

**COMMERCE, JUSTICE, SCIENCE, AND RE-
LATED AGENCIES APPROPRIATIONS FOR
FISCAL YEAR 2009**

THURSDAY, APRIL 3, 2008

U.S. SENATE,
SUBCOMMITTEE OF THE COMMITTEE ON APPROPRIATIONS,
Washington, DC.

The subcommittee met at 10:02 a.m., in room SD-192, Dirksen Senate Office Building, Hon. Barbara A. Mikulski (chairman) presiding.

Present: Senator Mikulski.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

STATEMENT OF HON. DR. MICHAEL GRIFFIN, ADMINISTRATOR

STATEMENT OF SENATOR BARBARA A. MIKULSKI

Senator MIKULSKI. Good morning. Today the Subcommittee on Commerce, Justice, and Science will come to order.

Today the subcommittee will hear from the National Aeronautics and Space Administration (NASA) Administrator, Dr. Michael Griffin, about the NASA budget request and its priorities. This is Administrator Griffin's fourth appearance before the CJS Subcommittee and we feel that we have a very good, productive relationship with both him and his team.

There are many issues facing NASA and there is also good news. And we look forward, as we talk with NASA, about its tremendous history.

This year we honor important milestones in America's space program. It is the 50th anniversary of NASA's creation. It is the 25th anniversary of when Dr. Sally Ride became the first American woman in space. But we want to be sure that NASA is not an agency with a great history, but with a great future.

We regard this year as a year of transition. We say this is a year of transition because this time next year we will have a new President, but whatever we do for this year's appropriation for fiscal year 2009 will be the operating budget for the President's first year for the space program. So we have got to get it right as the new President comes in. So as the chair this year, I want to make sure we put the right resources in the right places in the checkbook to make sure America's space program remains number one in the world.

When I looked at the President's budget for NASA, I was disappointed. I regarded it as stagnant despite the advocacy both from

the agency and externally. The President's budget request is \$7.6 billion. This is only \$300 million above the 2008 omnibus level. This 1.8 percent increase does not even keep up with inflation when one simply looks at rising energy costs. Science is held steady at \$4.4 billion, and though it does include launch plans for the decadal study, it is only 5 of the 17 priorities.

Of deep concern to this subcommittee are the cuts in aeronautic research. It is cut by \$65 million, for a total of \$447 million. We feel that aeronautics is so crucial to the future of America's aerospace industry. And once again, regrettably, there is no additional funding to help pay back NASA for the cost of returning the Shuttle to flight after the terrible accident a few years ago. And it also perpetuates a 5-year gap between the Shuttle's return in 2010 and the launch of Orion and Ares in 2015.

So we are worried about lost opportunities and we want to restore those opportunities and keep America's space program number one. We continue to face challenges from other countries. We know China is on the rise with its capability and its intent. Russia is always there, and we do not see this like a war for space, but we do say who is going to be the premier space agency. We want the United States to continue to lead the way not only for national prestige and honor, also not only for national security reasons, but the fact that we believe that our values, as we became the first in space, were that space belongs to the world and does not belong to a single nation.

Anyway, coming back to where we are, I will continue in my fight, joining with Senators Shelby and Hutchison, to fight again this year to add the \$1 billion to deal with the cost that was incurred in returning to flight after the *Columbia* accident. It should not be a question of whether we should or should not. It is just a question of doing it.

We are also going to remember the original Augustine Commission which says we need to have a balanced space program of human space exploration, a reliable space transportation system, and investments in science and also investments in scientific research.

For science, the budget request of \$4.4 billion is what the President requested. Science at NASA is guided by decadal reports prepared by the National Academy of Science. It also guides this subcommittee. These decadal reports are road maps for NASA. Science at NASA is something that is so important because it saves lives, saves the planet, and creates jobs for the future.

So I am puzzled why the science budget has been flat-funded for this year and for the next 5 years. We need to maintain our very important commitment to Earth science and the role that it plays in global warming. Missions like Ice, Clouds, Land Elevation Satellite (ICESat) and the tropical rainfall measurement mission (TRMM) measure and monitor the world's ice sheets and rain forests. We also need to have science that takes us into new breakthrough thinking like a great telescope like Hubble whose life we will extend and also the James Webb telescope. If you liked Hubble, you are going to be crazy about the James Webb telescope and what it will do for those advancements.

