

NASA FISCAL YEAR 2010 BUDGET REQUEST

HEARING

BEFORE THE

SUBCOMMITTEE ON SCIENCE AND SPACE

OF THE

COMMITTEE ON COMMERCE,
SCIENCE, AND TRANSPORTATION

UNITED STATES SENATE

ONE HUNDRED ELEVENTH CONGRESS

FIRST SESSION

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MAY 21, 2009
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FIRST SESSION

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THURSDAY, MAY 21, 2009

U.S. SENATE,
SUBCOMMITTEE ON SCIENCE AND SPACE,
COMMITTEE ON COMMERCE, SCIENCE, AND TRANSPORTATION,
Washington, DC.

The Subcommittee met, pursuant to notice, at 2:39 p.m. in room SR-253, Russell Senate Office Building, Hon. Bill Nelson, Chairman of the Subcommittee, presiding.

OPENING STATEMENT OF HON. BILL NELSON, U.S. SENATOR FROM FLORIDA

Senator NELSON. Well, good afternoon and thank you for being here.

We want to get into NASA, and this is on the heels of just a phenomenally successful mission. It is extraordinary that you can take humans and machines and put them together and make them do wondrous things that will open up all new avenues of information about what the universe is, how long it has been there, and why we are where we are in this infinite space called the universe. Congratulations to you, Mr. Scolese, for an exceptional, successful journey, and we look forward to their return.

The communication that Barbara Mikulski had with them from her Committee was just outstanding and you could see with the smiles on their faces in that extraordinarily clear photography just how much they are relishing the success.

I am going to put my opening statement in the record. We will do the same for Senator Vitter.

[The prepared statement of Senator Nelson follows:]

PREPARED STATEMENT OF HON. BILL NELSON, U.S. SENATOR FROM FLORIDA

Before we begin, I want to say a few things and I'd like to start by thanking Chris Scolese, NASA's Acting Administrator for being here today. I know that this is a very busy time and that as Acting Administrator you have to cover a lot of bases. Thank you for your hard work and dedication to our Nation's space program.

I also want to say just how inspiring it has been to witness this amazing Hubble servicing mission. Senator Mikulski graciously offered me the chance to stop by her hearing earlier today and chat briefly with the STS-125 crew and it has been fantastic to see just how well our human spaceflight programs and our science programs can work together. I am really looking forward to many more years of great scientific discoveries from Hubble and its top-notch team of scientists and engineers.

It is hard to believe that the Space Shuttle era is drawing to a close. Despite numerous issues, the Shuttle has been an amazing vehicle and has provided our country and our international partners with a unique capability. It astounds me that the U.S. will lose its ability to put astronauts into space just as we are completing the International Space Station.

But now we have to move on to the matter at hand, and that is the administration's proposed NASA budget. On this front I have to say that I am both grateful and dismayed. I am grateful that the administration has realized that this is a critical time for our space program and proposed additional funding in FY 2009 and 2010.

However, I am dismayed and frustrated by the proposed out-year budget levels, particularly in the Exploration account. This budget request shows a three billion dollar decrease in out-year Exploration funding compared to the amount previously identified as needed to accomplish these programs. It looks to me as if the administration's space policy is once again being set by OMB and that the budget request will not stay true to the comprehensive vision laid out by the President.

Last year then Senator Obama noted that the Bush Administration had underfunded NASA. When I look at these out-year budget numbers I fear that we are doomed to repeat that history. I sincerely hope that is not the case and will certainly do everything I can to make sure NASA is adequately funded.

Senator NELSON. Senator Vitter, do you want to make any comments?

**STATEMENT OF HON. DAVID VITTER,
U.S. SENATOR FROM LOUISIANA**

Senator VITTER. I just want to welcome the Administrator and also congratulate him on his work in general on this mission.

I will also submit my statement for the record so we can have more time for discussion.

[The prepared statement of Senator Vitter follows:]

PREPARED STATEMENT OF HON. DAVID VITTER, U.S. SENATOR FROM LOUISIANA

I want to thank the Chairman for scheduling this important hearing. NASA is at a critical stage in its history and the actions the White House and the Congress take on this Budget request will likely have repercussions for many years to come.

Mr. Scolese, I join my colleagues in welcoming you here as our witness today. Though you have been thrust into the role of Acting Administrator, I believe you have demonstrated not only a solid background and experience in NASA programs, but have also brought good grace and professionalism to a job that bears great responsibility. Thank you again for your service.

I also want to congratulate you and NASA for the outstanding work done by the Space Shuttle crew on STS-125, who are due to land, I understand, in Florida tomorrow. Their work to service the Hubble Space Telescope has been watched eagerly and hopefully all week, and we are pleased to hear of their success.

The FY 2010 Budget Request represents a hopeful sign that there is a strong recognition of the value of the Nation's civil space program in meeting the challenges we face as a nation. I continue to believe that the space program represents one of the best uses of taxpayer's dollars, because it is an investment that we can expect will return even greater value to our economy and bring scientific, medical and other benefits that can improve the lives of everyone.

The total funding level for NASA in this budget represents a 5-percent increase over the enacted level from FY 2009, which, as I said, is a hopeful sign. We may have differences among us regarding the distribution of those funds among NASA's various accounts, and we will address those as we move forward with our review of the budget in detail.

What I believe is clear to most of us, however, is that the projected funding levels provided in this proposal for the 5-years following FY 2010 represent a virtual no-growth budget that likely would not even keep pace with inflation. This should be a cause for concern for all those who support NASA, regardless of their specific program interests, since it would force the cancellation of programs, or the kind of competition for funding that generally leads to stretching of schedules or de-scoping of missions in ways that ultimately mean the taxpayer gets less payoff for more dollars spent. It is truly penny-wise and pound foolish.

We have a number of challenges, especially, in the area of human spaceflight. The planned retirement of the Space Shuttle puts highly skilled workers' futures in doubt, without a clear path to a replacement vehicle. We hope we will have such a path, but we do not have one at the moment that we can truly rely on.

To the Administration's credit, they have initiated a review of the country's human space flight programs, and they have selected the right man to lead that effort in Norm Augustine. But he and his team must be free to look at all available options and feel free to recommend the best approach forward, or their work will be in vain and we will still be searching for an answer that works.

We have got to find ways to minimize the gap in U.S. human spaceflight capability. Not simply because we believe the country should have that capability—though that's important—but because we have a highly skilled and dedicated workforce that makes U.S. human spaceflight happen, and we must not risk losing that work force, and seeing them forced to permanently leave the very kinds of jobs that can most directly serve to benefit the country and our economy.

Whether the solution requires keeping the Shuttle flying for some period of time to help us make better use of the newly-completed International Space Station, or accelerating a commercially-developed alternative, or some other means, we cannot afford, as a country, to surrender our long-held leadership in space exploration.

I will have questions for the record to focus on some of these challenges, and I look forward to the chance to discuss some of them, and some of the answers, with you today, Mr. Scolese.

Thank you again, in advance, for your testimony.

Senator NELSON. What we are going to do is put your statement in the record as well. So if you do not mind, we will just go on and start our questions.

Mr. SCOLESE. That is perfectly fine.

[The prepared statement of Mr. Scolese follows:]

PREPARED STATEMENT OF CHRISTOPHER SCOLESE, ADMINISTRATOR (ACTING), NASA

Mr. Chairman and Members of the Subcommittee, thank you for the opportunity to appear today to discuss the President's FY 2010 budget request for NASA. The President's FY 2010 budget request for NASA is \$18.686 billion. The FY 2010 request represents an increase of \$903.6 million above the amount provided for NASA in the FY 2009 Omnibus Appropriations Act (P.L. 110-8). The FY 2010 budget does a number of things: it supports the Administration's commitment to deploy a global climate change research and monitoring system; it funds a strong program of space exploration involving humans and robots with the goal of returning Americans to the moon and exploring other destinations; and it supports the safe flight of the Space Shuttle to complete assembly of the International Space Station by the Space Shuttle's planned retirement.

Highlights of the FY 2010 Budget Overview

With the FY 2010 budget request, NASA advances global climate change research and monitoring. The NASA investment in Earth Science research satellites, airborne sensors, computer models and analysis has revolutionized scientific knowledge and predictions of climate change and its effects. Using the National Research Council's recommended priorities for space-based Earth Science research as its guide, NASA will develop new space-based research sensors in support of the Administration's goal to deploy a global climate research and monitoring system. NASA will work to deploy these new sensors expeditiously while coordinating with other Federal agencies to ensure continuity of measurements that have long-term research and applications benefits.

The FY 2010 NASA request funds a robust program of space exploration involving humans and robots. NASA's astronauts and robotic spacecraft have been exploring our solar system and the universe for more than 50 years. The Agency will create a new chapter of this legacy as it works to return Americans to the Moon by 2020. NASA also will send a broad suite of robotic missions to destinations throughout the solar system and develop a bold new set of astronomical observatories to probe the mysteries of the universe, increasing investment in research, data analysis, and technology development in support of these goals.

With the FY 2010 request, NASA will complete the International Space Station (ISS) and advance the development of new space transportation systems and the unique scientific research that can be conducted onboard the ISS. The FY 2010 budget request funds for the safe flight of the Space Shuttle to complete the ISS, incorporates an additional flight to deliver the Alpha Magnetic Spectrometer (AMS) to the ISS, and then retires the Shuttle. NASA is committed to completing these nine remaining scheduled Shuttle flights, including the current mission underway to service the Hubble Space Telescope, which we believe can be accomplished by the

end of 2010. Funds freed from the Shuttle's retirement will enable the Agency to support development of systems to deliver people and cargo to the ISS and the Moon and explore other destinations. 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 requirements for ISS. In addition, the Agency will continue to utilize the ISS, the permanently crewed facility orbiting Earth that enables the Agency to develop, test, and validate critical space exploration technologies and processes, and to conduct microgravity research. NASA also will continue to coordinate with international partners to make this platform available for other government entities, commercial industry, and academic institutions to conduct research.

At the request of the Director of the Office of Science and Technology Policy, NASA is initiating an independent review of planned U.S. human space flight activities, with the goal of ensuring that the Nation is on a vigorous and sustainable path to achieving its boldest aspirations in space. This review will be conducted by a blue-ribbon panel of outside experts chaired by Norman R. Augustine. The panel will present its results in time to support an Administration decision on the way forward by August 2009. This Review of U.S. Human Space Flight Plans will examine ongoing and planned NASA human space flight development activities, as well as potential alternatives, and present options for advancing a safe, innovative, affordable, and sustainable human space flight program in the years following completion of the current Space Shuttle manifest and retirement. The independent review panel will seek input from Congress, the White House, the public, industry, and international partners. In addition, the review will examine the appropriate amount of R&D and complementary robotic activities needed to make human space flight activities most productive and affordable over the long term, as well as appropriate opportunities for international collaboration. It will also evaluate what capabilities would be enabled by each of the potential architectures considered. And it will evaluate options for extending International Space Station operations beyond 2016. We will keep the Congress informed, as appropriate, with the progress of the review.

It is important to note that the President has submitted a FY 2010 budget request for NASA Exploration Systems of \$3.963 billion, an increase of \$457.6 million above the FY 2009 Omnibus Appropriations level. During the review, the NASA workforce will continue to focus on the safe flight and operation of the Space Shuttle and ISS, and continue to work on all current exploration projects, including Ares I, Orion, and Commercial Crew and Cargo efforts.

The President's FY 2010 budget request includes \$507 million for Aeronautics Research, renewing NASA's commitment to cutting-edge, fundamental research in traditional and emerging disciplines to help transform the Nation's air transportation system and to support future aircraft. NASA research will increase airspace capacity and mobility, enhance aviation safety, and improve aircraft performance while reducing noise, emissions, and fuel consumption. The Integrated Systems Research Program, a new program beginning in FY 2010, will conduct research at an integrated system-level on promising concepts and technologies and explore, assess, and demonstrate the benefits in a relevant environment.

Finally, consistent with Administration priorities, NASA is developing plans to stimulate innovation and increase investments in technologies for the future while ensuring that nearer-term Agency commitments are met.

NASA Initial FY 2009 Operating Plan and Recovery Act Funding

Before I highlight key accomplishments and plans for activities across the Agency, I would like to summarize NASA's initial FY 2009 Operating Plan, including Recovery Act funding, as recently submitted to the Subcommittee. The initial FY 2009 Operating Plan is \$18,784.4 million, or \$1,170.2 million above the President's FY 2009 request, which reflects an increase of \$168.2 million in the regular appropriation and \$1,002.0 million in the Recovery Act. NASA is appreciative of the action by the Committees on Appropriations and Congress in providing regular appropriations for the Agency with full funding for Science, Aeronautics, Exploration, Space Shuttle, ISS, and Education. This total FY 2009 appropriations level, with minor adjustments within the total, will enable NASA to meet critical priorities, in accordance with the direction from the Congress and the President. NASA also appreciates the efforts by the Committees to include funding for NASA in the Recovery Act. This funding will help NASA achieve programmatic goals in Science, Exploration and Aeronautics, and repair damage done to the NASA Johnson Space Center during Hurricane Ike, and support national recovery goals.

NASA has allocated the \$1,002.0 million in Recovery Act funds as follows:

- Science, \$400.0M

- Earth Science, \$325.0M
- Astrophysics, \$75.0M
- Aeronautics, \$150.0M
- Exploration, \$400.0M
 - Constellation Systems, \$250.0M
 - Commercial Crew and Cargo, \$150.0M
- Cross Agency Support, \$50.0M
- Inspector General, \$2.0M

I would be happy to address the objectives to which NASA is applying the Recovery Act funds in detail.

Science

NASA's Science Mission Directorate continues to expand humanity's understanding of our Earth, our Sun, the solar system and the universe with 57 science missions in operation and 31 more in development. The Science budget funds these missions as well as the research of over 3,000 scientists and their students across the Nation. The President's FY 2010 request for NASA includes \$4,477.2 million for Science.

