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**Statement of
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Administrator
National Aeronautics and Space Administration**

before the

**Committee on Commerce, Science and Transportation
United States Senate**

Mr. Chairman and Members of the Committee, thank you for the opportunity to appear today to discuss additional information about the President's FY 2011 budget request for NASA, following the President's important speech at the NASA Kennedy Space Center (KSC) in Florida. NASA is grateful for the support and guidance received from this Committee through the years and looks forward to working with you to implement the President's bold new direction for the Agency.

The President's FY 2011 budget request is good for NASA because it sets the Agency on a sustainable path that is tightly linked to our Nation's interests. The President recognizes that what is truly needed for beyond low-Earth orbit (LEO) exploration are game-changing technologies; making the fundamental investments that will provide the foundation for the next half-century of American leadership in space exploration. In doing so, the President has put forward what I believe to be the most authentically visionary policy for human space exploration that we have had since President Kennedy challenged NASA to send humans to the Moon and return them safely back to Earth. At the same time, under the new plan, we will ensure continuous American presence in space on the International Space Station (ISS) throughout this entire decade and likely beyond, re-establish a robust and competitive American launch industry, launch more robotic probes into our solar system as precursors for human activity, invest in a new heavy lift research and development (R&D) program, and build a technological foundation for sustainable, beyond-LEO exploration, with more capable expeditions in lunar space, and human missions to near-Earth asteroids, the Moon, Lagrange points, and, ultimately, Mars. NASA will embark on these transformative initiatives by partnering with the best in industry, academia and other government agencies, as well as with our international partners.

At the request of the Committee, today I will provide additional details about pending revisions to the President's FY 2011 budget request for NASA. I will discuss NASA's progress in developing plans for the new exploration initiatives included in the FY 2011 budget request, including initial planned program assignments for major programs by Center. Additionally, my testimony will provide additional detail about three significant updates that were announced by the President when he visited KSC on April 15, 2010. NASA is working expeditiously to provide specific budgetary details to reflect these updates and we will share them with this Committee and other Congressional stakeholders as soon as we are able.

President Obama Visits KSC

During his visit to KSC, the President articulated a strong commitment to NASA's mission and future U.S. human space exploration. The President also outlined an ambitious effort to foster the development of ground-breaking technologies; increase the number, scope, and pace of manned and unmanned space missions; make human spaceflight safer and more efficient; and help create thousands of new jobs. The President directed that NASA proceed to develop a crew rescue vehicle based on the Orion space-capsule to support emergency crew return requirements on the ISS, and providing a technological foundation for systems that can later take us beyond Earth's orbit. In addition to investing in transformative heavy-lift technologies, the President has called on NASA to select a basic rocket design, no later than 2015, and then begin to build it. The President also said that after decades of neglect, we will increase investment – right away – in other groundbreaking technologies that will allow astronauts to reach space sooner and more often, to travel farther and faster for less cost, and to live and work in space for longer periods of time more safely. And, the President laid out the goals and strategies in this new vision for NASA. Fundamentally, the exploration of space will be a sequence of deep-space destinations for human missions matched to growing capabilities, progressing step-by-step, beginning with crewed flight tests – perhaps a circumlunar mission -- early next decade of vehicles capable of supporting exploration beyond LEO, a human mission to an asteroid by 2025, and a human mission to orbit Mars and return safely to Earth by the 2030s. Finally, the President committed to providing \$40 million for workforce transition initiatives to aid Florida's Space Coast.

NASA expects to submit a revised FY 2011 budget request to the Congress in the near future that will identify funding requirements for the restructured Orion crew capsule as well as funding requirements and authorization for workforce transition for Florida and potentially other locations.

Restructuring the Orion Crew Capsule

Per the President's direction, we are going to build on the good work already completed on the Orion crew capsule and focus the effort to provide a simpler and more efficient design that would provide crew emergency escape from the ISS and serve as part of the technical foundation for advanced spacecraft to be used in future deep space missions. This approach also will preserve a number of critical high-tech industry jobs in key disciplines needed for our future deep space exploration program.

We have put together a formulation team including Headquarters and Center personnel to develop a baseline approach that meets these requirements, balanced with the other priorities proposed in the President's FY 2011 budget request. This team will report to me within three weeks on how best to meet these requirements.