Again, aeronautics. In 1998, the aeronautics budget at NASA was \$1.5 billion. Today it is less than \$500 million. Every commercial aircraft flying today uses technology developed by NASA. We must maintain this leadership, and we see, as we travel the world, how competitive aerospace is becoming.

The budget request for the Space Shuttle is \$3 billion. It calls for 10 more flights to the Space Station by 2010 and one flight is reserved to service the Hubble telescope. Retiring the Shuttle and transitioning the workforce will be major challenges for NASA. The United States cannot afford to lose our science and engineering talent. Therefore, we need to look at what will be our employment plan.

As always, no matter what we do, the safety of our astronauts has to be number one. The budget request for exploration is \$3 billion. It is over \$600 million above 2008, and this subcommittee, chaired by both myself and Ranking Member Shelby are absolutely committed to the goal of returning U.S. astronauts to the Moon and maintaining a presence there. We estimate that it will cost \$16 billion to build Ares and Orion. While this is a significant investment, we again continue to be disturbed by the gap of almost 5 years between the retirement of the Space Shuttle and the launch of Orion and Ares. I want to know what we can do, as we engage in our conversation, to minimize the time gap and minimize the impact on the workforce and what is our path forward.

The Space Station is \$2 billion, \$200 million above the omnibus level. It is a national laboratory. We must keep our international commitments. We need to make sure we finish the station and we also need to continue to have access to the Shuttle which goes to our partnership with the Russians and the commercial orbital transportation services (COTS) program. I fully support the COTS program which is funded at \$170 million.

We have a tough road ahead as we put together our bill. It will be the intention of the committee to have our bill completed before the Memorial Day recess so that we can be ready to fly our space ship, the CJS bill.

So having laid that groundwork, we are going to turn to Administrator Griffin.

But I want the record to show that Senator Richard Shelby is not here because his duties as the ranking member of the Banking Committee have him on the floor. He is the lead ranking member on moving the bill to deal with our terrible, terrible housing and foreclosure crisis. Senator Shelby must be on the floor, but we assured him his views would be presented here. We will submit his statement and questions for the record. He has questions about the future of robotic missions to the Moon, the NASA education program, the gap in human space flight, and issues related to accountability and stewardship. I too share those questions. Without objection, we will put these in the record and I will proceed.

[The statement follows:]

PREPARED STATEMENT OF SENATOR RICHARD C. SHELBY

Thank you, Madam Chairwoman.

Dr. Griffin, thank you for joining us today. This is an important hearing because it gives us an opportunity to discuss the significant role of the National Aeronautics and Space Administration (NASA) and its fiscal year 2009 budget proposal.

NASA's proposed budget is \$17.6 billion. This is a \$300 million, or 1.8 percent, increase over the fiscal year 2008 funding level. This is a sizeable sum considering the funding constraints that the Federal Government faces, yet it still does not begin to provide enough for NASA to do all of the critical missions it has been asked to do. Therefore, the Committee continues to be posed with many difficulties as we try to develop a sound budget for NASA.

The budget reflects funding choices that have been made by the Administration to achieve the goal of returning to the Moon, providing a \$357 million increase for the Exploration account.

However, without overall growth in NASA's base budget, this translates to either little growth or even serious cuts in funding for other critical missions and activities. The budget keeps science funding flat for years to come, as well as proposing serious reductions in aeronautics and education programs.

The proposed budget continues to force the development and operation of manned vehicles to compete with science and education for limited funding, making balancing NASA's budget increasingly difficult.

When the President proposed his vision for returning to the Moon, he outlined a funding plan that showed what it would take to continue our leadership in space exploration. Yet, the funding levels that were initially proposed have never been requested by the Administration. The shortfall for NASA has been estimated to be up to \$4 billion. This, coupled with serious budget constraints faced by this subcommittee, have made it challenging, if not nearly impossible, to provide NASA with the money it needs to carry out its critical missions.

Last year, through the leadership of Chairwoman Mikulski, the Senate attempted to alleviate some of NASA's budget constraints by approving an additional \$1 billion. This funding would have allowed NASA's exploration programs to continue without massive cuts to science and aeronautics accounts. Further, it would have helped NASA's budget recover from the effects of the *Columbia* shuttle disaster. However, these efforts were met by opposition within the Administration and ultimately thwarted.