The Science budget request includes \$1,405.0 million for *Earth Science* in FY 2010, and steadily increases Earth Science funding in the outyears. NASA's 15 Earth Science missions in operation provide a large share of the global observations used for climate change research in the United States and elsewhere. This year, NASA's Earth Science satellites enabled research to understand how changes both in the tropics and in Arctic sea ice are changing ocean biology globally. NASA also recently conducted the first Ice Bridge aircraft campaign to demonstrate a new airborne laser capability to bridge the gap in time between ICESats 1 and 2. In FY 2010, NASA plans to launch the Glory mission to map atmospheric aerosols and continue the long record of solar influences on climate, and the Aquarius mission to provide the first global measurements of sea surface salinity. NASA will complete development of the NPOESS Preparatory Project and continue development of the Global Precipitation Mission and the Landsat Data Continuity Mission (LDCM). The request fully funds development of a Thermal Infra-red Sensor (TIRS) at a total cost of approximately \$150–175 million. A decision whether to fly TIRS on LDCM or another spacecraft will be made this summer; meanwhile, funding for TIRS is carried within the LDCM budget. The launch vehicle failure of the Orbiting Carbon Observatory (OCO) was a significant loss to the climate science communities, and NASA is assessing options to recover from that loss; we will inform the Congress of the results of these studies when they become available. NASA is continuing to work aggressively to implement the recommendations of the National Research Council Decadal Survey for Earth Science. The first two Decadal Survey missions, SMAP and ICESat-II, will continue formulation in FY2010, and the next two, DESDynI and CLARREO, will be accelerated and transition to formulation. NASA also expects to issue its first Venture-class Announcement of Opportunity later this year, implementing another important decadal survey recommendation.

The FY 2010 Science budget request includes \$1,346.2 million for *Planetary Science*. NASA's Planetary Science missions continue to return images and data from the far reaches of the Solar System. This year, the Mars Phoenix Lander completed its mission, conducting the first chemical test providing evidence of water ice on another planet. MESSENGER returned stunning imagery of portions of the planet Mercury never before seen. The Cassini spacecraft continues to provide unparalleled science of the Saturnian system; the spacecraft flew within 25km of Enceladus viewing the ejecting plumes and surface, and data from 19 fly-bys of Titan enabled creation of a radar map showing 3-D topography revealing 1,200-meter (4,000-foot) mountain tops, polar lakes, vast dunes, and thick flows from possible ice volcanoes. Development is continuing on the Juno mission to Jupiter for launch in 2011. NASA and ESA jointly announced they will work together on a Europa Jupiter System mission as the next outer planets flagship mission. The rovers Spirit and Opportunity continue to study the Martian surface and have exceeded their fifth year of successful operations. NASA is continuing development of the Mars Science Laboratory (MSL) for launch in 2011 and selected MAVEN, a Mars aeronomy mission, as the next Mars Scout mission for launch in 2013. NASA has integrated its lunar science research program with the Lunar Precursor Robotic Program into a single Lunar Quest Program under the Science Mission Directorate, which includes the LADEE mission, the U.S. nodes of the ILN, and a new virtual university research collaboration called the NASA Lunar Science Institute. The

Moon Mineralogy Mapper (M3) was launched aboard Chandrayaan-1 and has begun making scientific observations of the Moon's composition. Development is continuing on the GRAIL mission to map the Moon's gravity field for launch in 2011. NASA has issued an Announcement of Opportunity for the next New Frontiers mission, and will do so for the next Discovery mission later this year.

The FY2010 Science budget request includes \$1,120.9 million for *Astrophysics*. 2009 is the International Year of Astronomy, and NASA's Astrophysics program will deploy exciting new capabilities for studying the cosmic frontier. The Kepler mission, launched in March, is NASA's first mission dedicated to the search for Earth-like planets in our galaxy. ESA will launch the Herschel and Planck missions in April, carrying several NASA instruments, to study the far-infrared sky and the cosmic microwave background. The final Hubble Space Telescope servicing mission aboard STS-125, currently in progress, is upgrading the observatory to its peak scientific performance. Late this calendar year, NASA plans to launch the Wide-field Infrared Survey Explorer (WISE) as part of its highly successful Explorer Program, following on the recent successes of the Fermi Gamma-ray Space Telescope (launched as GLAST in July 2008), which has provided the best-ever view of the gamma-ray sky revealing energetic sources in our solar system, our galaxy, and galaxies billions of light-years away. Development is continuing on the James Webb Space Telescope, which passed its Confirmation Review in 2008 and has an Agency commitment to launch in 2014. Development continues on the NuSTAR mission to study black holes for launch in 2011, along with a Soft X-ray Spectrometer to fly on Japan's Astro-H mission in 2013. Development continues on the airborne Stratospheric Observatory for Infrared Astronomy or SOFIA, which will conduct open door flight tests in 2009 and early science flights in 2010, with planned full operational capability in 2014. Conceptual design is continuing for ambitious future mission concepts to investigate the origins of planets, stars, and galaxies; to search for Earth-like planets around nearby stars; and to examine the nature of dark energy, dark matter, gravity waves, and black holes. These and other mission concepts are currently under consideration by the NRC's decadal survey for Astrophysics, or Astro2010, which will be completed during 2010, and will provide recommendations to NASA on the science community's highest priority science questions and strategic missions for the next decade.

The FY 2010 Science budget request includes \$605.0 million for *Heliophysics*. The fleet of NASA Heliophysics missions strategically placed throughout the solar system is providing researchers the first ever solar system-wide view of solar influences on the Earth and other planets, and the dynamic structures of space itself. This virtual "Great Observatory" is in place and functioning for the next solar magnetic activity cycle, and has already detected the first signs of a new solar maximum anticipated for 2011-2012. Late this year or early next, the launch of Solar Dynamics Observatory will add to this fleet the capability to observe the solar atmosphere to a depth one-third of the Sun's radius to study the flow of plasmas that generate magnetic fields and the sudden changes that produce coronal mass ejections that we experience as space weather. Also this year, NASA plans to select two Small Explorer (SMEX) missions in response to an Announcement of Opportunity issued in 2008, which could be either Heliophysics or Astrophysics missions depending on the proposals selected. Development of the Radiation Belt Storm Probes mission to study the interactions of space weather events with Earth's magnetic field is continuing for launch in 2012. The Magnetosphere Multi-Scale mission to observe the processes of magnetic reconnection, energetic particle acceleration, and turbulence in Earth's magnetosphere will undergo a Confirmation Review this year for a planned launch in 2014. Finally, NASA is continuing early formulation work on the Solar Probe-Plus mission that will travel into, and sample, the near-Sun environment to probe the origins of the solar wind.

Aeronautics Research

NASA's FY 2010 budget provides \$507 million for Aeronautics Research. Over the past year, the Aeronautics Research Mission Directorate has continued to pursue long-term, innovative, and cutting-edge research that develops revolutionary tools, concepts, and technologies to enable a safer, more flexible, environmentally friendly, and more efficient national air transportation system. NASA Aeronautics Research also plays a vital role in supporting NASA's space exploration activities.

A primary goal across Aeronautics Research programs is to establish strong partnerships with industry, academia, and other government agencies in order to enable significant advancement in our Nation's aeronautical expertise. NASA has put many mechanisms in place to engage academia and industry, including industry working groups and technical interchange meetings at the program and project level, Space Act Agreements (SAAs) for cooperative partnerships, and the NASA Research An-

nouncement (NRA) process that provides for full and open competition for the best and most promising research ideas. To date, 68 SAAs have been established with industry partners across all programs and 375 NRAs have been awarded to academia, industry and non-profit organizations. NASA Aeronautics has continued to collaborate with the Joint Planning Development Office (JPDO), Federal Aviation Administration (FAA), U.S. Air Force, Army, and other government organizations.

New for FY 2010, \$62.4 million has been provided for the *Integrated Systems Research Program* (ISRP) to conduct research at an integrated system-level on promising concepts and technologies and explore, assess, or demonstrate the benefits in a relevant environment. The research in this program will be coordinated with ongoing, long-term, foundational research within the three other research programs, and will be closely coordinated with other Federal Government agency efforts. The project within ISRP will be the Environmentally Responsible Aviation (ERA) Project, a “green aircraft initiative,” that will explore and assess new vehicle concepts and enabling technologies through system-level experimentation to simultaneously reduce fuel burn, noise, and emissions. The ERA project will transfer knowledge outward to the aeronautics community so that aircraft and propulsion system manufacturers can confidently transition these technologies into new products, as well as transfer knowledge inward to the Fundamental Aeronautics Program when the need for further development at a foundational level is identified.

NASA’s *Airspace Systems Program* (ASP) has partnered with the JPDO to help develop concepts, capabilities and technologies that will lead to significant enhancements in the capacity, efficiency and flexibility of the National Airspace System. For FY 2010, ASP has been reorganized from the NextGen Airspace and NextGen Airportal projects into the NextGen Concepts and Technology Development project and the NextGen Systems Analysis, Integration and Evaluation project. The distinctions between airport operations, terminal-area operations and en-route operations were sometimes confusing, leading to time expended determining the line of demarcation between the responsibilities of the two projects. A more significant distinction is the development of air traffic management concepts and the technologies that enable air traffic management improvements and the evaluation of these concepts and technologies at a system level. The previously planned work on airspace concepts, technologies and systems will continue. This new project structure is better aligned to the nature of the work being performed. A notable accomplishment for ASP is the successful completion, by NASA researchers in collaboration with academia and the FAA, of a series of human-in-the-loop experiments that explored advanced concepts and technology for separation assurance, which ensures that aircraft maintain a safe distance from other aircraft, terrain, obstacles, and certain airspace not designated for routine air travel. The technology being developed by NASA and its partners is critical to relieving air-traffic controller workload, a primary constraint on airspace capacity that is expected to increase in coming years. In the future, this Program will continue to develop new technologies to solve important problems such as surface traffic planning and control, and initial algorithms for airport arrival and departure balancing as well as developing traffic flow management concepts for increased efficiencies at the regional and national levels for different planning intervals.

NASA’s *Fundamental Aeronautics Program* (FAP) conducts research in all aeronautics disciplines that enable the design of vehicles that fly through any atmosphere at any speed. For FY 2010, all ARMD research into planetary entry, descent and landing (EDL) has been consolidated into the Hypersonics project in FAP. EDL is an integral part of many space missions and is not easily divided into distinct hypersonic and supersonic phases. This change will provide more focus to technical developments and will also yield technical management efficiencies. The FAP program has supported the testing of various new concepts that will help enable much improved capabilities for future vehicles. For example, wind-tunnel testing was conducted for several promising powered lift concepts. Powered lift concepts increase lifting force on an aircraft at slow speeds (*e.g.*, at take-off and landing) without increasing drag under cruise conditions. Successful use of the concepts will enable short take-off and landings on runways less than 3000 feet, which will increase next-generation air transportation system capacity through the use of shorter fields and improved low-speed maneuverability in airport terminal areas. Testing was also completed for a Smart Material Actuated Rotor Technology (SMART) helicopter rotor, which offers the potential for significant noise and vibration reduction in rotorcraft. Future work includes technologies and advanced tools to evaluate the trades between noise, emissions, and performance of future aircraft entering service in the 2012–2015 timeframe. Additionally, with the transfer of technologies to be matured to system-level within ISRP, the Subsonic Fixed Wing (SFW) project is streamlining its research content. This is enabling new efficiencies across the

foundational disciplines remaining in the project. The integrated system-level research in this program will be coordinated with on-going, long-term, foundational research within the three other research programs, and will focus specifically on maturing and integrating technologies in major vehicle systems and subsystems for accelerated transition to practical application.

NASA's *Aviation Safety Program* (AvSP) continues to develop tools and technologies to improve on today's incredibly safe air transportation system, while ensuring that future technologies can be safely incorporated to the system. Examples of advances that support this development include NASA's ongoing and new research into aircraft icing. For example, with current knowledge we cannot extrapolate how ice forms on a straight wing such as found on a turbo-prop to how it will form on a swept wing, or a radically new aircraft configuration. The Aviation Safety Program is tackling this with a combination of computational models and experiments in NASA's Icing Research Tunnel. We are establishing that, in high and cold flight conditions, ice can form deeper in jet engines than previously understood. NASA is working collaboratively with the FAA, industry and international partners, such as the National Research Council of Canada, to conduct tunnel tests of the underlying physics, to fly our instrumented S-3 Viking into such engine icing conditions, and design upgrades to our Propulsion System Lab in which jet engines may be tested in detail. Additional future work in Aviation Safety includes addressing gaps in validation and verification of critical flight software, developing new data-analysis capabilities to mine aviation operational data for safety issues, examining the safety of new vehicle systems and structures, and tackling the biggest human factors issues in the NextGen flightdeck.

NASA's *Aeronautics Test Program* (ATP) is focused on ensuring a healthy suite of facilities and platforms to meet the Nation's testing needs including the development of new test instrumentation and test technologies. As part of its continuous efforts to improve facility operational efficiencies, ATP initiated the National Force Measurement Technology Capability, to address the severe erosion of NASA's capability to utilize strain gage balances in wind tunnel testing. The National Partnership for Aeronautics Testing, a strategic partnership between NASA and the Department of Defense (DOD), recently commissioned a study of government-owned, mid-to-large supersonic facilities necessary to fulfill future air vehicle test requirements. The Program will continue to develop a long-term strategic approach that aligns the NASA and DOD facilities to meet future requirements with the right mix of facilities and appropriate investments in facility capabilities.

