million) to FY 15 ($349.0 million), it is unlikely that such projected levels will appreciably reduce the backlog in the near future. The Aerospace Safety Advisory Panel's 2009 Annual report identifies NASA's aging infrastructure as an important issue:

"Over 80 percent of NASA facilities are beyond their design life, and annual maintenance is underfunded.1 Facilities continue to degrade and facilities failures are starting to impact missions and have safety implications Agency-wide. Evidence for this can be seen in the increasing number of small fires, key equipment losses through failures in material handling and transportation facilities, and in the "weak signals" that we observe in current safety reports. The infrastructure used to launch complex vehicles into space must be reviewed and maintained down to the smallest component to remain safe. In the past, one of NASA's goals was 'ten healthy Centers.' A considerable investment in facility maintenance, repair, and replacement is needed for this goal to be achieved. This may be unrealistic in the current economic climate. If funding is not available, NASA should consider consolidating its programs and efforts at fewer Centers so that its activities may be safely continued at the remaining facilities. This planning needs to be part of a conscious and deliberate facilities strategy."

In the 2008 NASA Authorization Act (P.L. 110-422, Section 1022), the Congress had expressed concern over the need for adequate maintenance and upgrading of NASA's facilities In that legislation, the NASA Administrator was directed to determine and prioritize the maintenance and upgrade backlog at each of NASA's Centers and associated facilities and "*develop a strategy and budget plan to reduce that maintenance and upgrade backlog by 50% over the next five years.*" The Administrator is to deliver those reports to Congress concurrent with the delivery of the FY 11 budget request; the Committee has not yet received these reports.

Issues and questions related to Construction and Environmental Compliance and Restoration include the following:

- *How long will it take NASA to reduce its maintenance and upgrade backlog? Does NASA have any plans to do so?*
- *Is the continued degradation of facilities impacting agency missions and the safety of these missions?*
- *Will NASA's proposed strategy for human exploration have any effect on its future environmental compliance and restoration responsibilities?*

Other Issues

Economic Impact of NASA Activities

NASA's workforce and technology developments have a broad impact on the economy and society. NASA's past programs have developed technologies that are being used in the timing signals on an automatic teller, for credit card verifications at the gas station, and for providing tools that help navigate us through traffic. NASA's Spinoffs 2009 report identifies several NASA-developed technologies that are spawning commercial products and services including:

- A NASA device that was developed to study cell growth in a simulated weightless environment that is used for medical research on treatments for heart disease and diabetes among other conditions;
- Scheduling software designed for the Hubble Space Telescope that is being used to help hospitals increase their efficiency in allocating capacity for imaging procedures; and
- Spacesuits with a sun-blocking fabric and cooling systems that are being modified for clothing to protect people with light sensitivities and people at the beach and who encounter sun exposure.

These products and services represent examples of how NASA-supported technologies and developments can be transitioned into products and services that contribute to a growing commercial space industry that is estimated at approximately $174 billion globally for 2008, according to The Space Report 2009.

In addition to stimulating commercial activity, NASA's challenging missions also lead to technological developments that make U.S. companies more competitive on a global basis and that enable companies to earn more work. At a Committee on Science and Technology hearing on the aerospace workforce and industrial base held in December 2009, one witness testified that "*It is no accident that the USA aerospace prime contractors and the hundreds of subcontractors have developed leadership positions on the vast majority of the relevant technologies. The NASA programs have clearly enabled USA companies to develop and maintain these leadership positions*." Some of the industrial base that NASA supports also serves U.S. national security programs.

NASA's scientific and technical jobs, like those of the broader aerospace industry, are highly skilled and well paid. NASA reports that it supports 45,000 work year equivalent contractors at or near its NASA centers. In addition, the Aerospace Industry Association, estimates that NASA indirectly supports 151,000 contractors. NASA also attracts the best and the brightest scientists and engineers. As one witness at the December 2009 Committee hearing on the aerospace workforce and industrial base who represented a NASA supplier company stated: "*NASA programs are really, really hard problems….What that does is attract the very best and the very brightest engineers, and bright engineers attract other bright engineers*."