Dr. Griffin, you have commented in the past that NASA cannot do all it is asked to do with the funding provided. Yet, when more funds are proposed, the cooperation from those in the Administration have been painfully absent.

While the NASA budget clearly cannot move forward without more funding, the fiscal year 2009 budget does stay the course for the work NASA is currently doing. It contains some interesting pieces that will help further our understanding of the solar system and our own Moon. A proposed new outer planets flagship mission and the upcoming Hubble servicing mission will enhance the world class science that NASA does every day.

The plan has been laid out, and now NASA is doing its best to implement it. Accomplishing the vision for exploration must keep moving forward.

I am particularly pleased to see that the Administration has seen the wisdom of flying a robotic lunar precursor mission and the benefits that can be achieved in doing such a mission. The National Research Council indicated that this type of mission would be beneficial in their lunar science report and I look forward to discussing further how this mission will be implemented by NASA.

As we continue to discuss the future of NASA, it is important to remember that NASA's know-how not only allows us to reach beyond Earth, but also directly impacts our daily lives.

Scientists at Marshall Space Flight Center developed software that clarifies and refines image processing to allow us to view clear, new images of the Sun. The software adjusts and corrects computer and video images for zoom, tilt and shakiness, giving us the ability to review the Sun in a whole new way. Yet, this capability has applications far closer to home. This technology is now being used in countless criminal cases to assist our law enforcement in solving crimes.

Last month, a young female student at Auburn University was kidnapped and murdered. Through the expertise of the U.S. Marshal's Service, the killer's image was captured in a grocery store surveillance video where the victim's debit card was used. The Marshal's Service sent the surveillance images to Dr. David Hathaway at Marshall Space Flight Center in Huntsville where an image enhancement program was used to clear the grainy surveillance photos. It was these images that were later used to capture the killer.

And this type of work does not stop here. It is my understanding that Dr. Hathaway has also been assisting America's Most Wanted in the Lane Bryant Chicago murders. He is to be commended for being such an asset to the law enforcement community and NASA is to be lauded for their role in developing this vital technology.

We could spend all morning talking about the many successes of NASA, and yet we are here today to discuss the difficulty in balancing a budget that will fund only a fraction of the potential this agency could achieve.

The continual budget strains will require that we all work together as partners to ensure NASA can meet its many objectives.

It is my hope that the implementation of the President's vision can be accomplished while still maintaining the capabilities that NASA has developed in other mission areas.

The Administration did not leave many crumbs on the table, but I look forward to discussing how we may find a solution that keeps all of NASA's activities moving forward. While it will be a difficult task given the demands for funding across all of the agencies funded in the CJS bill, I look forward to working with you, Dr. Griffin, and the Chairwoman to ensure that NASA receives the funds necessary to achieve the nation's goals.

Thank you, Madam Chairwoman.

OPENING STATEMENT OF ADMINISTRATOR GRIFFIN

Senator MIKULSKI. So, Dr. Griffin, we are going to turn to you and go with your testimony.

Dr. GRIFFIN. Thank you and good morning, Chairman Mikulski. I too regret Senator Shelby could not be here, but please be assured we will answer his questions for the record as expeditiously as possible.

I want to thank you for inviting me here today to discuss our fiscal year 2009 budget request of \$17.6 billion. Rather than delving into the details of the budget request itself, I would like to use this opportunity to explain the rationale behind the strategic choices made with America's investment in our Nation's space program.

Our annual budget represents less than six-tenths of 1 percent of the \$3.1 trillion Federal budget, a small yet strategic investment in our Nation's leadership on "The New Frontier", as President Kennedy characterized our Nation's first halting steps and then giant leaps beyond Earth.

When strategically applied, America's investment in NASA also benefits our Nation by spurring development in new, innovative technologies and advancing our scientific understanding of the Earth, the Sun, the solar system, and the rest of the universe in ways that we can hardly fathom today, but which inspire us to learn more. Space exploration also contributes to our national security in a very deep way by enabling us to build closer ties with other nations and societies and by inspiring young people to study difficult subjects—mathematics, science, and engineering—so that the next generation of Americans remains at the cutting edge of technical progress. What we do is rocket science. The conquest of air and space is one of mankind's most interdisciplinary activities. The capabilities we bring into being help not only to build a better future for aviation and space; they benefit our entire society.