Exploration Systems

Human space flight is important to America's political, economic, technological and scientific leadership. In the span of a few short years, NASA has already taken long strides in the formulation of strategies and programs to develop a robust program of space exploration. These critical steps will allow our Nation to build the next-generation space flight vehicles that will carry humans and deliver cargo to the ISS and the Moon, and on to other destinations in our solar system. The President's FY 2010 budget request for Exploration Systems is \$3,963.1 million, an increase of \$457.6 million above the FY 2009 appropriation and \$225.4 million above the planned FY 2010 level in last year's request. Based on the Recovery Act funds and the President's increased budget request for FY 2010, the Exploration Systems budget plan includes about \$630 million more in FY 2009 and FY 2010 than the previous plan. At this critical juncture, full funding at the President's requested level is essential for expediting development of new U.S. human space flight systems to support the International Space Station and explore the Moon and other destinations beyond low-Earth orbit.

The Constellation Program will apply additional Recovery Act funds to critical activities related to the successful completion of the Orion, Ares I and Ground Operations projects. The Commercial Crew and Cargo Program plans to use Recovery Act funds to stimulate efforts within the private sector in order to develop and demonstrate technologies that enable commercial human space flight capabilities—efforts that are intended to foster entrepreneurial activity leading to job growth in engineering, analysis, design, and research, and to economic growth as capabilities for new markets are created.

Following the Review of U.S. Human Space Flight activities, the Administration will provide an updated request for Exploration activities, as necessary. In the meantime, NASA is proceeding as planned with current Exploration activities, including Ares I, Orion, Commercial Crew and Cargo efforts, and lunar systems.

During the past year, NASA Exploration Systems continued to make significant progress in developing the next-generation U.S. human space flight vehicles and their associated ground and mission support systems. In the next several weeks, the

first lunar robotic mission, the Lunar Reconnaissance Orbiter and the Lunar Crater Observation Sensing Satellite spacecraft, will be launched from the Cape Canaveral Air Force Station aboard an Atlas V, which will help NASA scout for potential lunar landing and outpost sites. Later this year, two major test flights for the Constellation Program will be conducted: Ares I-X is the first developmental test flight to support the design of the Ares I Crew Launch Vehicle; and the Pad Abort 1 (PA-1) is the first test of the Launch Abort System to be used on the Orion Crew Exploration Vehicle. NASA will continue to work with other nations and the commercial sector to coordinate planning, leverage investment, and identify opportunities for specific collaboration on Exploration activities.

The *Constellation* Program continues to complete the formulation phase of its projects—in particular Ares I, Orion, and major ground facilities. Major development work is underway, contracts are in place, and we have a dedicated group of civil servants and contractors who are all working hard to accomplish the Constellation Program's objectives. So far, NASA engineers have conducted about 6,500 hours of wind tunnel testing on subscale models of the Ares I to simulate how the current vehicle design performs in flight. These wind tunnel tests, as well as the Ares I-X test flight, will lay the groundwork for maturing the Ares I final design prior to its Critical Design Review (CDR). When launched later this year from NASA's Kennedy Space Center in Florida, the Ares I-X will climb about 25 miles in a two-minute powered test of the First Stage performance and the First Stage separation and parachute recovery system. Work on the Orion Project also continues to advance. Recently, NASA conducted testing of the water recovery process for the Orion capsule, and NASA also selected the material for Orion's heat shield. Later this year, Orion's PA-1 test will take place at White Sands Missile Range, New Mexico. PA-1 will demonstrate the Launch Abort System's ability to pull crew to safety should there be an emergency while the Orion and Ares I stack is still on the launch pad.

In September 2008, Ares I completed a key milestone with its Preliminary Design Review (PDR). PDR is the final step of the initial design process, and thereby a crucial milestone during which the overall project verifies that the preliminary design can meet all requirements within acceptable risk limits and within cost and schedule constraints, and identifies technical and management challenges and addresses approaches for eliminating or mitigating them. This fall, the Orion is expected to have progressed to the point of completing PDR, and obtaining Agency approval to proceed to Critical Design Review (CDR). Current plans call for Ares I to progress to the point of obtaining Agency approval by early 2010 to proceed to CDR.

As part of the Commercial Crew and Cargo Program and its associated Commercial Orbital Transportation Services (COTS) cargo projects, NASA is completing its promised \$500 million investment to the two funded COTS partners, Space Exploration Technologies Corporation (SpaceX) of El Segundo, California, and Orbital Sciences Corporation (Orbital) of Dulles, Virginia. Recently, SpaceX successfully operated the full complement of the first stage engines of the Falcon 9, the SpaceX launch vehicle. Orbital continues to progress in achieving engineering milestones, and completed its PDR earlier this month. In addition, NASA has two non-funded COTS partners.

The transition of NASA facilities, infrastructure, property, and personnel from the Space Shuttle Program to the Constellation Program continues to be a major activity. This joint effort between the Space Operations and Exploration Systems Mission Directorates includes the utilization and disposition of resources, including real and personal property; personnel; and processes in order to leverage existing Shuttle and Space Station assets for NASA's future Exploration activities.

NASA's *Advanced Capabilities* programs include the Human Research Program (HRP) and the Exploration Technology Development Program (ETDP). These programs continue to reduce risks for human explorers of the Moon and beyond by conducting research and developing new technologies to aid future explorers. HRP focuses on the highest risks to crew health and performance during exploration missions while also developing and validating a suite of human health countermeasures to facilitate long-duration space travel. For example, NASA is conducting research to better understand the effect of space radiation on humans and to develop effective mitigation strategies. This year, HRP delivered a space radiation risk assessment tool, provided cockpit display design requirements for the Orion spacecraft, and provided design requirements for the new Constellation Space Suit System. HRP is also conducting research onboard the ISS with regard to: the cardiac structure and function of astronauts; radiation shielding technologies; and, the effect that certain pharmaceuticals may have on the prevention of bone loss during long-duration missions. ETDP will conduct a range of activities, including testing cryogenic hydrogen and methane propulsion systems for future missions; developing a small pressurized

rover for transporting astronauts on the lunar surface; and demonstrating the capability to produce oxygen from lunar soil. ETDG also is conducting experiments on the Space Station to investigate the behavior of fluids and combustion in microgravity, and operating instruments to monitor atmospheric contaminants on the Space Station.

Space Operations

The FY 2010 budget request includes \$6,175.6 million for Space Operations.

It is an exciting time for NASA's *Space Shuttle Program*. At this moment, the astronauts of Shuttle Atlantis are in orbit on STS-125, the final mission to service the Hubble Space Telescope. We anticipate that the work they are doing, which includes upgrading the Hubble's instruments, should extend the observatory's operational life several years. The President's FY 2010 budget funds the safe flight of the Space Shuttle to conduct its remaining missions, including the AMS flight and completing assembly of the ISS. NASA is committed to completing the eight remaining scheduled Shuttle flights, which we believe can be accomplished by the end of 2010. These Shuttle flights will leave the ISS in a configuration to support a broad portfolio of research and to receive and be maintained by commercial cargo services. The FY 2010 budget request includes \$3,157.1 million for the Space Shuttle Program.

NASA and its Russian, European, Canadian, and Japanese *International Space Station* partners are working together to realize one of the most inspiring dreams of the last 50 years: the establishment of a station in Earth orbit for the conduct of various types of research. We are now approaching two significant milestones. In May, the ISS will host its first six-person crew. The recent delivery of the Station's final set of solar arrays and other equipment by the crew of STS-119 represents the final step toward this goal. In June, the STS-127 mission will deliver the third and final component of the Japanese *Kibo* laboratory—the *Kibo* Exposed Facility. The addition of the Exposed facility enables the *Kibo* laboratory, with the European *Columbus* module and the U.S. *Destiny* module, to complete the three major international science labs on ISS, setting the stage for utilization of ISS as a highly capable microgravity research facility. The President's FY 2010 budget request includes \$2,267.0 million for the ISS.

The ISS will represent both an unparalleled international cooperative effort and a U.S. National Laboratory in orbit. Scientists will be able to conduct biomedical and engineering research from a unique vantage point. Some of the work will increase our knowledge of the effects of long-duration human space flight, which is critical for the design and operation of future human space vehicles, including those being developed under the Constellation Program to return U.S. astronauts to the Moon and explore other destinations. Other research will not be focused on space exploration at all, but may have significant applications right here on Earth. Medical research, for example, may be applicable to the development of vaccines; NASA's research into salmonella aboard the Space Shuttle and ISS has already increased our knowledge in this area. In the key areas of energy and the environment, the ISS serves as a daily demonstration of "green" technologies and environmental management techniques. The ISS receives 120kW of power from its solar arrays to operate the Station and run experiments. The ISS environmental system is designed to minimize the amount of mass that has to be launched from Earth to support the Station, so recycling is a must. STS-119 supplied ISS with a replacement Distillation Assembly for Station's water recycling system, which is key for supporting a full six-person crew for extended periods of time. Given the central role science and technology play in our society, it is important that the United States maintain a leadership role in these fields. The availability of a research laboratory in the microgravity environment of space will support this aim.

Another benefit from Space Shuttle missions and ISS research is reflected in the programs' ability to inspire the next generation of Americans. This was reflected recently in the delighted faces of students who participated in the uplinked phone call between President Obama and the crews of the ISS and STS-119 on March 24. The ISS will support the President's goal of making math and science education a national priority by demonstrating what can be accomplished through science and engineering, and by inspiring both teachers and students.

NASA is relying on U.S. industry to develop vehicles to deliver supplies and experiments to the ISS. In December 2008, the Agency awarded two Commercial Resupply Services (CRS) contracts for the provision of this critical capability. Cargo resupply is important for the continued viability of ISS. In addition, the vendors involved will gain valuable experience in the development and operation of vehicles that can 1) fly to the ISS orbit; 2) operate in close proximity to the ISS and other docked vehicles; 3) dock to ISS; and, 4) remain docked for extended periods of time.

The FY 2010 budget request includes \$751.5 million for *Space and Flight Support*, which supports Space Communications and Navigation, Launch Services, Rocket Propulsion Testing, Crew Health and Safety, and the new Human Space Flight Operations programs.

Education

The FY 2010 budget request for Education totals \$126.1 million and furthers NASA's commitment to Science, Technology, Engineering, and Mathematics (STEM) education. NASA will continue its successes in developing a future aerospace work force, improving the technological competitiveness of our Nation's universities, attracting and retaining students in STEM disciplines, and engaging the public in NASA's missions. NASA will accomplish these goals by offering competitive research grants to universities, providing targeted educational support to Minority Serving Institutions, and strengthening curricula at two-year community colleges. NASA's plans to streamline and centralize internship and fellowship application processes will realize cost savings and facilitate student access to information while attracting a wider, more diverse participant base. The Agency is also seeking new opportunities for student involvement in current space and aeronautics research missions and flight projects, including those using high altitude balloons, sounding rocket payloads, airborne sensors, and space satellites. NASA will further these efforts through a new project, Innovation in STEM Education, which will allow the Agency to investigate and offer opportunities for student and faculty to participate in NASA-related research. In coming months, the Agency will complete award announcements for competitive grant programs in K-12, global climate change, and informal education, and revise and issue new solicitations using FY 2009 funds.

NASA will further pursue a goal to attract and retain students in STEM disciplines in the upcoming Fiscal Year. Last year, the Interdisciplinary National Science Program Incorporating Research & Education (INSPIRE) program engaged over 200 high schools in STEM areas, and NASA Explorer Schools conducted instructional and enrichment activities that reached over 105,000 students. The March 2009 STS-119 mission also provided a unique educational opportunity as two Mission Specialists who are science teachers, Joe Acaba and Richard Arnold, were part of the crew. NASA Education continues to provide internships, fellowships, and research opportunities to help students and educators gain hands-on experiences in a range of STEM-related areas. These opportunities provide students with the motivation, inspiration, and experience needed to serve the Nation's current and future workforce needs. In FY 2008, the Agency provided more than 3,000 summer internships, reached 5,331 students through significant research experience or grants, and provided 139 grants to underrepresented and underserved institutions.

NASA will also engage elementary and secondary school and informal education audiences by using Earth and deep space observations, the flight experience of Educator Astronaut Dorothy Metcalf-Lindenburger aboard STS-131, as well as future missions to the Moon and other destinations. New technologies such as social networks, Internet collaborations, a new virtual magnet school, and remote control of science instruments will expand and enhance these efforts. In FY 2010, NASA also plans to provide an online professional development system for students training to become educators, in-service teachers, and informal educators. Additionally, NASA will promote continuous public awareness of its mission and improvement to STEM literacy by partnering with informal education providers, which allows Agency partners to share the excitement of NASA missions with their visitors in meaningful ways.

Cross-Agency Support

NASA Cross-Agency Support provides critical mission support activities that are necessary to ensure the efficient and effective operation and administration of the Agency, but cannot be directly aligned to a specific program or project requirement. These important functions align and sustain institutional and program capabilities to support NASA missions by leveraging resources to meet mission needs, establishing Agency-wide capabilities, and providing institutional checks and balances. Cross-Agency Support includes Center Management and Operations, Institutional Investments, and Agency Management and Operations. The FY 2010 budget request includes \$3,400.6 million for Cross Agency Support.

Center Management and Operations funds the critical ongoing management, operations, and maintenance of nine NASA Centers and major component facilities. NASA Centers continue to provide high-quality support and the technical talent for the execution of programs and projects. The FY 2010 budget request includes \$2.084 million for Center Management and Operations.

Institutional Investments funds design and execution of non-programmatic revitalization construction of facilities projects, demolition projects for closed facilities, and environmental compliance and restoration activities. The Construction of Facilities Program makes capital repairs and improvements to NASA's critical infrastructure to improve safety and security and improve NASA's operating efficiency by reducing utility usage. NASA continues to right size the infrastructure by demolishing facilities that are no longer needed. Emphasis has been placed on energy and water conservation. Currently, NASA has five buildings that are certified under the Leadership in Energy and Environmental Design (LEED) criteria, three additional buildings that are built and awaiting certification as LEED Silver facilities, and 13 buildings in various stages of design and construction as High Performance Buildings and are expected to be LEED-certified when completed. The FY 2010 budget request includes \$355.4 million for Institutional Investments.