I have directed the team to align this work so that it complements, and does not compete with, our commercial crew development effort. In this manner, we will simplify the requirements for potential crew service providers to the ISS by having the restructured Orion effort fulfill the important safety requirement of emergency escape system for astronauts on the ISS. I have also directed the formulation team to focus on innovative approaches to oversight, and believe that we can significantly reduce oversight requirements based on lessons learned in previous focused development flight programs. We must accomplish this activity more efficiently and effectively to maintain a healthy funding balance across our exploration priorities. And this will be done without reducing our commitment to safety for crew escape. The crew rescue mission has many fewer requirements than the deep space mission, providing design flexibility and reducing the system's lifecycle cost. Finally, the team must identify how this activity will align with the development efforts proposed in the Flagship Demonstration program as

well as our other technology efforts so that investments in these programs can be leveraged to the greatest extent possible.

The funding for this restructuring will come within NASA's top-line request released in February. The out year funding requirements will be refined as part of the President's FY 2012 budget submission.

Heavy-Lift Technologies

During his visit to KSC, the President specifically recognized the need for a heavy lift launch capability to carry humans beyond LEO by requiring a decision on a vehicle design no later than 2015. Such a decision would include setting performance goals, identifying lift capability and selecting the general vehicle design – work that will ultimately lay the path for launching a spacecraft for crewed missions into deep space.

The FY 2011 budget request includes funds for NASA to conduct the important R&D and analysis necessary to make an informed decision on a heavy-lift vehicle no later than 2015. This effort will primarily focus on the development of a U.S. first-stage hydrocarbon engine for potential use in future heavy lift (and other) launch systems, as well as basic research in areas such as new propellants, advanced propulsion materials manufacturing techniques, combustion processes, propellant storage and control, and engine health monitoring. Additionally, NASA will initiate development and testing of in-space engines. Areas of focus could include a liquid oxygen/methane engine and low-cost liquid oxygen/liquid hydrogen engines. This work will build on NASA's recent R&D experience in this area, and the test articles will be viewed as a potential prototype for a subsequent operational engine that would be re-startable and capable of high acceleration and reliability. These technologies will increase our heavy-lift and other space propulsion capabilities and significantly lower operations costs – with the clear goal of taking us farther and faster into space consistent with safety and mission success criteria. In support of this initiative, NASA will explore cooperative efforts with the Department of Defense and also develop a competitive process for allocating a small portion of these funds to universities and other non-governmental organizations. This research effort along with many of our new technology initiatives will be coordinated with the broader Agency technology initiative led by NASA's new Chief Technologist.

On May 3, 2010, NASA issued a Request for Information (RFI) seeking general information regarding potential launch or space transportation architectures (expendable, reusable, or a hybrid system) that could be utilized by multiple customers (e.g., NASA, commercial and other Government agencies). The RFI solicits information regarding propulsion system characteristics; technology challenges related to liquid chemical propulsion systems; as well as innovative methods to manage a heavy-lift development program to include effective and affordable business practices. The RFI is open to the broad space community, including commercial, other Government agencies and academia. Information obtained from the RFI will be used for planning and acquisition-strategy development for current heavy-lift planning activities, funded at a total of \$100 million in the FY 2010 Consolidated Appropriations Act (P.L. 111-117).

Assistance for the Florida Space Coast

The men and women who work in the Space Coast's aerospace industry are some of the most talented and highly trained in the nation. It is critical that their skills are tapped as we transform and grow the country's space exploration efforts. The 2004 decision to end the Shuttle means that approximately 6,000 jobs need to be transitioned into the new space strategy and related industries. Recognizing the concerns of our dedicated Shuttle workforce as they conclude this remarkable program and look forward to