This year, we celebrate the 50th anniversary of NASA's creation by the Congress with the passage of the National Aeronautics and Space Act of 1958, a strategic national response to the historic achievements of the Soviet Union in the arena that President Kennedy would label, so aptly, "this new ocean." It was this foresight in recognizing the strategic importance of space which inspired and challenged a now aging generation of Americans, my generation, to study math, science, and engineering so that we could take part in this great enterprise.

However, as we celebrate NASA's 50th anniversary, I must also tell you that I am worried. Senator Mikulski, in absentia members of the committee, I am concerned that our Nation is now facing a silent *Sputnik*, a moment when many other countries are racing for a new high ground of innovation while our own advantages—technological, economic, intellectual—are showing signs of wear. While I believe that America's greatest days lie always ahead of us, this optimism is misplaced unless we recognize our problems, confront them, and strive with concerted energy to fix them. We need your help.

We face many challenges at NASA, but I believe the greatest of these is the need to maintain a determined and unified sense of purpose as we pursue the tasks before us. Our achievements, the things we do that awe the world, do not come cheaply, quickly, or easily. Space exploration is not for the faint of heart. It is not for those who are easily distracted. It is not for those who require instant gratification.

This year, all of us in the space community took a moment to recall where we were just 5 years ago when the Space Shuttle *Columbia* disintegrated over Texas and Louisiana, and to reflect upon the ultimate sacrifice our astronauts made while pursuing our Nation's endeavors in space, and to take cautious, sober pride in the progress that we have made in the short time since then.

At great expense, and with considerable technical difficulty, we returned the Space Shuttle to flight, and we are using it today to complete the assembly of the International Space Station (ISS). In the last few months, we have installed the European Columbus laboratory, the first of three components of the Japanese Kibo module, and the Canadian Dextre robotic arm. We have 10 more assembly and logistics missions ahead of us, plus one final Shuttle servicing mission to the Hubble space telescope scheduled for later this year. Barring unforeseen circumstances, I believe we are well positioned to complete station assembly by 2010, and then retire the Shuttle in accordance with the thoughtful recommendations of the Columbia Accident Investigation Board (CAIB).

It took a crisis, the *Columbia* tragedy, for our Nation's leaders in the White House and Congress to recognize the truth of the damning assessment of the CAIB. Quoting, "The U.S. civilian space effort has moved forward for more than 30 years without a guiding vision." The President and Congress honored the sacrifice of the *Columbia* crew, with a new civil space policy noteworthy for the logical progression of its goals and its clarity of purpose. We must not allow that clarity to fade with the passage of time. We must not let it just slip away.

So, we are honoring America's prior commitments to our international partners on the station. We have begun the necessary steps, now turning into longer strides to develop a new generation of capabilities with the Orion crew exploration vehicle and the Ares family of rockets to replace the aging Space Shuttle. We are using the market provided by the ISS to help bring about U.S. commercial space transportation capability with our COTS program that you mentioned.

By being good partners on the ISS and with an armada of Earth and space science missions, through good times and in bad, it is my

belief that other countries will want to join the United States in returning to the Moon, exploring Mars and other planets and moons of our solar system, and discovering what lies beyond. There is little we cannot do if we pursue this common vision together.

However, please do not confuse my desire for international collaboration with a willingness to rely upon others for strategic capabilities. Today we are dependent upon the Russian *Soyuz*. This dependence upon Russia for such a critical capability is not an option we would choose, but it is where we are today. In fact, we must seek an exception to the Iran, North Korea, Syria Nonproliferation Act (INKSNA) because we have no immediate replacement for the Shuttle and no other recourse if we wish to sustain the ISS.

Since that is a fact—and I prefer to deal in facts—I am glad that in today’s world we have the option to avail ourselves of Russian crew transportation capabilities. But we did not get here by design. We got here by default. And as Admiral Gehman observed in the CAIB report, “. . . previous attempts to develop a replacement vehicle for the aging Shuttle represent a failure of national leadership.” That failure has had and will have costs. The most important of those costs are not measured in money or in jobs, though both of these measures have been much in the news, but rather in terms of our Nation’s posture and standing in the world. I will leave it to others to assess the larger consequences of the failure of American leadership, to which Admiral Gehman referred.