NASA's FY 2010 request includes \$961.2 million for *Agency Management and Operations*, which funds the critical management and oversight of Agency missions, programs and functions, and performance of NASA-wide activities, including five programs: Agency Management, Safety and Mission Success, Agency Information Technology Services, Innovative Partnerships Program, and Strategic Capabilities Assets Program.

- The FY 2010 budget request provides \$412.7 million for *Agency Management*, which supports executive-based, Agency-level functional and administrative management requirements. Agency Management provides for the operational costs of Headquarters as an installation; institutional and management requirements for multiple Agency functions; assessment and evaluation of NASA program and mission performance; strategic planning; and independent technical assessments of Agency programs.
- The FY 2010 budget request provides \$183.9 million for *Safety and Mission Success* activities required to continue strengthening the work force, training, and strengthening the fundamental and robust cross-checks applied on the execution of NASA's mission, and to improve the likelihood for safety and mission success for NASA's programs, projects, and operations. The engineering, safety and mission assurance, health and medical independent oversight, and technical authority components are essential to NASA's success and were established or modified in direct response to many of the key Challenger and Columbia accident board recommendations for reducing the likelihood for future accidents. Included under Safety and Mission Success is the Software Independent Verification and Validation program.
- The FY 2010 budget request for *Agency Information Technology Services* is \$150.4 million, which encompasses cross-cutting services and initiatives in IT management, applications, and infrastructure necessary to enable the NASA Mission and improve security, integration and efficiency of Agency operations. NASA plans significant emphasis on continued implementation of five major Agency-wide procurements to achieve the following: (1) consolidation of IT networks leading to improved network management, (2) consolidation of desktop/laptop computer services and mobile devices to improve end-user services, (3) data center consolidation to provide more cost-effective services, (4) Agency public website management to improve access to NASA data and information by the public, and (5) Agency business systems development and maintenance to provide more efficient and effective business systems. NASA will also continue to improve security incident detection, response, and management through the Security Operations Center.
- The request for the *Innovative Partnerships Program* (IPP) is \$184.8 million. IPP works with all four Mission Directorates to provide innovations meeting NASA's technology needs, and transfers NASA technology for broad Spinoff applications that improve quality of life and contribute to economic growth. Included in the IPP portfolio are: NASA's SBIR/STTR Programs seeking out innovative high-technology small businesses; a new Innovative Technology Project seeking high-impact revolutionary research and technology projects; a Seed Fund to address technology needs through cost-shared, joint-development partnerships; use of commercial flight services by the FAST program to demonstrate new technologies; Innovation Ambassadors to exchange ideas; and the Centennial Challenges prize program for the citizen inventor. IPP seeks partnerships through offices at all 10 NASA Centers.
- Finally, NASA is requesting \$29.4 million in FY 2010 for the *Strategic Capabilities Assets Program* (SCAP). This program funds the costs required to sustain key Agency test capabilities and assets, such as an array of flight simulators,

thermal vacuum chambers, and arc jets, to ensure mission success. SCAP ensures that assets and capabilities deemed vital to NASA's current and future success are sustained in order to serve Agency and national needs. All assets and capabilities identified for sustainment either have validated mission requirements or have been identified as potentially required for future missions.

Conclusion

The President's FY 2010 budget request for NASA supports the Administration's commitment to deploy a global climate change research and monitoring system, funds a robust program of space exploration involving humans and robots with a goal to return Americans to the Moon by 2020 and explore other destinations, and funds the safe flight of the Shuttle to complete assembly of the ISS through its retirement, planned for the end of 2010. The FY 2010 budget request funds continued use of the ISS to enable the Agency to develop, test, and validate critical exploration technologies and processes and, in coordination with our international partners, to make the ISS available support other government entities, commercial industry and academic institutions to conduct unique research in the microgravity environment of space. It will also stimulate private sector development and demonstration of vehicles that may support NASA's cargo and crew requirements. And it renews NASA's commitment to aeronautics research to address fundamental aeronautics, aviation safety, air traffic management, and mitigating the impact of aviation on the environment. NASA's diverse portfolio of science, technology, engineering and mathematics (STEM) educational activities is also aligned with the Administration's goal of improving American innovation and global competitiveness. NASA looks forward to working with the Subcommittee on implementation of the detailed FY 2010 budget request.

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

Senator NELSON. Senator Vitter?

Senator VITTER. Great. Again, thank you, Mr. Administrator, for being here. We had a good meeting in my office recently, and thank you for that. I am going to cover a little bit of that ground because I think it is important to discuss publicly.

As I said in my office, I applaud the appointment of Norm Augustine who has enormous background and credibility to lead the current review that is going on right now. But I am very concerned about the constraint he was formally given. He was told basically to review and look at options but with the absolute constraint that the present budget numbers would be honored and basically told not to consider anything above that line.

Now, we obviously need to be aware of costs and that needs to be part of the discussion. I am not disputing that, but I think not to consider anything above a certain arbitrary line, even slightly above it—if you read the directive, that is what it says. I hope it is not acted upon in that spirit, but that is what it says. How can that review be full and adequate and completely productive with that arbitrary budget constraint?

Mr. SCOLESE. Well, I think you characterized the intent of the review accurately, which is to go off and look at human space flight from now forward, look at extending the Space Station, and developing options to accomplish the goals of returning humans to the moon, getting them out of low Earth orbit, and supporting the Space Station.

Yes, there is, as you said, a fiscal constraint to stay within the budget. But I think it is fair to say that Norm Augustine and the team is going to be looking at it, and if they cannot find a solution that fits within the budget or an option that fits within the budget, then I am sure they will provide other options.

Senator VITTER. Well, I mean, it seems to me there have to be options that fit within the budget, but that in and of itself is a very constrained question. It seems to me the better question is what are all of the options, what are the costs of all of the options, and then we can make a reasonable cost-benefit judgment based on what the option accomplishes and what the cost is. And there could be some very good options that might be slightly above that line.

Do you think in practice he will consider all of those options?

Mr. SCOLESE. I think he will consider all of those options. Which ones he will bring forward I cannot say. But I do think he will consider all those options.

Senator VITTER. Well, as I said in my office, I hope in practice the review is a little different than the directive on paper because on paper the review basically says ignore anything above this arbitrary dollar line. I think that is very limiting and counter-productive.

Now, obviously, cost has to be considered, but let us understand all the reasonable options, the true cost of all the reasonable options, and then make good decisions.

Mr. SCOLESE. I understand that, yes, sir.

Senator VITTER. The second big concern that we talked about in my office is that while this review is going on—and admittedly, it is supposed to report pretty quickly in August, but while it is going on, contractors around the country, including Michoud in Louisiana, are proceeding with plans, in some cases, to lay off folks or to give notice to folks, which are premised on the old Bush administration stated policy that we are not going to fly the Shuttle after 2010 basically no matter what.

Now, that policy has changed, as I understand it, and the present policy is that we are going to fly all of the planned missions and we hope to fly them by 2010, but if it happens to slip a little bit, we will deal with it and we will still fly them.

What assurances can you give us that that new directive has gone to the contractors and they are being asked to stop any actions in the next few months, which could basically get in the way of certain future options that Norm Augustine and his panel may very well suggest to us?

Mr. SCOLESE. Certainly. First, let me say that flying the Shuttle safely is our number one priority. We must do that. In order to do that, we need the people, the people that have been supporting this program for years, continue to support the program, are making the mission that is flying today a success. So we need all of those people to be there and support the program right up until wheel-stop on the very last mission that flies, whenever that is.

The way we are working that is, of course, working with our contractors and working internally to provide people with options, one, to retain the work force. We are trying, wherever possible, to give people opportunities to work on the next program, the Constellation program, Orion and Ares. So they are working Shuttle. They are also working Constellation activities. This way they know that when Shuttle comes to an end, they will have something to go to.

We are also making sure that we have the workforce that we need for each element to support that last Shuttle flight. So we are retaining those people and those capabilities and those testing that

we will need to fly that last one. And that we can do within NASA and we can make sure that those people are there.

We are also working with the contractor community and talking to them to get retention bonuses so that people will stay on. That has not proven to be a problem. This workforce is extremely dedicated, very loyal to the program, as you all well know.

In the interim, as we are working through all of these, I have spoken to Lockheed and there will be no more notices for layoffs at least until the fall when we get through the review with the Augustine review panel. We are working with them to minimize the amount of impact that will be coming by placing people on other contracts or retaining them in other activities within Lockheed. So we are working actively with the contractor community to retain the workforce and minimize the impacts.

Senator VITTER. Specifically at Michoud in Louisiana—and I bring that up because I know a lot about it not because it is the only important thing, but just as an example. We were told yesterday that there will still be notices that were planned a long time ago in June and/or July. That is inconsistent with what you just said. So if we can figure out which is correct.

Mr. SCOLESE. Well, I think there are two things being said. There were notices given earlier this year. Those will be effected in the June/July timeframe. Any new notice will be after that in the fall, and we are working with Lockheed to minimize the impact of those reductions.

Senator VITTER. We will work with you to double check that, but that clarification would make sense. I just want to make sure that is what is going on and there are not new notices starting in June or July.

Mr. SCOLESE. There are no new notices starting June or July.

Senator VITTER. Great.

Along the same vein, why would it not make sense for NASA, the Administration, the Congress, whomever, all of the above to reinstate the prohibition that expired on April 30, at least until we get the Augustine panel report?

Mr. SCOLESE. Well, as you know, we started the Shuttle retirement back in 2005 and stopped production. We did not continue production of elements that we did not need to carry out the manifest, as we understood it. So it has been going on since then.

The activities that we have done now is we have delivered the last tank or are in the process of delivering the last tank for the final Shuttle mission, as well as we are in the process of completing the engines for the final mission and other activities. So as we complete those activities, we need to stop because we do not have the materials to produce additional tanks.

But what we are doing is we are making sure that we are keeping the people, the people that we need, to service those equipment, should there be a problem, to analyze issues, should there be an issue, and to maintain those until, as I said, the last flight. So it is not a complete stoppage, if you will. We are trying to do it in a very logical, methodical and sensible way so that we can be prepared to deal with any issue that may come up as we fly out the manifest.

Senator VITTER. OK. That is all I have for now, Mr. Chairman.

Senator NELSON. Thank you, Senator Vitter.

Mr. Scolese, do you believe that there is any way that we can meet President Obama's commitment to a human mission to the moon by 2020, given the out-year numbers that came out last week from OMB?

Mr. SCOLESE. We are still looking at that, but I can say very truthfully that it is going to be challenging to meet that to the original plan that we had before.

Senator NELSON. I agree. I would echo what Senator Vitter said about the out-years numbers, and I have shared my dissatisfaction with Dr. Orzag and Dr. Holdren about that. But I am very optimistic that someone of Norm Augustine's quality and his experience is going to see through that and he is going to recommend what he legitimately thinks should be. So in that regard, I am not as concerned as you are, Senator Vitter, that Dr. Augustine will feel like he is constrained to use their numbers because you simply cannot do everything that NASA has to do if you leave those out-year numbers.

What is NASA's estimate of probability of completing the remaining missions on the Space Shuttle by the end of—well, let us make it easier—calendar year 2010?

Mr. SCOLESE. Well, actually I do not think I have that number. I have it till September 2010. As you know, we worked the manifest, and I would have to get you the exact numbers, but it is on the order of between 50 and 70 percent confidence that we can complete those missions by September 2010, depending on which model that one uses. And looking at a deterministic model where we actually just put in the data—so one is a probabilistic, the other is a deterministic—we have actually some margin to the September 2010 date.

But, of course, as you well know, we have to look at it essentially every week to make sure that parts are coming in when they are supposed to be coming in and that we are not having any issues. Of course, we have been known to have weather delays we well. So we have to work all those things, but our probabilistic models indicate that we can do it and our deterministic model indicates that we can make that timeframe. But, again, it is not the date anymore. We intend to fly out the manifest.

[The information referred to follows:]

As of March 2009, NASA estimated the probability of flying out the remaining missions in the Shuttle (including the Alpha Magnetic Spectrometer flight) by the end of 2010 as being 62 to 79 percent. These numbers were generated after the launch of STS-119, but before STS-125 and STS-127.

Senator NELSON. Which is what the commitment from the White House is.

Mr. SCOLESE. That is correct, yes.

Senator NELSON. And they have publicly stated that commitment.

I want to put on the record; since the *Columbia* disaster, what is the most number of missions that we have flown in a year?

Mr. SCOLESE. We will have to get that for the record. I believe it was eight. Oh, since the *Columbia* disaster. I'm sorry. No. I believe it was four, four or five.

[The information referred to follows:]

During the 12-month period between June 1, 2007 and May 31, 2008, NASA launched six Space Shuttle missions: STS-117, -118, -120, -122, -123, and -124.

Senator NELSON. I think the record will show four.

We are now in May 2009, and there are eight missions remaining. How many would be flown between now and September 30, of this year?

Mr. SCOLESE. We will have flown four missions between now and September 30th.

Senator NELSON. Of the four missions of—

Mr. SCOLESE. For this year, at the completion of this mission, we will have flown two this calendar year. We have one scheduled for June, one scheduled for August, and we had one before that. So in the fiscal year, it will be five.

Senator NELSON. OK, but between now and September 30—

Mr. SCOLESE. We will have two more missions.

Senator NELSON. Two more missions. So that leaves you six remaining.

Mr. SCOLESE. Yes.

Senator NELSON. And did you say that the probability is 70 percent?

Mr. SCOLESE. 50 to 70 percent. That is correct.

Senator NELSON. And you could fly the remaining six missions within a 12-month period.

Mr. SCOLESE. That is correct.

Senator NELSON. But you would never sacrifice any question of safety to get those six off.