transitioning to new work, the President has announced a \$40 million initiative to develop a plan for regional economic growth and job creation for the Florida Space Coast. On May 3, 2010, the President issued a Memorandum directing the establishment of the *Task Force on Space Industry Workforce and Economic Development*. The task force is charged with developing, in collaboration with local stakeholders, an interagency action plan to facilitate economic development strategies and plans along the Space Coast and to provide training and other opportunities for affected aerospace workers so they are equipped to contribute to new developments in America's space program and related industries. They will also explore future workforce and economic development activities that could be undertaken for affected aerospace communities in other States, as appropriate. The Secretary of Commerce and I will serve as Co-Chairs. Other team members will include: the Secretary of Defense; the Secretary of Labor; the Secretary of Housing and Urban Development; the Secretary of Transportation; the Secretary of Education, the Chair of the Council of Economic Advisors; the Director of the Office of Management and Budget; the Administrator of the Small Business Administration; the Director of National Intelligence; the Director of the Office of Science and Technology Policy; the Director of the National Economic Council; and the heads of other Executive agencies, as needed. As directed, the team will report its recommendations to the President by August 15. The \$40 million for this initiative will be taken from the funds requested for Constellation transition in the original FY2011 Presidential budget request.

This interagency group's recommendations will build on the Administration's ongoing efforts in the KSC region. The Department of Labor is already planning a pilot program to better assist the region's workers, including those highly-skilled workers who work in the aerospace industry, through efforts to establish one-stop local transition centers for affected workers where they can receive coordinated local, state, and federal workforce assistance tied to economic development efforts; and the designation of a single Federal point-of-contact for affected areas.

To further facilitate these efforts, the Department of Commerce's Economic Development Administration (EDA) is prepared to support a comprehensive economic adjustment strategy for the Kennedy Space Center economic region. With funding provided through NASA, the EDA will provide both financial and technical assistance to start implementing those plans and promote economic development in the region through such activities as infrastructure upgrades and improvements, entrepreneurial networks, and skill-training facilities and equipment. The exact mix of activities will depend on the recommendations and request of local entities across the region.

In addition, on April 30, 2010, the Department of Labor announced a \$1.2 million grant to assist approximately 200 workers affected by layoffs at ATK Launch systems in Corinne, Utah, in connection with the transition of the Space Shuttle and Constellation programs.

NASA Prepares to Implement the FY 2011 Budget Request

Pursuant to the President's proposed new course, NASA has initiated planning activities to be able to effectively and efficiently implement these new activities in a timely manner upon Congressional enactment of the FY 2011 budget. In April, NASA outlined for the Committee the Agency's planned major program assignments across the Agency's Centers for new or extended activities proposed as part of the President's FY 2011 budget request. These planned assignments build on the deep knowledge and expertise that NASA has built up over five decades, recognize the wealth of experience, commitment, and expertise resident at the NASA Centers, and expand upon the strengths at each Center.

I wish to emphasize that establishment of program offices and initiation of effort in support of new or extended activities for this proposed new work is contingent upon Congressional approval of the President's FY 2011 request for these activities. These planned program assignments will enable NASA

to engage workforce at the Agency's Centers in formulation activities for the array of program initiatives in Science, Aeronautics, Space Technology, Exploration, and Space Operations reflected in the President's FY 2011 request. While we will be developing details on the specific numbers of employees at our Centers that will be assigned to new program offices and activities, these planned assignments are intended to provide the Committee additional detail regarding the depth and scope of the President's FY 2011 proposed budget plan.

Planned major program assignments for elements contained in the FY 2011 budget, by Center, follow:

- Johnson Space Center, Texas
 - Exploration/Flagship Technology Demonstrations, Manager
 - Exploration/Commercial Crew Development, Deputy Program Manager
 - Exploration/Commercial Cargo Development, Manager
 - Exploration/Human Research, Manager
 - ISS, Manager
- Kennedy Space Center, Florida
 - Exploration/Commercial Crew Development, Manager
 - Space Operations/21st Century Launch Complex, Manager
 - Exploration/Flagship Technology Demonstrations, Deputy Program Manager
 - Space Shuttle/Completion of Manifest, Manager
- Marshall Space Flight Center, Alabama
 - Exploration/Heavy Lift and Propulsion R&D, Manager
 - Exploration/Robotic Precursor Program, Manager
 - Space Technology/Crosscutting Capability Demonstrations/Technology Demonstration Missions, Manager
 - Space Technology/Centennial Challenges Program, Manager
- Stennis Space Center, Mississippi
 - Exploration/Heavy Lift and Propulsion R&D, First Stage and Upper Stage Rocket Testing
 - Exploration/Commercial Crew Development, Engine Testing for Commercial Vehicles
- Glenn Research Center, Ohio
 - Exploration/Exploration Technology Development and Demonstration, Manager
 - Space Technology/Early Stage Innovation/Research Grants
 - Aeronautics Research/Integrated Systems Research Program, support
- Langley Research Center, Virginia
 - Space Technology/Game Changing Technology/Game Changing Development, Manager
 - Climate Initiative: SAGE III; CLARREO (managed jointly with Goddard); Venture Class
 - Aeronautics Research/Integrated Systems Research Program and Airspace Systems Program, support
- Dryden Flight Research Center, California
 - Space Technology/Crosscutting Capability Demonstrations/Flight Opportunities, Manager
 - Aeronautics Research/Integrated Systems Research Program and Airspace Systems Program, support
- Ames Research Center, California
 - Exploration/Precursor Robotic Missions/Exploration Scouts, Manager
 - Space Technology/Game Changing Technology/Small Satellite Subsystem Technologies, Manager
 - Space Technology/Crosscutting Capability Demonstrations/Edison Small Satellite Demonstrations, Manager
 - Aeronautics Research/Integrated Systems Research Program and Airspace Systems Program, support

- Goddard Space Flight Center, Maryland
 - Joint Polar Satellite System (restructuring NPOESS), procurement structure modeled after past successful programs
 - Climate Initiative: ICESat-2; CLARREO (managed jointly with Langley); DESDynI (managed jointly with Jet Propulsion Laboratory); Earth Systematic Missions Program.
- Jet Propulsion Laboratory, California
 - Climate Initiative: SMAP; DESDynI (managed jointly with Goddard); GRACE, OCO-2.

Following the release of the FY 2011 budget request, NASA established study teams within the Exploration Systems Mission Directorate (ESMD) to ensure we understand the steps (and the implications of those steps) that would need to be taken for an orderly transition of the Constellation Program and to plan for the implementation of the new initiatives in the Exploration program. The work undertaken by these teams is a necessary part of that planning. Following is a brief summary of the additional details developed for each initiative, as “point of departure” plans to support FY 2011 budget implementation, once the budget is approved. Please note these are preliminary ESMD plans that may need to be modified following finalization of Agency plans regarding the restructuring of the Orion crew capsule.

- **Flagship Technology Demonstrations:** The next generation of capabilities key to sustainably exploring deep space will be demonstrated through four proposed missions: advanced space propulsion in 2014, in-space propellant and fuel transfer in 2015, light weight/inflatable modules in 2016, and aero-assist in 2017. Autonomous operations and advanced life support capabilities will also be tested on these missions. Detailed definition of each mission’s content is currently under way.
- **Heavy Lift and Propulsion Technology:** Planned technology investments will lead to a demonstration of an in-space engine in 2015, development of a first stage propulsion system by 2020, and maturing other foundational propulsion technologies to support a heavy lift vehicle decision in the 2015 timeframe. NASA’s efforts will be primarily focused on a LOX/RP first stage and either a LOX/methane or LOX/hydrogen in-space engine. Additional research will be dedicated to analysis and trades regarding fuel types, performance requirements, and vehicle architectures.
- **Exploration Robotic Precursors:** A series of annual exploration robotic precursor missions is being planned, beginning with launch of a Near-Earth-Orbit (NEO) mission in 2014, followed by a lunar lander in 2015, and two Mars missions in 2016 and 2018, respectively. In addition, smaller robotic scout missions will be launched every 12-18 months to support reconnaissance, evaluate hazards, and develop systems and operations in support of future human exploration.
- **Enabling Technology Development and Demonstration:** Enabling technology will advance fundamental technologies in 10 portfolio areas that will lead to ground and flight demonstrations in lunar volatiles, high power electric propulsion, autonomous precision landing, human exploration tele-robotics, fission power systems, and other areas. The flight demonstrations will be done as part of flagship demonstrations, robotic precursor missions, or utilizing the ISS, ground tests and analogs.
- **Human Research:** Through research and technology development, the goal of the Human Research Program is to reduce the highest risks to crew health and performance for space exploration missions. Increased investments will be made in the fields of biomedical technology, space radiation research, and behavioral health research. There are also plans to make increased use of the ISS facilities.
- **Commercial Crew:** NASA is continuing to define plans to expedite and improve the robustness of ISS crew and cargo delivery. In addition, NASA is developing a plan that supports the development of commercial crew transportation providers to whom NASA could competitively award crew transportation services. Solicitations for commercial crew transportation development will provide opportunities for both established and traditional aerospace companies as well as emerging