So let me be perfectly clear. While we have made significant progress in the past 5 years, the journey ahead is not easy. It requires courage on the part of those who must carry it out and commitment from those in leadership who would see it succeed. To reach this point in the aftermath of *Columbia* has required extraordinary self-sacrifice by everyone involved, and even more will be required in the years ahead. Transition from Shuttle to Orion and Ares, the next generation of constellation systems, while utilizing the Space Station with its six-person crew, and sustaining it with United States and commercial and foreign transportation services, is NASA’s greatest management challenge.

We must not make promises we cannot keep. We must carefully consider any new missions to ensure that they are affordable. We must set priorities. We must focus upon the next steps: finishing the Station, building a new space transportation system to replace the Shuttle, and then venturing out again beyond low Earth orbit. We must keep always before us the real reasons why we explore this New Frontier, and the consequences of allowing our hard-earned leadership on that frontier to slip away.

None of this will be finished in a single year, a single presidential administration, a session of Congress, or even in the lifetime of anyone here today. It is a challenge for generations to come, but one which requires leadership on our part today on behalf of those generations to come.

In the immortal words of President Kennedy, “Now is the time to take longer strides.”

Thank you.

Senator MIKULSKI. Thank you, Dr. Griffin.

[The statement follows:]

PREPARED STATEMENT OF MICHAEL D. GRIFFIN

Chairman Mikulski and Members of the Subcommittee, thank you for the opportunity to appear today to discuss the President's fiscal year 2009 budget request for NASA. The President's budget request for NASA is \$17.6 billion, a 2.9 percent increase over the net budget authority enacted for 2008, along with a steady, five-year runout commensurate with inflation. This increase demonstrates the President's commitment to funding the balanced priorities he set forth for the Agency in space exploration, Earth and space science, and aeronautics research. We are making steady progress in achieving these goals. I ask for your continued support as you consider the President's fiscal year 2009 budget request for NASA.

When I testified before this Subcommittee last year, I spoke about the Administration's balanced priorities for our Nation's civil space and aeronautics research goals as set forth by the Congress and the President. NASA's mandate is clear, and NASA's authorizing legislation, as well as the level of funding appropriated to NASA in fiscal year 2008, tell me that Congress broadly endorses the balanced set of programs the Agency has put forward in this era of limited budget growth.

I have said this in other forums, but it warrants repeating here: at present funding levels, NASA's budget is sufficient to support a variety of excellent space programs, but it cannot support all of the potential programs we could execute. No plan or level of funding can fully satisfy all the many constituencies we have. Balanced choices must be made. But they cannot continually be remade and revisited if there is to be steady progress toward our common, defined objectives.

As the Columbia Accident Investigation Board noted, and as stakeholders acknowledged in ensuing policy debates, it would have been far worse to continue with the prior lack of strategic direction for human space flight, to continue dithering and debating and inevitably widening the gap between Shuttle retirement and the availability of new systems. Until and unless the Congress provides new and different authorization for NASA, the law of the land specifies that we will complete the International Space Station, retire the Shuttle, design and build a new spaceflight architecture, return to the Moon in a manner supporting a "sustained human presence," and prepare the way to Mars.

We are doing those things as quickly and efficiently as possible. System designs for the early elements have been completed, contracts have been let, and consistently solid progress is being made with a minimum of unexpected difficulty. True, the progress might be slower than all of us would prefer, but applying resources in the right direction, irrespective of pace, is always productive—and we are doing that. The Ares I Crew Launch Vehicle and the Orion Crew Exploration Vehicle, as they are presently taking form, are the building blocks for any American future beyond low-Earth orbit (LEO).

Given that this endeavor will be our first step beyond LEO for crewed spacecraft since 1972, I believe that bypassing the Moon to venture directly into deep space—a proposal some have suggested revisiting—poses unacceptable risk. Returning to the Moon and consolidating the gains to be made thereby will set us properly on the path toward Mars. I ask for your continued support and leadership as we progress toward achieving these worthy National objectives.