Mr. SCOLESE. That is right. Schedule has not been a priority. It is safe flight of the Shuttle and its crews. We have to do that in order to do anything in space. So safety of flight is our number one priority, and that will determine when we fly ultimately. Our models are just that, sir. They are just models.

Senator NELSON. Will you notify us immediately if your assessment of probability changes?

Mr. SCOLESE. Yes. We keep routine updates of the manifest and we will continue to provide those. If we see that we are not going to make it, we will notify everybody when we start to see that.

Senator NELSON. You have been negotiating a contract with the Russians to provide launch services after the retirement of the Shuttle. Does that have a firm, fixed date at which those launch services would start?

Mr. SCOLESE. I would have to go off and look and see if it is a firm, fixed date, but it will begin after the completion of the Shuttle to carry crew to the station and bring them back. As you know, we have been relying on Soyuz since the beginning of the station program for crew rescue, and in the aftermath of the *Columbia* disaster, we were, of course, transporting crew on Soyuz. So we have been relying on Soyuz for some time, but you are correct. Following the retirement of the Shuttle, we will be relying on Soyuz exclusively to carry crew to and from the station, as well as for rescue.

[The information referred to follows:]

The two most recently signed contract modifications with the Russian Federal Space Agency (Roscosmos) for Soyuz crew transportation and related services provide a total of nine Soyuz “seats” for launches in the fall of 2011 through the launches in the fall of 2012. These services are independent of the Shuttle manifest,

as the Soyuz vehicle is required for the provision of on-orbit crew rescue capability for six-month periods; the Shuttle cannot provide this capability.

Senator NELSON. So the start date is not a problem. It is entirely dependent upon the length of time that the Shuttle flies.

Mr. SCOLESE. I will have to look specifically at the provisions. I cannot tell you that off the top of my head. As you know, we are still in the process of completing that contract. So I will have to take that one for the record and get back to you.

Senator NELSON. All right.

It has been reported in the press that you are negotiating a price of \$51 million per seat?

Mr. SCOLESE. That is correct.

Senator NELSON. And what do we pay per seat now?

Mr. SCOLESE. Approximately \$47 million per seat.

Senator NELSON. Per seat. And when was that price concluded?

Mr. SCOLESE. It was in the last agreement, which I would have to, again, get you the exact date of when that was done, but that has been probably since—I will have to get you the exact date. I do not have it off the top of my head.

The services, though, are for training, the flight to and from the station, and rescue capability, and any of the provisions that are required for a long-duration flight.

[The information referred to follows:]

NASA signed contract modifications for crew transportation and related services with Roscosmos on December 2, 2008, and on May 28, 2009.

Senator NELSON. How many seats is NASA committed to buy?

Mr. SCOLESE. We are committed, I believe, to buy six seats.

Senator NELSON. For example, you take three up on a Soyuz.

Mr. SCOLESE. Well, we do not pay for the Russians. So the cosmonauts would be theirs, and we pay for our crew members that we are responsible for, which include NASA members, ESA, and JAXA member, our partner members that we are responsible for.

Senator NELSON. In last year's authorization bill, there was guidance to NASA about COTS-D Space Act agreements to develop a U.S. commercial alternative to Soyuz. We authorized \$150 million in funding for COTS-D. I noticed that you are putting \$150 million of stimulus funds toward the Commercial Crew and Cargo program, but not actually initiating COTS-D agreements. Why are you not initiating these Space Act agreements?

Mr. SCOLESE. Well, we are working the commercial program as you defined. There was cargo on it. We have those two contracts with SpaceX and Orbital to do cargo. We had one for COTS-D. I cannot recall a specific—\$150 million to go on to COTS-D.

We did this year in the stimulus identify \$150 million to stimulate a commercial activity, and it is broken into two pieces: \$70 million to go off and develop capabilities that any visiting vehicle would need, including commercial vehicles, and that includes developing the human space flight rating requirements, the requirements that you need to be certified for human space flight. As you well know, we build human spacecraft and design them so infrequently that we have to write those requirements down. So part of this is to make those available to everybody, make them understandable to everybody, and that will help not only the commercial

providers broadly, but all of us. And then \$80 million to stimulate activity for a commercial crew.

Senator NELSON. We have 7 minutes left in the vote. I am going to recess the Committee, and I will be right back.

Mr. SCOLESE. OK.

Senator NELSON. Thank you.

[Recess.]

Senator NELSON. The Committee will resume.

I want to go back to the question that I had asked you earlier. You described the breakdown of how you intend to program \$150 million for Commercial Crew and Cargo. Instead of putting the dollars into the various component pieces that would enable crew capability, would it not make more sense just to invest that in a milestone-based demonstration flight?

Mr. SCOLESE. We discussed that, and we believe that we need to take a measured approach to developing commercial crew. As you know, again it is a very difficult prospect to develop a crewed vehicle to carry crews safely to and from space, let alone rendezvous and dock with the Space Station. So we are working a measured development where we work progressively from developing the capability to get into space, to conduct the rendezvous and docking with the Space Station, to crew rescue, which can be done without having to worry about crew escape, all the way up to carrying crew. That is the philosophy that we are working to achieve.

To do that, we needed to do some things that broadly help the community that wants to do this, as I mentioned earlier, about developing clear and concise specs and standards so that we can safely put our crew on those vehicles. And further, I think you have seen the annual report of the Aerospace Safety Advisory Panel that had some questions about the detail of our human rating requirements. So that is all part of what we are trying to accomplish, and we believe that will get us a commercial crew capability quicker and safer than if we were to just go off and suggest that we fund a capability.

Senator NELSON. But that was not what the legislation said. The legislation said that \$150 million was funding for COTS-D. In this case, you would not even have to pay until the COTS-D partner was able to successfully demonstrate that capability. Is that not right?

Mr. SCOLESE. It would be dependent upon how we structured it. Of course, we wanted to maximize competition for the vehicle. As you know, there is only one COTS-D provider.

Senator NELSON. Well, when I say "you," I am referring to NASA, and you were not the Acting Administrator at the time. This is an example of where NASA has not followed the legislation.

Now, let me ask you this. Would \$150 million be enough to demonstrate that capability?

Mr. SCOLESE. We would have to look at it, but I do not think so, sir.

Senator NELSON. Well, what do you think it would be?

Mr. SCOLESE. I would have to get back to you on that, but it would be several times that, I would expect, because recall, we have to develop not only the crew portion of it. We have to develop the life support systems, the launch escape systems, the recovery

systems. All of those have to be developed and demonstrated, and \$150 million does not seem enough to do that.

Senator NELSON. We had a unique opportunity, if NASA had listened and followed the law, we had a unique opportunity this year between the 2009 operating plan and the additional funds provided by the stimulus bill and the development of the 2010 budget to craft a COTS-D plan that would have funded the program at the level that the folks needed. That path was not pursued. NASA did not obey the law.

Again, I am not saying it to you because you are the Acting Administrator since January 20, but I want to point this out that sometimes NASA does not want itself to be helped. We have got to get our act together.

Senator VITTER?

Senator VITTER. Thank you, Mr. Chairman. Let me just go back briefly to these layoffs and WARN Act notices because we have gotten conflicting signals from this discussion and some previous discussions, and I just want to nail that down hopefully here, if not, as a follow-up.

[The information referred to follows:]

In 2006 and 2008, NASA issued competitive announcements seeking proposals for commercial cargo and crew transportation capability demonstrations. Based on the input received from commercial space companies who submitted proposals during those time periods, NASA believes the costs associated with a COTS-related crew transportation demonstration effort would exceed \$150M.

I think you said there would be no new WARN Act notices from Lockheed between now and the report. Is that right?

Mr. SCOLESE. That is correct.

Senator VITTER. Now, we have a briefing page from NASA, which is not necessarily inconsistent with that, but it says companies are expected to issue additional WARN Act notices over the next several months. Now, that may not be Lockheed. But are they expected from other contractors between now and the report, and is that advisable given that we do not know what the report will recommend?

Mr. SCOLESE. Well, sir, we have to be careful in how we report. I am not sure which report you are looking at, if you are looking at, I think, October of last year's report, which could be referencing that, in which case—

Senator VITTER. In terms of WARN Act notices, I am looking at a recent NASA briefing; in terms of the report, I am talking about the Augustine report.

Mr. SCOLESE. No. I understand but I do not know what the date of—

Senator VITTER. This is a briefing dated yesterday.

Mr. SCOLESE. Yesterday, OK. I have not seen that briefing, so it is hard for me to comment on it. We, of course, do not know when necessarily WARN Act notices will go out or if they are even necessarily related to the Shuttle, but we do work closely with the contractor community to understand what is going on. It probably will be better for me to explain what we are doing and how we are coordinating, and then I will go back and find out exactly what you are looking at and get you a specific answer to that question.

As I was saying, we are working hard to make sure that we retain the workforce that we need within NASA for the civil servants where we have direct control of what is going on. We do not anticipate a loss of work force. We anticipate a shift of the workforce as we move from Shuttle to constellation. To effect that and to keep people working, we are making sure that we have incentives to retain the people that we need who may want to retire, to encourage them to stay a little bit longer until we can fly out the Shuttle—that has not been a problem—to provide people with career paths, job opportunities on Constellation so they know they have a place to go to when the Shuttle goes away, but they know their prime job is to fly the Shuttle. The contractor workforce and civil service workforce is an extremely dedicated workforce that is doing a great job.

On the contractor side, we are trying to do the same thing. We have less control, of course, so we work with the contractor community to provide opportunities where we can and to encourage the contractors to provide opportunities for these people as they win contracts. We provide retention bonuses, funding to accomplish that so that people can stay, and provide support for retraining where that is appropriate. The contractors have been very good at trying to place people when there are displacements that are needed, and from what I can tell, they have done a very good job. Our estimates have always been high. So less people have been impacted than we have projected.

But as for the specific data that you have there, I have not seen it. I apologize for that.

Senator VITTER. Sure.

Mr. SCOLESE. I will have to go back and look at it.

Senator VITTER. If we can follow up just so that I can frame the question, this is from NASA yesterday about WARN Act notices and it says “companies are expected to issue additional WARN Act notices over the next several months as Shuttle manufacturing activities continue to wind down.” So it is Shuttle-related, not necessarily Lockheed. So your previous statement may be true. But it does seem to be expected between now and the Augustine report. So my question is, does that make sense between now and the Augustine report, when the Augustine report may suggest something that these actions make either impossible or very expensive to do.

Mr. SCOLESE. I understand. Again, I will get you the specifics because I cannot do that here. But we know that there is nothing that will make it impossible.

[The information referred to follows:]

Contractors issue Worker Adjustment and Retraining Notification (WARN) Act notices based on their projections of their total business. Space Shuttle contractors continue to reduce workforce as production, support, and operations milestones associated with the last flights are completed. Most of the drawdown activity is taking place through normal workforce attrition, primarily by not backfilling positions that become available through retirements, reassignments, or other kinds of voluntary separations. When plans call for workforce reductions in excess of normal attrition rates by a sufficient margin, Federal law requires contractors to issue WARN Act notices to employees 60-days prior to any potential involuntary separation activities. During that 60-day period, contractors continue to monitor their workforce attrition trends and will, if necessary, adjust their final termination notices accordingly. WARN Act notices may also be issued in cases where employees are “rebadged” from an incumbent to a new contractor.

WARN Act notifications associated with reductions in Shuttle contractor workforce planned for early FY 2010 were issued in late July.

The Administration will consider the options to be made by the Review of U.S. Human Space Flight Plans Committee, and take the appropriate next steps, in consultation with Congress. In the meantime, the Agency continues to implement established policy to retire Shuttle after the safe completion of the current manifest and the assembly of the International Space Station, which we believe can be accomplished by the end of 2010.

Senator VITTER. Well, nothing is impossible, but if something becomes triply expensive, it might as well be impossible.

Mr. SCOLESE. Well, I did not say it would not be expensive. I just said it would not be impossible.

Senator VITTER. Well, that is my point.

Mr. SCOLESE. I understand.

Senator VITTER. Exactly my point. It, as a practical matter, would be impossible.

Now, we have been talking a lot about Shuttle. The other way to close the gap is from the other direction. For instance, for Ares V and Altair development that was originally planned to start in 2011, I believe, and that is now beginning in 2013. What is the possibility of shifting that back closer to 2011? Is that a possibility and at what cost?

Mr. SCOLESE. Well, certainly for Ares V and Altair, it is possible to move those developments up. I would point out that for Ares V, we are actually making progress, as we work on Ares I because there are common elements. The Ares I utilizes the same solid or a similar solid to what the Ares V is planning on using, and the upper stage engine, the J2X, is the same between the Ares I and the Ares V. So as we are working on Ares I, we are also working on the Ares V. But, of course, if additional resources were available, we could, in fact, move up both of those activities. I believe they were ready to start in earnest more in the 2012 timeframe, but again, we can go off and look more into that.

Senator VITTER. OK.

The final question for now. In the past there has been some discussion that in my opinion exaggerated safety concerns about Shuttle use of the PRA tool and other things. Most recently, NASA's formal opinion is that there is a 98.7 percent probability of safely executing each flight planned as of now. Is that NASA's current confident estimation, bottom line?

Mr. SCOLESE. That number is not familiar to me. Are you looking at the range of numbers there?

Senator VITTER. I am looking at a NASA report, page 9. It is the Shuttle extension report, page 9. That says the latest Space Shuttle probabilistic risk assessment, PRA, indicates that the single mission risk for loss of crew and vehicle is 1 in 77. Stated another way—and this is what I quoted—there is a 98.7 percent probability of safely executing each flight. So is that NASA's current bottom line?

Mr. SCOLESE. Yes. In the appendix of that report, there is a variance that shows our confidence level and those numbers. While the PRA is a good indicator, it is not the only indicator. The Shuttle is a very complex vehicle to operate, and I think that is the best way to describe it and that report describes that as well. It is an aging vehicle as well. So it is more than just what is the prob-

ability that all the pieces are going to work. It is the likelihood that we are going to be able to deal with all of those issues as they come up. So, yes, the numbers that you quoted are exactly right, but our uncertainty, which is in the appendix of that report, shows that there is a reasonably large error associated with those numbers—or error bar, as we call it, associated with those numbers.