entrepreneurial companies. Related to this activity, this summer, NASA plans to release a Request for Information to seek industry feedback on our human rating requirements. .

- **Constellation Transition:** The team is leveraging expertise from across the Agency to develop a rapid and cost effective ramp-down plan that will free the resources required for new programs. As part of the early characterization and integrated planning effort, this team has initiated a broad survey of current workforce, contracts, facilities, property, security, knowledge capture, information technology, and other government agency interface issues to determine what infrastructure and hardware could be used by the new programs and projects. The transition plan will outline three phases as part of an action plan for initial deliverables: Near-term actions, transitioning of Constellation elements, and transition of assets/resources to new Exploration focus areas and other NASA programs, where appropriate.

NASA is taking prudent steps to plan for the new initiatives included in the FY 2011 budget request, including Requests for Information (RFI), workshops, and preliminary studies. NASA is eager to receive external input from industry, academia, and other partners, and is accomplishing this via a series of RFIs and industry workshops conducted this spring and into the summer. Doing so will ensure that NASA receives important feedback from our space partners before it begins to finalize its implementation plans for the new technology demonstrations and human spaceflight systems development activities that will be supported by the FY 2011 budget, once approved by Congress. During CY 2010, NASA plans to issue a series of program formulation documents seeking input from the broader space community. The following are tentative timeframes for these activities:

- **Flagship Technology Demonstrations:** RFI in May/June.
- **Heavy Lift and Propulsion Technology:** RFI issued May 3, 2010; Broad Agency Announcement (BAA) in May/June.
- **Exploration Robotic Precursor Missions:** RFI in May/June.
- **Enabling Technology Development:** RFI issued May 7, 2010; BAA in June/July.
- **Human Research Program:** BAA in July

The first major public discussions about NASA's FY 2011 planned activities will occur at a two-day Exploration Enterprise Workshop scheduled for May 25-26 in Galveston, Texas. The workshop will bring together a broad community of stakeholders from industry, academia, and the Federal Government to engage in discussions related to strategy building, development, and the implementation of the new plans for human and robotic exploration in space.

The workshop will focus on the President's FY11 budget request for NASA Exploration. The Agency has completed the initial phase of planning for the new technology and robotic programs and will provide insight into progress to date. The objectives of the workshop are to:

- Describe and discuss the activities planned for inclusion in the new programs
- Discuss NASA Center proposed Program assignments
- Solicit feedback, ideas and suggestions from interested parties
- Prepare for the next steps once the new programs are implemented

In addition, NASA has also established study teams to plan for the implementation of the new initiatives related to the ISS Augmentation, 21st Century Space Complex and Space Technology. Additional information on these planning efforts as well as planned RFIs, workshops, and preliminary studies are outlined below.

- **ISS Augmentation:** The ISS program is reviewing functionality enhancements that will make the space station more capable and efficient, including: upgraded environmental systems and communications, techniques for saving space and improving the use of pressurized volume, tools for optimizing flight- and ground-crew time, upgrading and expanding payload operations, enhancing EVA and robotics use on Station, and reducing the complexity of international interfaces.
 - NASA will initiate an independent organization, as recommended by the Augustine Committee and the National Research Council that will support the space station research community.

- **21st Century Space Launch Complex:** NASA has developed a list of potential project ideas with preliminary estimates to be used as one potential source of solutions to customer needs as they are identified. These initial focus areas will be adjusted as customer needs are better understood: 1) Expanding capabilities to support commercial launch providers; 2) Environmental remediation; 3) Enhancing payload processing capabilities; and, 4) Supporting the modernization of the launch range capabilities.
 - This month, NASA will release an RFI to get a first-hand understanding of investments that would be most useful in support of launch and related activities in order to help the Agency prioritize near-term projects.