Attachment 1

NASA's FY 2011 Budget Request

Budget Authority ($M)	FY 2009	ARRA	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015
Science	4,503.0	400.0	4,493.3	5,005.6	5,248.6	5,509.6	5,709.8	5,184.0
Earth Science	1,377.3	325.0	1,420.7	1,801.8	1,944.5	2,089.5	2,216.6	2,282.2
Planetary Science	1,288.1	0.0	1,341.3	1,485.7	1,547.2	1,591.2	1,630.1	1,649.4
Astrophysics	1,229.9	75.0	1,103.9	1,076.3	1,109.3	1,149.1	1,158.7	1,131.6
Heliophysics	607.8	0.0	627.4	641.9	647.6	679.8	704.4	750.8
Aeronautics and Space Research and Technology	500.0	150.0	507.0	1,151.8	1,596.9	1,650.1	1,659.0	1,818.2
Aeronautics Research	500.0	150.0	507.0	579.6	584.7	590.4	595.1	600.3
Space Technology	0.0	0.0	0.0	572.2	1,012.2	1,059.7	1,063.9	1,217.9
Exploration	3,505.5	400.0	3,779.8	4,263.4	4,577.4	4,718.9	4,923.3	5,179.3
Exploration Research and Development	0.0	0.0	0.0	1,551.4	2,577.4	3,318.9	3,623.3	3,979.3
Commercial Spaceflight	0.0	0.0	0.0	812.0	1,400.0	1,400.0	1,300.0	1,300.0
Constellation Transition	0.0	0.0	0.0	1,900.0	600.0	0.0	0.0	0.0
Constellation Systems	3,033.2	400.0	3,325.8	0.0	0.0	0.0	0.0	0.0
Advanced Capabilities	472.3	0.0	454.0	0.0	0.0	0.0	0.0	0.0
Space Operations	5,764.7	0.0	6,180.6	4,887.8	4,290.2	4,253.3	4,362.6	4,130.5
Space Shuttle	2,979.5	0.0	3,139.4	989.1	86.1	0.0	0.0	0.0
International Space Station	2,060.2	0.0	2,317.0	2,779.8	2,983.6	3,129.4	3,221.9	3,182.8
Space and Flight Support (SFS)	725.0	0.0	724.2	1,119.0	1,220.6	1,123.9	1,140.7	947.7
Education	169.2	0.0	183.8	145.8	145.8	145.7	145.7	146.8
Cross-Agency Support	3,356.4	50.0	3,095.1	3,111.4	3,189.6	3,276.8	3,366.5	3,462.2
Center Management and Operations	2,024.3	0.0	2,067.0	2,270.2	2,347.4	2,427.7	2,509.7	2,594.3
Agency Management and Operations	921.2	0.0	941.7	841.2	842.2	849.1	856.8	867.9
Institutional Investments	293.7	50.0	23.4	0.0	0.0	0.0	0.0	0.0
Congressionally Directed Items	67.2	0.0	63.0	0.0	0.0	0.0	0.0	0.0
Construction and Evironmental Compliance and Restoration	0.0	0.0	448.3	397.3	363.8	366.9	393.5	398.5
Construction of Facilites	0.0	0.0	381.1	335.2	316.3	319.5	344.6	349.0
Environmental Compliance and Restoration	0.0	0.0	67.2	62.1	47.5	47.4	48.9	49.5
Inspector General	33.6	2.0	36.4	37.0	37.8	38.7	39.6	40.5
NASA FY 2010	17,782.4	1,002.0	18,724.3	19,000.0	19,450.0	19,960.0	20,600.0	20,990.0
Year to Year Change			5.30%	1.50%	2.40%	2.60%	3.20%	1.90%

Source: NASA

Attachment 2

Responsiveness to NASA Authorization Act of 2008

The NASA Authorization Act of 2008 [P.L. 110-422] authorized policy and appropriations for Fiscal Year 2009. The FY 2011 budget request appears to be responsive to the 2008 NASA Authorization Act in a number of areas, but diverges markedly from other areas of policy direction in the Act. Areas where the budget reflects direction and priorities established in the 2008 Act include: support for NASA's Earth Science Decadal Survey missions; support for aeronautics R&D on "green aviation"; support for extension of the operation and utilization of the International Space Station to at least 2020; and funding for exploration-related technology development activities. In addition, the request provides initial funding, in combination with funds requested for DOE, for restarting the domestic production of plutonium-238. The Administration's request for FY 2011 diverges from the 2008 Act in its proposed cancellation of the Constellation Program and in its investment in the development of commercial crew human spaceflight vehicles as the only potential direct U.S. access to the International Space Station, following the retirement of the Shuttle. The 2008 Act had made clear that the Congressional intent for a congressionally authorized commercial crew initiative "*not come at the expense of full funding of the amounts authorized…and for future fiscal years, for Orion Crew Exploration Vehicle development, Ares I Crew Launch Vehicle development, or International Space Station cargo delivery*." In addition, while the FY 2011 request for NASA focuses heavily on advanced technology development, the request does not propose funding for advanced technology development within the Science Mission Directorate, as directed in the 2008 Act.