Senator VITTE. That is all I have right now, Mr. Chairman.

Senator NELSON. Senator Isakson?

**STATEMENT OF HON. JOHNNY ISAKSON,
U.S. SENATOR FROM GEORGIA**

Senator ISAKSON. Thank you, Mr. Chairman. I apologize for missing your testimony and being late. I really was anxious to hear it. I just really have a couple of questions.

The last Shuttle flights are next year. Is that right?

Mr. SCOLESE. That is correct.

Senator ISAKSON. The budget request that I show here is \$18.68 billion in 2010 and basically roughly the same amount of money over the 4 years succeeding. Is that a sufficient amount to develop the next generation craft that will fly?

Mr. SCOLESE. It will allow us to proceed on the development of those vehicles, yes.

It was asked earlier if that would support the 2020 lunar landing, and I stated then and I will state again that that would be a challenge. We are still in the process of evaluating what the budget represents in terms of human lunar return and the time-frame for that. So talking about a 2020 date, that would be a real challenge to make the 2020 date with that funding level.

Senator ISAKSON. But development of the vehicle and test flying it in orbital test missions is achievable. It is going to the moon by 2020—

Mr. SCOLESE. Yes. In fact, the budget provides a greater opportunity to make the 2015 initial operational capability that we were talking about. The budget provides us funding in the early years where we really need it to get the initial operational capability where we end up with, in the Constellation program, the program that is developing those vehicles, approximately \$630 million additional in 2009 and 2010. So that provides us greater assurance of making that 2015 initial operational capability.

Senator ISAKSON. When the Shuttle stops flying next year and the next generation is in development, there is about a 5-year period in there. Are the Russians going to do all the shuttling back and forth to the Space Station?

Mr. SCOLESE. Yes.

Senator ISAKSON. Will we fly with them?

Mr. SCOLESE. Yes.

Senator ISAKSON. Is it Kazakhstan where they go out of?

Mr. SCOLESE. Yes. They fly out of Kazakhstan, yes.

Senator ISAKSON. One other question. There has been some written about the Chinese space program and their goal to go to the moon. How vibrant and rich is their space program right now from what you know?

Mr. SCOLESE. From what we know, their space program is very vibrant and very rich. They are doing a lot and they certainly have

significant capabilities. We do not actually know what their ultimate objectives are, but they certainly are building the capability that would allow them to go to the moon if they chose to at some point in the future.

Senator ISAKSON. My reason for asking is I am fascinated by space exploration and envious of the chairman and his experience in so doing, but I think we must remain competitive in the advancement of space. We reacted to the Soyuz quickly—not the Soyuz, but *Sputnik* quickly in the 1960s. I was around then and remember that day when we thought we were behind and we leapt ahead. I think it is important for us to remain competitive and stay ahead, critically in the best interest of this country.

So I appreciate what you do and thank you for your testimony.

Mr. SCOLESE. Thank you.

Senator NELSON. Senator Isakson, you were not here when we talked about how the Administration has committed to continue to fly the Space Shuttle for the remaining eight flights until the Space Station is completed. NASA says it has a probability of 50 to 70 percent likelihood that they could fly out all of those Shuttle missions by the end of 2010.

There are a considerable number of folks, yours truly included, that feel like that that is not a realistic flight schedule. We provided for that in the budget resolution that we passed by adding another \$2.5 billion in budget authority and outlays in Fiscal Year 2011, should the Shuttle have to continue to fly in 2011 to complete the Space Station.

The budget that the President has submitted, identifies \$400 million in Shuttle retirement costs not previously accounted for. And it transfers those funds from the exploration budget. Now does that \$400 million include retention incentives to retain critical workforce personnel until the final Shuttle mission is completed?

Mr. SCOLESE. I would anticipate that it does. I have to look at the exact details, but it is intended for that. Transition and retirement would include those, yes.

Senator NELSON. Would you get back to us on that?

Mr. SCOLESE. Yes.

[The information referred to follows:]

The \$400M is specifically to conduct Shuttle Transition and Retirement (T&R) activities. Severance and Retention (S&R) is funded separately within the Space Shuttle Program budget. The S&R work helps maintain a high-quality Space Shuttle workforce through the use of appropriate retention strategies, and also provides severance for particular specialties. The NASA funding plan for S&R efforts is as follows:

- FY 2009 = \$16.0M
- FY 2010 = \$165.0M
- FY 2011 = \$95.7M

Senator NELSON. Do you anticipate additional close-out and retirement costs being identified over and above the \$400 million?

Mr. SCOLESE. There could be. That is an estimate based on what we know today. So there could be additional costs as we learn more about what needs to be done. But that is our best estimate as of today.

Senator NELSON. In last year's authorization bill, we emphasized the importance of the ISS as a National Laboratory. It was Senator

Hutchison who, about 5 years ago, in the NASA authorization bill had first designated the Space Station as a National Laboratory. In that authorization bill, we directed NASA to develop a national lab management plan. We emphasized in there KSC's space life science lab, as an asset of the Space Station national lab. Is there any effort underway to develop a separate funding line for ISS national lab activities?

Mr. SCOLESE. We are working the ISS as a national lab, and we have identified resources in the Constellation program and in the station program to do that. So I guess the answer is, yes, we are doing that.

Senator NELSON. OK. Would you get back to us with the details on that?

Mr. SCOLESE. Yes, we can do that.

[The information referred to follows:]

At this time, there is no separate funding line at NASA for ISS National Laboratory efforts. While creating a separate line for this work is an option, it is one NASA would have to review as part of the annual budget formulation process. The intent of the National Laboratory initiative is to accommodate the missions of other U.S. government agencies, private firms and non-profit institutions. The NASA investment is limited to the funds required to enable these partnerships and thus stimulate their investment.

Senator NELSON. For the Space Station to function as a National Laboratory, it has got to have the ability to bring cargo back, the down-mass capability. Obviously, we are going to be limited once the Shuttle is retired in that down-mass capability. What is NASA going to do to address that need?

Mr. SCOLESE. We are working the down-mass with our partners, of course, and also with the commercial cargo to go off and address that. So we are working our plans to go off and develop that. That will be an evolving activity, as the commercial cargo comes on line, our ability to work with the Soyuz and with our European and Japanese allies on pulling this all off. So that is an evolving capability that we will be working.

But you are absolutely right. I mean, as we use ISS more and more—and you know, we are getting a six-person crew beginning this month. So we are starting now to use ISS for what it was intended, as a laboratory. In the near term, we will be able to use the Shuttle, and in the longer term, we will have to use these new capabilities until we get to full-up capability with Orion and be able to carry down about the equivalent down-mass that we got with the Shuttle.

Senator NELSON. So until you get Orion, your down-mass capability is only Soyuz?

Mr. SCOLESE. And whatever we can develop with the commercial capabilities and with our European and Japanese colleagues.

Senator NELSON. Well, how far along in their development are they?

Mr. SCOLESE. Not very far along. Well, they are far along in delivery of capability. In terms of down-mass, that is still a capability that has to be developed.

Senator NELSON. So we really do not have a down-mass capability except what you can stick in the Soyuz. Well, that is hardly

any because you have not got a lot of room in there to cram anything in, do you?

Mr. SCOLESE. Well, there is some room, but we are also looking at ways of accomplishing the goals that would be achieved by bringing down-mass down by doing it on the Space Station and getting that data down-linked to the Earth in effective ways. As you know, we do that with our robotic spacecraft that are sitting there on Mars doing experiments. Here we have the capability of having people doing those and collecting the data and down-linking that as well.

So we are looking at many ways of bringing the information back if we cannot bring the samples back. So we are going to do both. We are going to try and bring the samples back to the best ability that we can, and we are going to evolve as we learn more and more. In the absence of being able to bring the samples back, we are going to get the data back in a way that the researchers on the ground can use it effectively.

Senator NELSON. Would you share the specifics of that with us? That sounds very promising if you can do data links and bring them back. Share with us what we are going to sacrifice in the way of down-mass until we get Orion.

Mr. SCOLESE. OK. We can provide that information to you.

[The information referred to follows:]

It should be noted that while both Soyuz and Orion will be able to provide a modest amount of downmass, NASA will rely on industry to provide both up- and downmass to and from the International Space Station (ISS) after the retirement of the Shuttle. The Agency has signed two Commercial Resupply Services (CRS) contracts for these services. For the period between 2010 and 2015, one of the CRS vendors is under contract to provide a minimum of 3 Metric tons of downmass; the projected. ISS downmass requirement for the same period is 9.6 Metric tons. NASA is working with researchers to encourage minimization of down-mass requirements through increased use of data products produced on orbit that can be digitally down-linked. The down-link capacity on ISS is scheduled to be upgraded to 300 megabytes per second to serve this purpose.

Senator NELSON. As you should have been briefed, last year's authorization bill required a number of reports from NASA. One of the overdue reports is to identify other Federal programs that can use the workforce and facilities that will become available when the Shuttle retires. There happen to be some facilities in New Orleans. There happen to be some facilities in the Kennedy Space Center and others.

Now, that report was due in March and this is the end of May. When can we expect that report?

Mr. SCOLESE. I will have to look back. It should be available in the next month.

[The information referred to follows:]

NASA completed the Aerospace Skills Retention and Investment Reutilization Report and submitted it to Congress on July 22, 2009.

Senator NELSON. NASA has based its Ares I/Orion initial operating capability date as March 2015 on a 65 percent confidence calculation. Is that IOC date still based on that confidence level?

Mr. SCOLESE. That is the confidence level that we are targeting. We develop our confidence level at approximately the preliminary design review which is scheduled for being completed early next

year. That is the time when we will say specifically what date and what confidence level. However, all of our indications right now are that we are working toward that date and that confidence level, March 2015 and 65 percent confidence level. But we still have more work to do to validate that.

Senator NELSON. OK, 65 percent.

There seemed to be a number of changes that you are considering in the Orion spacecraft in order to improve the chances that you are going to make that 2015 date. One change includes cutting the crew from six to four. When do you expect to make a decision on those changes?

Mr. SCOLESE. Again, those are all part of the preliminary design review which is going on right now. The changes, for the most part, are to improve performance and improve reliability of the vehicle. In any design process, one wants to sit down and go off and understand that.

We have not given up a six-person crew. What we are doing is we are looking at the design. We are looking at what we need to do in order to support the initial operational capability so we can provide higher confidence. We are looking at the design to see where we can make improvements.

Two areas of improvement that are worth mentioning that resulted in design changes are the launch abort system where we revised that to more effectively cover the crew module so that we can reduce acoustic loads which makes it safer and better for the crew as they are on ascent and makes it better if they have to abort. We also changed the power system so that it would be more reliable in orbit during the mission so that we could have a higher confidence of completing the mission.

So many of these changes are being done as we are learning what it is that we are doing in this design process, and it has to be remembered that we still have not completed our preliminary design of this vehicle yet. So there may still be other changes. They are getting smaller and smaller as we get smarter and smarter, and we get further along on the design.

Senator NELSON. When is that design review?

Mr. SCOLESE. It is scheduled for the early next year time-frame when it is all going to be complete. We do it in stages. We do the elements and then we do the entire system. So we will do Ares. We will do Orion. In fact, we have done Ares already. We will do Orion later this summer/early fall. And then we will do the entire system where we look at the ground system, the spacecraft, the launch vehicle, and all the associated elements in the early part of next year.

Senator NELSON. I want to ask you a question specifically about the workforce at the Kennedy Space Center. Initially you were going to absorb some of the job losses when the Shuttle is retired, which you say is going to be in 2010. I think it is going to be 2011. They were going to be absorbed by the work on the lunar lander. Now, given that the present numbers that came out of the President's office for the out-year funding, essentially eliminates some of that out-year lunar funding, when do you expect to have any updated workforce projections?

Let me say parenthetically that that question may be, and I hope it will be, answered by Dr. Augustine in his report.

Mr. SCOLESE. Well, that was going to be my answer. We will provide an updated workforce for Fiscal Year 2010 only. That is another one of the reports that you were mentioning next month. We will only look at 2010 because we do have the budget being looked at, the program being looked at. And then at the completion of the review this summer, we will update those workforce numbers, as well as the entire plan, if so needed. But we will update the plan based on the results of the review.

Senator NELSON. When do you expect that we will see the report on the mishap investigation and recommendation with regard to the orbiting carbon observatory?

Mr. SCOLESE. That is still in the works. It has proven to be a more difficult investigation than we all thought. The teams are working that. I would hope we have that done before the end of the summer, but it is taking longer. The problem has proven to be more difficult to identify and resolve than was originally assumed. But it is important to recognize it was a launch vehicle faring issue that we are working. It was not associated with the spacecraft or the instrument.

Senator NELSON. Another delay that was no fault of NASA's was the solar dynamics observatory and the lunar reconnaissance orbiter. That delay is because they have had problems with Atlas V launch slots. But that costs NASA money.

Mr. SCOLESE. Yes, it does.

Senator NELSON. How much?

Mr. SCOLESE. We will get you the exact numbers, but it is in the tens of millions of dollars. LRO and SDO are in different budgets. We will get you the specific numbers. And SDO is still TBD, of course, so we cannot give a final number until we actually have a launch date solidified. Right now, we are hoping that we can get it launched in October.

[The information referred to follows:]

The estimated cost impact to the Major Program Annual Report baseline of delaying the SDO launch by 15 months to November 2009 is \$58.0M. There continue to be issues with the Atlas launch vehicle fleet that will delay the launch of SDO beyond November 2009. NASA will provide additional cost information once the full extent of the launch delay is known. (*\$58.0M represents the increase in SDO's Base Year 2006 Development Cost of \$623.7 to \$681.7M.*)

Senator NELSON. You need to know that I think that this Committee ultimately, with regard to a very important satellite used by a lot of communities, including defense, the NPOESS. I think that you are going to see our recommendations to get to those problems, that NASA take more of the lead. I have been visiting with the Air Force about how they need to let you all be the lead on this.