- **Space Technology:** NASA's Space Technology initiative under the Office of the Chief Technologist (OCT) will develop and demonstrate advanced space systems concepts and technologies enabling new approaches to enhance NASA's current mission set and enable future missions. Planning teams continue to make significant progress: an internal technology governance plan has been approved; an Agency-level technology road mapping activity is planned to begin in July; and, approved technology program plans for Early Stage Innovation, Game Changing Technology, and Crosscutting Capability Demonstrations will be completed by the end of June.
 - NASA will issue a Crosscutting Capability Demonstrations RFI in late May 2010. Game Changing Technology Industry Day will occur in late June 2010. Early Stage Innovation NASA Research Announcements (NRA's) are targeted for late June 2010. An RFI soliciting potential topics for the proposed Space Technology Graduate Fellowship program has been released to the NASA Centers and Federal Research Laboratories.

Finally, NASA has established the Human Exploration Framework Team (HEFT) to serve as a cross-Agency planning activity. The team is being led by the Exploration Systems Mission Directorate and staffed with technical leaders from across NASA Centers. The team is focused on developing and reviewing the integrated set of requirements and technologies required for future human spaceflight missions to many destinations, including Mars. As part of its broad integration charter, HEFT will develop implementation recommendations on the performance and pacing requirements for the technologies needed for future human exploration missions using "design reference missions," or DRMs. These DRMs will be the basis for validating capabilities and missions for five, 10-, and 15-year horizons, with milestones including crewed missions beyond the Moon into deep space by 2025, sending astronauts to an asteroid, and eventually landing on Mars. NASA expects to have initial products from the HEFT team this summer.

Extension and Enhanced Use of the International Space Station

A key element of America's future in space is the ISS that is due to be completed this year. As of May 2009, the ISS is able to support a six-person permanent crew. The three major science labs aboard ISS were completed in 2009 with the delivery of the Exposed Facility of the Japanese Kibo module. The ISS represents a unique research capability which the United States and its partner nations can use to conduct a wide variety of research in biology, chemistry, physics and engineering fields that will help us better understand how to keep astronauts healthy and productive on long-duration space missions. If Congress approves the FY 2011 budget request, NASA will be able to fully utilize the ISS and increase its capabilities through upgrades to both ground support and onboard systems. Importantly, this budget extends operations of the ISS, likely to 2020 or beyond.

ISS research is anticipated to have terrestrial applications in areas such as biotechnology, bioengineering, medicine and therapeutic treatment. The FY 2011 budget request for ISS reflects increased funding to support the ISS as a National Laboratory in which this latter type of research can be conducted. NASA has two MOUs with other U.S. government agencies, and five agreements with non-government organizations to conduct research aboard the ISS. NASA intends to continue to expand the community of National Laboratory users of the ISS.

ISS can also play a key role in the technology demonstrations and engineering research associated with exploration. Propellant storage and transfer, life support systems, and inflatable technology can all benefit by using the unique research capabilities of ISS. In addition to supporting a variety of research and development efforts, the ISS will serve as an incubator for the growth of the low-Earth orbit space economy.

As a tool for expanding knowledge of the world around us; advancing technology; serving as an impetus for the development of the commercial space sector; demonstrating the feasibility of a complex, long-term, international effort; providing critical data regarding human long duration spaceflight; and, perhaps most importantly, inspiring the next generation to pursue careers in science, technology, engineering, and mathematics, the ISS is without equal.

Conclusion

Americans and people worldwide have turned to NASA for inspiration throughout our history – our work gives people an opportunity to imagine what is barely possible, and we at NASA get to turn those dreams into real achievements for all humankind. This budget gives NASA a roadmap to even more historic achievements as it spurs innovation, employs Americans in fulfilling jobs, and engages people around the world as we enter an exciting new era in space. NASA looks forward to working with the Committee on implementation of the FY 2011 budget request.

Chairman Rockefeller, thank you for your support and that of this Committee. I would be pleased to respond to any questions you or the other Members of the Committee may have.