In light of the independent review team recommendations, what does NASA see to be the best future options for NPOESS?

Mr. SCOLESE. Well, the independent review team recommended that there be a restructuring to have more independent oversight and insight into the development of that vehicle, and we agree with that. So whether NASA provides that capability, as you are suggesting, or whether the Air Force does that, it needs to be done. That is the critical piece, I think, that is being missed.

I believe the other recommendation they made was coming down and having everybody have a common understanding of what the

requirements and the goals are for this mission. We all need to get aligned on those goals, or else it will be very difficult to resolve issues as they come up.

Senator NELSON. You are initiating a green aircraft initiative that will work to reduce the fuel burn, the noise, and the emissions. Will it also include aviation biofuels?

Mr. SCOLESE. Yes. That is a component of the activity. The intent is to look at the entire chain, if you will, the air space system as well as the vehicle systems, to come up with a broader, more capable solution. Trying to find a solution in one area to reduce fuel or to reduce our dependence on a fuel type is not probably going yield the advantage that would happen by looking at it as a complete system where we adjust the aircraft system, the avionics, the air traffic control system, and how we fly our airplanes. So the intent of the program is to look at all of those things and bring those all together into a system approach to obtain better fuel efficiency and better safety, and biofuels would be a portion of that.

Senator NELSON. In your budget, a part that took a serious reduction is Center Management and Operations. Do you think this is going to significantly impact the field centers' ability to perform needed facilities maintenance?

Mr. SCOLESE. It is a challenge for us. It was an area that we adjusted based on our budget priorities, and it will have an impact. We are addressing that. We made it a priority last year to go off and prioritize our facility needs and our facility activities. Continued reduction in that would be a serious problem. So we are looking at that very closely to minimize future impacts. We have a plan that is laid out now that we believe will allow us to effectively manage our centers, but we cannot afford to change it very much from where we are today.

Senator NELSON. I promised you that I was going to get you out of here by 4 o'clock and it is 7 and a half minutes until 4 o'clock. We want you to know how much we appreciate your public service and that of all of the NASA team. We have to bore in on what we think are the shortcomings, but that does not at all diminish the hardy congratulations for the continuing can-do spirit and the team work that results in successes like we have just seen. So that is extraordinary, and we commend you for it.

What we are going to increasingly do with this new administration is hold NASA accountable. When we ask for reports, we as the separate legislative branch, expect those reports, and to have them on time instead of the slow walk that has occurred in the past. That is the way that we can have the legitimate sharing of information that we have to have between the legislative and executive branches in order to make and to continue this as a successful space program.

And without objection, Senator Hutchison's opening statement will be entered into the record.

[The prepared statement of Senator Hutchison follows:]

PREPARED STATEMENT OF HON. KAY BAILEY HUTCHISON, U.S. SENATOR FROM TEXAS

I want to welcome you to this hearing on NASA's FY 2010 Budget Request, and thank you for your service as Acting NASA Administrator. In such a time of transi-

tion, it cannot be an easy or comfortable place to be, but you have exhibited great competence, ability and dedication in filling that role.

I also want to take note of the outstanding work just completed by the STS-125 crew, who are scheduled to land tomorrow at the Kennedy Space Center, in not only restoring the Hubble to full service, but increasing its capability. What a tremendous example of the marriage of space science, astronomy and human spaceflight in completing a task that offers such a huge potential scientific reward. You have my thanks and congratulations for that, as well.

As we review the proposed FY 2010 Budget for NASA, we see an agency that is indeed at a crossroads. It is a crossroads we have foreseen, but it is, I'm afraid, one for which we have not adequately prepared.

We face the prospects of an extended gap in the ability to fly U.S. astronauts on US-owned launch vehicles to work on the U.S. segment of the U.S.-led International Space Station. At the moment, the only real, operational alternative we have to fill that gap is through the purchase of launch services aboard Russian Soyuz vehicles.

I don't know many who are especially happy with this circumstance. Certainly it is something we have been concerned about since this "transition plan" was first announced back in January of 2004.

Since then, this Subcommittee has made every effort and authorized sufficient funds and established policy guidance that could have made this situation less lengthy and less disruptive of our workforce and spaceflight industry. But the funds were not requested, and the funds were not appropriated, and now here we are.

As a result, the budget-makers have been driving our Nation's space program, rather than the policy-makers, in either the White House or the Congress. In my opinion, that is wrong and needs to be change. Policy should not simply be a consequence of budgets. That's not how this Nation gained its leadership position in space, and it's not how we can maintain it.

Hopefully, we will see a change in that practice. We have heard encouraging words from the President and from his Science Advisor, Dr. Holdren, and we have seen the initiation of an independent review by someone many of us know well and admire deeply, Mr. Norman Augustine.

I applaud the review of human spaceflight he will lead. It would have been better to have been started sooner, but we are where we are.

I hope that the Review effort can be freely and openly conducted and that the review team will be able to look at what the Nation really needs to do in the Human Space Flight arena, and not be limited by what the Office of Management and Budget wants to make available.

The Congress, working with the President, need to be given an honest appraisal of the options, a clear understanding of their respective costs, and then, together, decide what is in the national interest. Knowing Norm Augustine as I do, I believe he will provide us with that honest assessment.

I will have questions later, and for the record, regarding specific areas of concern and interest in the NASA budget.

Thank you again for your service, Mr. Scolese, and I look forward to your testimony.

Senator NELSON. Thank you all.

The meeting is adjourned.

[Whereupon, at 3:53 p.m., the hearing was adjourned.]

A P P E N D I X

RESPONSE TO WRITTEN QUESTIONS SUBMITTED BY HON. BARBARA BOXER TO CHRISTOPHER SCOLESE

Question 1. During the 1990s, NASA went through a wave of retirements and a persistent hiring freeze that has shifted the agency toward an older work force. Without a change in course, the proportion of NASA employees who are 50–59 years old will make up nearly half the entire civil-service workforce by 2014.

How does this budget support ongoing efforts to recruit the next generation of NASA workers, and encourage undergraduates to enter science, technology, engineering and math (STEM) fields of study? Has the increase of hiring term-limited employees under the previous Administration impacted the recruitment of younger employees? If so, how?

Answer. NASA's ability to inspire student interest and achievement in STEM fields of study is grounded in its unique mission, work force, facilities, research, and innovations. NASA's education programs create a pipeline to the future workforce by engaging students through a continuum of progressive opportunities from informal education to K–12 classrooms, undergraduate study, graduate programs, and development of institutional research capability. The NASA pipeline is designed to inspire, engage, educate, and ultimately employ well-qualified STEM employees in aerospace and support the future STEM workforce for the Nation. Specifically:

- NASA informal education programs build STEM-interest in the general public by providing NASA exhibits, workshops, and special activities at museums, science centers, planetariums, and the activities of community organizations and clubs.
- K–12 classroom activities are based on NASA missions and stimulate excitement in students. Educator training and professional development programs improve teacher proficiency and confidence in teaching NASA and STEM content.
- High school to undergraduate “bridge” or transitional projects ensure that high performing students from grades 9–12 are nurtured by NASA. Projects like the Interdisciplinary National Science Project Incorporating Research and Education Experience (INSPIRE) provide year-round activities and summer residential experiences that better prepare these promising workforce candidates for more in depth NASA higher education research and training.
- NASA's higher education budget supports the targeted development of individuals who are prepared for employment in disciplines needed to achieve NASA's mission and strategic goals. Graduates of these projects have had in-depth and hands-on experience with research and engineering that support NASA's scientific and exploration missions. Experiences include NASA/industry internships, scholarships, competitions, and engineering design work. These students, drawn from national audiences, are interested in, prepared for, and able to contribute immediately to the NASA/aerospace work force.
- The Office of Education budget builds academic infrastructures supporting STEM education, particularly in community colleges identified as Minority Serving Institutions (MSIs).
 - This approach results in an increased number of students studying STEM disciplines, particularly in traditionally underserved and underrepresented populations.
 - Students from these community colleges have a better chance of entering a 4-year institution and achieving in STEM fields. Community colleges are also a rich potential source of technicians to support the NASA missions.
 - A unique project, Curriculum Improvement Partnership Award for the Integration of Research, has been created to support the development of STEM curricula at community colleges as they lead the production of a diverse technical work force.

- Many MSI and non-MSI community colleges are served by the National Space Grant College and Fellowship Program (Space Grant). State-based Space Grant consortia provide NASA and aerospace content and involvement opportunities to students, faculty, and the public in that state. Community colleges that are engaged with Space Grants are able to enhance the STEM education experience of their students by leveraging resources, unique facilities, and experienced staff from larger universities.
- Educational technologies expand the reach of NASA STEM content to audiences that have completed NASA programs, or cannot easily access NASA Centers and facilities.
 - Members of the NASA Student Ambassadors Virtual Community will continue to interact with NASA, share information, make professional connections, collaborate with peers, represent NASA in a variety of venues (e.g., recruitment events), and help NASA inspire and engage future interns. The community's website provides the latest NASA news, announcements, member profiles, forums, polls, blogs, NASA contact information, tools for recruiting and public speaking about NASA, and links to cutting-edge research and career resources.
 - Telepresence technologies allow NASA staff to cost-effectively reach thousands of teachers and students nationwide. Social networks and virtual realities allow participants to share information about NASA's exploration mission in formats that more effectively meet the interests of today's younger audiences.

During the previous Administration, there was an increase in the hiring of term-limited employees as a percentage of all hires, particularly starting in FY 2003. In FY 2000–2002, the proportion of term hires ranged from 9–10 percent. In FY 2003, the percentage rose to 32 percent, and between FY 2004–2008 it ranged from 44–48 percent. At the same time, there was an increase in the “recruitment of younger employees”, for this purpose defined as employees between the ages of 20–29 years old. In FY 2000–2002, the proportion of younger hires ranged from 1–4 percent. In FY 2003, the percentage rose to 14 percent, and between FY 2004–2008 it ranged from 17–25 percent. Statistically, there is a strong correlation (linear relationship) between the increasing proportions of term hires and younger employees in the NASA recruitment program. This data suggests that doing more term hiring in recent years has been compatible with the NASA's long-standing goal of hiring diverse work force, including younger employees. Anecdotal evidence from Center human resources offices suggests that advertisements for term positions are attractive to younger candidates and that they generally do not have reservations about accepting term employment.

Trends in Perm-Term Mix and Age of NASA Outside Hires and CO-OP Conversions

FY 2000–2009**

Year	Total Outside Hires and CO-OP Conversions	Hires by Appointment Type			Hires by Age		20–29 as percent of Total
		Perm	Term	Terms as percent of Total	20–29 yrs	30 yrs or older	
FY 2000	911	816	95	10 percent	11	900	1 percent
FY 2001	853	768	85	10 percent	28	825	3 percent
FY 2002	592	536	56	9 percent	23	569	4 percent
FY 2003	683	462	221	32 percent	97	586	14 percent
FY 2004	1,101	571	530	48 percent	186	915	17 percent
FY 2005	1,056	576	480	45 percent	206	850	20 percent
FY 2006	1,211	682	529	44 percent	262	949	22 percent
FY 2007	1,351	747	604	45 percent	281	1,070	21 percent
FY 2008	1,546	850	696	45 percent	389	1,157	25 percent
YTD FY 2009*	539	392	147	27 percent	93	446	17 percent

* As of June 6, 2009.

Includes Outside Hires and CO-OP Conversion to Perm/Term Status, and does not include students hired into student/CO-OP Programs.

** Note: There is a strong statistical correlation (0.931) between the increasing proportions of term hires and younger (20–29 yrs) employees.

The Cooperative Education Program, a component of the Student Career Experience Program (SCEP), have consistently represented 2.5 to 3 percent of NASA's workforce over the last decade and continues to serve as a major pipeline into

NASA's entry level science and engineering work force. Upon completion of program requirements, most SCEP employees are converted and brought into the NASA work force. NASA centers have an active co-op program that funds training and development, tuition assistance, and travel for participants.

Question 2. For over 25 years, Landsat 5 has gathered thermal infrared imagery that water managers in Western States use to calculate agricultural water use. This valuable data has facilitated greater water use efficiency, negotiations on water rights, and changes in water usage to maximize economic and environmental benefits.

What progress has NASA made in including a thermal infrared sensor with the Landsat Data Continuity Mission (LDCM)? What additional authority does the agency need to guarantee the continuity of this important data?

Answer. NASA is developing a Thermal Infra-Red Sensor (TIRS) with the intent of integrating it on the Landsat Data Continuity Mission (LDCM) in time for the LDCM launch readiness date of December 2012. NASA estimates the cost of development of the TIRS instrument, integration of TIRS onto the spacecraft, and in-orbit check out of spacecraft and TIRS instrument to be \$131–151M. Congress has appropriated \$10M in FY 2009 to “initiate development of a thermal infra-red sensor” for LDCM. In its initial FY 2009 Operating Plan, NASA has identified a total of \$90.1M for TIRS instrument development: \$51.6M in FY 2009 funds appropriated as part of the American Recovery and Reinvestment Act (P.L. 111–5) and \$38.5M within the LDCM budget. NASA will address the matter of the balance of funds required to complete TIRS as part of the formulation of future-year budgets.

The TIRS instrument Preliminary Design Review (PDR) was successfully completed in May 2009, and the LDCM mission PDR is scheduled for mid-July. The instrument development is proceeding according to plan, but the schedule remains challenging. If NASA determines TIRS development cannot be completed in time for the December 2012 LDCM launch readiness date, NASA will examine its options for flight of the TIRS, including delaying the LDCM launch readiness date or flying TIRS on an alternate platform.

Question 3. The Ames Research Center in Sunnyvale, CA recently signed an enhanced use lease agreement with a group of universities led by the University of California, Santa Cruz and Foothill-De Anza Community College District. This agreement will allow these universities to join more than 50 industry, university and non-profit organizations already located in the NASA Research Park at Moffett Field. These lease agreements have been instrumental in facilitating science and technology education and fostering a community of researchers, students and educators whose work will help keep the United States at the forefront of technological innovation.

How have the restrictions on enhanced use leases passed as part of the FY 2009 Omnibus Appropriations Act impacted NASA's ability to meet the terms of these leases? What progress has the agency made in reviewing existing enhanced use leases to establish a uniform policy that supports collaborative efforts such as those established at the NASA Research Park in California?

Answer. The limitations on obligations of expenditure of Enhanced Use Leasing (EUL) revenue in FY 2009 will not have an impact on the NASA Centers. After careful review, it was determined that original estimates provided to Congressional staff for EUL revenue mistakenly displayed reimbursable services for Federal tenants. Since Federal tenants do not pay rent, and their reimbursable services are not procured through EUL authorities, they should not have been included in the estimates.

With this correction, total estimated revenues from EUL decrease to: \$3.3M for FY 2007; \$5.1M for FY 2008; \$6.2M for FY 2009 and \$7.1M for FY 2010. The FY 2009 revenues are less than the \$9M limitation in the FY 2009 Omnibus Appropriations Act.

Based on the enactment of Agency-wide EUL authority, NASA has undertaken a review of the Agency's experience and lessons learned from the NASA EUL demonstration program. As a result, NASA is updating policies for out-leasing NASA facilities and land, including an updated NASA Procedural Requirements document (NPR 8800.15) and an updated EUL Desk Guide. The revised policies will establish a uniform EUL policy across the Agency, managed by NASA Headquarters.

Question 4. California is home to a suborbital reusable launch vehicle industry that is successfully developing commercial vehicles for research as well as tourism. Researchers at NASA Ames Research Center have been evaluating the use of these vehicles to conduct lower cost suborbital research—an expansion of which was authorized by the NASA Authorization Act of 2008 (P.L. 110–422). What progress has

NASA made in expanding the suborbital research program? How does this budget provide for and support research using suborbital reusable launch vehicles?

Answer. NASA runs a very active suborbital science program consisting of conventional aircraft used as airborne laboratories, scientific balloons, and most recently, unmanned aerial systems. The NASA Dryden Flight Research Facility operates the ER-2 the DC-8, and two Global Hawk unmanned aerial vehicles used for NASA Earth Science missions, and manages the development and operations of the Stratospheric Observatory For Infra-red Astronomy (SOFIA). The NASA Ames Research Center hosts the SOFIA science and mission operations center.

With regard to emerging human suborbital launch vehicles, NASA is studying the use of commercially available, passenger carrying suborbital rockets as platforms to conduct research in areas such as physiological research at the onset of weightlessness, and demonstration and validation of technologies in the microgravity environment, and has created a Human Suborbital Flight effort led by the Space Operations Mission Directorate. As these emerging capabilities become available, NASA will work with providers through a competitive process to acquire services that support Agency users.

NASA's Science Mission Directorate (SMD) is always interested in any platform that enables high priority Earth and space science. The SMD has issued multiple calls for Earth and space science investigation ideas. SMD issued two Requests for Information (RFIs) (Feb/Mar 2008; Sep/Dec 2008) seeking expressions of interest in potential NASA science investigations and payloads/experiments taking advantage of the new platforms. The response was low for both RFIs, totaling only 6 responses suggesting a concept for an Earth or space science investigation (14 responses suggested ESMD-relevant investigations). Even so, a NASA Research Announcement was issued (Aug/Dec 2008) seeking proposals for funded concept studies in Earth and space science using any capability of the new platforms. Again, the number of responses was low—17 compliant proposals. These were subjected to standard community peer review. Most proposals fared poorly in peer review, rated as poor science or poor use of the platform. The only highly rated proposal was selected for a 1 year funded concept study ("Firefly on Demand", PI: Joanne Hill, USRA/GSFC, for study of terrestrial gamma-ray flashes emitted during thunderstorms and their impact on upper atmosphere energetics).

While these efforts have not identified uses for such platforms for the space and Earth sciences, NASA is continuing to explore this concept and the potential benefits it might bring to other areas of research and technology development. NASA is actively seeking out potential benefits through Commercial Suborbital Science Workshops, the most recent of which was held on May 3 in Los Angeles, and focused on biological sciences and aeromedical research. This event was held in conjunction with the Aerospace Medical Association's Annual Meeting. As an example, with many people potentially experiencing the weightlessness of suborbital space flight, large amounts of data could be collected for research into the physiological effects occurring during the onset of microgravity. Such data could yield important new insights.

Another application for suborbital platforms is in the demonstration and validation of technologies in the microgravity environment. NASA's Innovative Partnerships Program (IPP) has established a program for Facilitated Access to the Space environment for Technology development and training (FAST) that is currently using commercially available services from the Zero-G Corporation for parabolic aircraft flights. The IPP through its FAST program intends to use commercially available suborbital flight services to extend the period of technology testing in weightlessness by an order of magnitude—from 30 seconds at a time to around 5 minutes, when those services become available. Since the vehicles to provide these services are still in various stages of development and testing, it will take time for this activity to mature although initial test flights may occur as soon as next year.

RESPONSE TO WRITTEN QUESTIONS SUBMITTED BY HON. TOM UDALL TO
CHRISTOPHER SCOLESE

Question 1. NASA's support of the commercial space industry has been successful in attracting new industry participants, driving innovation, and lowering the cost of access to space. What type of programs and funding are provided in the FY2010 Budget to build on this success?

Answer. As part of the Commercial Crew and Cargo Program and its associated Commercial Orbital Transportation Services (COTS) cargo projects, NASA is completing its promised \$500M investment to the two funded COTS partners, Space Exploration Technologies Corporation (SpaceX) of El Segundo, California, and Orbital

Sciences Corporation of Dulles, Virginia. Both companies continue to make progress toward achieving their specific milestones, and FY 2010 funding will be used to pay the companies once they have successfully completed their milestones.

The purchase of cargo services to the International Space Station (ISS) is being conducted through the separate ISS Commercial Resupply Services procurement effort. In December 2008, contracts were awarded to two service providers, Space Exploration Technologies and Orbital Sciences Corporation, for cargo delivery beginning as early as late 2010. The service will encompass all work required to integrate the launch vehicle, orbital vehicle, and cargo to perform cargo resupply missions to the ISS. The solicitations were for standard resupply service for any combination of the following: internal (pressurized) cargo upmass, external (unpressurized) cargo upmass, cargo return, or cargo disposal. A minimum of 40 metric tons (MT) of upmass is contracted between 2010 and 2015. Timely commercial cargo capability is critical for effective ISS operations. There is no planned back-up capability for ISS commercial cargo. Without commercial cargo capability, the crew size and research operations planned for ISS would need to be reduced.

In the area of launch vehicles, the Agency has initiatives in place to enable new entrants to the medium-class launch services arena to make an improved business case. In 2006, the Agency modified its NASA Launch Services (NLS) contract (by which it purchases small, medium, and large launchers for robotic missions) to allow new vehicles with no previous flight history to participate in the competition.

Previously, NASA required vehicles to have had at least one successful flight to participate. Under the NLS contract, companies may propose new launch service capabilities during “on ramp” opportunities in February and August annually. Space Exploration Technologies’ Falcon-9 vehicle is an example of an emerging launch vehicle that has taken advantage of this opportunity.

Also, several companies have asked NASA for support in the development of their vehicles, and NASA has issued two Space Act Agreements with companies to provide that support. Finally, NLS expires in June of 2010. In light of that, a Request for Proposals has just been issued, with meetings being planned for July 2009. The expectation is to complete the procurement process by June 2010. Further detail on these activities will be provided to Congress shortly as part of the NASA report on small- and medium-class launch services pursuant to Section 621 of the NASA Authorization Act of 2008 (P.L. 110-422).

In addition, the Innovative Partnership Program (IPP) has multiple programs that, if funded by Congress, will provide funding to stimulate commercial space flight in the FY 2010 budget to build on NASA’s initial success for attracting new entrants, including:

- *FAST*: Facilitated Access to the Space Environment for Technology Development and Training (FAST) provides opportunities for emerging technologies to be tested in a microgravity or fractional-gravity environment (e.g., Moon or Mars). Currently the program is focused on testing technologies on parabolic aircraft flights using commercially-available services from the Zero-G Corporation, flew technologies from five Small Business Innovation Research (SBIR) firms in 2008, and has competitively selected 21 technologies to fly this coming August. Starting in 2010, if funded, the FAST program plans to provide funding to the Human Suborbital Flight Program to begin testing technologies on commercial flights of suborbital RLVs. The Administration has requested \$2M for FAST in FY 2010.
- *Centennial Challenges*: Centennial Challenges is NASA’s program to award cash prizes for significant advances in technologies of interest to NASA and the Nation. The program encourages innovation in the private sector by seeking creative solutions from diverse and unconventional sources. Prizes offer a uniquely cost-effective means of technology development. No funds are expended until the technology advancement is actually demonstrated. Centennial Challenges includes several prizes that are directly stimulating commercial space and lower-cost access to space, including prizes for reusable rocket-powered vehicles, improved astronaut gloves, and robotic lunar excavation. The Administration has requested \$4M for Centennial Challenges in FY 2010.
- *SEED Fund*: The SEED Fund is intended to develop or mature technologies targeted at filling some of NASA’s technology gaps, in close coordination with the Mission Directorates. It is designed as a highly leveraged fund, with partners who have ‘skin in the game’ through cost-sharing in the technology development. Over the past few years, over 80 projects have been funded with every IPP dollar yielding an average of 3.8 dollars in total technology development. The SEED fund has previously funded new technology developments within the commercial space transportation industry, such as LOX-Methane engine tech-

nology from Armadillo Aerospace, new cryogenic fluid management technologies with Sierra Lobo, cryogenic tank technology from Orion Propulsion, and the FASTRACK to support flight testing on Zero-G and commercial suborbital platforms. The Administration has requested \$4M for SEED Fund in FY 2010.

- *SBIR/STTR*: The Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR) programs provides technology development opportunities for many small businesses, and many of those projects represent pathways to meet some of the challenges arising in the emerging commercial space industry. In this year's NASA 2009 SBIR solicitation, to create an even more direct linkage to the needs of the emerging commercial space industry, NASA is establishing a crosscutting topic on Low Cost Access To Space (LCATS). The goals of the LCATS topic are to provide more frequent and reliable access to space at lower cost for a wide variety of science missions. This topic provides potential research and technology development that may contribute to significant cost reductions and savings in the long-term that will enable NASA to refocus limited resources on missions beyond Earth orbit. Federal Government funding of SBIR activities is, by statute, a percentage of research and development funds.
- *Innovative Technology*: NASA has established an Innovative Technology Initiative to fund unique early-stage proof-of-concept projects from NASA employees and NASA partners. The initiative is designed to fund projects that have the potential to revolutionize NASA's work or to enable whole new capabilities, which includes projects targeted at low-cost access to space. The Administration has requested \$2.8M for "Innovative Technology" in FY 2010.
- *Partnership Development*: NASA enters into many partnerships with external organizations and companies to develop technologies of common interest and also to transfer NASA-developed technology for other "Spinoff" applications that can provide public benefit through quality-of-life improvements and economic growth. Many of these partnerships and transfers of technology benefit the emerging commercial space community. Some examples of this are: the licensing of inflatable technology to Bigelow Aerospace, which has enabled their impressive development of commercial space capabilities, and provision of software for numerous applications such as orbit determination software to DigitalGlobe, Inc. in support of their Earth imaging satellite missions. The Administration has requested \$23.8M for "Partnership Development" in FY2010 to support ongoing activities at all ten NASA centers.

Question 2. I am concerned about U.S. reliance on foreign countries for space launch. This is not only an issue in relation to the Shuttle's retirement. America went from being the No. 1 nation in commercial space launch to having only one commercial launch in 2006. What in this budget will help make America's commercial space launch program competitive with international rivals in Russia and Europe that currently dominate the market? How will you revive the American commercial space launch industry and bring those jobs back from overseas? How does the NASA FY2010 budget reduce the United State's growing dependence on foreign launch capability?

Answer. Please see the NASA response to Question #1, above, regarding NASA's efforts to promote the development and use of U.S. domestic launch vehicles by funding the ISS Commercial Resupply Services contracts and the NASA Launch Services contract (and its successors), as well as providing technical assistance to the developers of launch vehicles. Per the National Space Policy, NASA uses U.S. commercial space capabilities and services to the maximum practical extent for its missions. This helps create a stable demand for these services. NASA has initiated an independent review of ongoing U.S. human space flight plans and programs, as well as alternatives, to ensure the Nation is pursuing a path that is safe, innovative, affordable, and sustainable.

Question 2a. Why is there no further funding in the FY2010 budget for the Commercial Orbital Transportation Services (COTS) program?

Answer. The FY 2010 budget does include funding for the COTS projects, which are funded under the Commercial Crew and Cargo Program office budget line. For FY 2010, \$39.1M is included to pay for the milestones that NASA expects its funded COTS partners, SpaceX and Orbital, to achieve in FY 2010. The FY 2010 funding also includes \$20M to restore a funding reduction that was included in the enacted FY 2009 budget.

Question 3. What NASA funding, if any, is directed to enhance spaceport infrastructure?

Answer. NASA currently has projects funded at the NASA Wallops Flight Facility in Virginia which improve the Agency's infrastructure on the Wallops Island launch facility. The Mid-Atlantic Regional Spaceport will see indirect benefits from this work. This funding was provided by Congressional direction in the FY 2009 Omnibus Appropriations Act.