Before I highlight key elements of NASA's fiscal year 2009 budget request, I would like to summarize NASA's initial fiscal year 2008 Operating Plan. The initial Operating Plan provides aggregate funding of \$17.3 billion, at the level of the President's fiscal year 2008 request. Pursuant to the rescission of \$192.5 million in NASA unobligated balances in the Consolidated Appropriations Act, 2008 (Public Law 110-161), aggregate funding in NASA's fiscal year 2007 Operating Plan is reduced by \$185.2 million, and prior year balances are reduced by \$7.2 million. Implementation of direction in Public Law 110-161 has resulted in a total reduction of \$620.9 million in planned NASA activities, consisting of the rescission of \$192.5 million, offsets for programmatic augmentations totaling \$345.2 million, and site-specific Congressional interest items totaling \$83.2 million. Finally, in accordance with Congressional direction, NASA has established seven Agency appropriations accounts in the fiscal year 2009 budget request. As a result, the budgets for NASA's programs and projects are requested in terms of direct costs, not the additional indirect costs associated with operating the Agency's field Centers, assuring safety and mission success, and Agency management and operations. The direct budgets will continue to reflect labor, travel, and procurement costs associated with each program and project. The indirect costs are now budgeted solely within the Cross Agency Support account, and not in the NASA programs and projects. We will strive to ensure that these changes are transparent to our stakeholders.

I am appreciative of the action by the Committees on Appropriations and Congress in providing regular fiscal year 2008 appropriations for the Agency at the level

of the President's request, including essentially full funding for the Orion, the Ares I, the Space Shuttle, and the International Space Station. This total fiscal year 2008 appropriations level, with some adjustments within the total, will enable NASA to meet critical priorities in accordance with the direction from the Congress and the President.

HIGHLIGHTS OF THE NASA FISCAL YEAR 2009 BUDGET REQUEST

I am pleased to report that the fiscal year 2009 budget represents a substantial step forward in responding to the recommendations of the National Research Council's (NRC) first decadal survey of Earth Science, released in January 2007. The five-year budget runout requests \$910 million for priorities enumerated in the report. Funding will support development of two Decadal Survey new mission priorities—the Soil Moisture Active/Passive (SMAP) mission scheduled to launch as early as 2012, and the Ice, Clouds, and Land Elevation Satellite II (ICESat II) scheduled to launch in 2015—as well as formulation of three additional decadal survey missions.

Working closely with NOAA, we also are making significant progress toward restoring climate sensors that had been removed from the tri-agency National Polar-orbiting Operational Environmental Satellite System (NPOESS) in 2006. The fiscal year 2009 budget request of \$74 million for NOAA supports the addition of a Clouds and the Earth's Radiant Energy System (CERES) instrument onto NASA's NPOESS Preparatory Project (NPP) satellite, set to launch in 2010; instrument development and ongoing analyses to identify a suitable satellite platform for hosting the Total Solar Irradiance Sensor (TSIS); and development of climate data records. These actions, which will be implemented through close coordination between NASA and NOAA, come in addition to the inclusion of the Ozone Mapping and Profiler Suite (OMPS)-Limb sensor on the NPP satellite that was announced earlier in 2007.

The Agency's fiscal year 2009 budget request also reflects a number of exciting developments in the space sciences, including an increase in the number of new missions, a new initiative in lunar science and initiation of plans for high-priority missions in Astrophysics and Planetary Exploration. The fiscal year 2009 request includes an increase of \$344 million over 5 years for Lunar Science in order to better understand our Moon. NASA's Science Mission Directorate, with support from the Exploration Systems Mission Directorate, is developing two small lunar landers, and the Science Mission Directorate is initiating a series of new and exciting missions headed to the Moon over the next decade. Meanwhile, we are focusing our Mars program after 2013 on a Mars sample return mission to launch by 2020, and have identified funds to initiate development of an outer planets flagship mission to be selected in October of this year for launch by 2017. The budget also significantly increases Research and Analysis funds in the space sciences to gain better value from the missions we are flying, and so too, it increases the funding and, therefore, the flight rate of our suborbital rocket and balloon research programs in the space sciences.

Our Aeronautics Research portfolio is positioned to address the challenges facing the Next Generation Air Transportation System, while also developing world-class aeronautics expertise and capabilities. Research is aligned with the National Plan for Aeronautics Research and Development and Related Infrastructure, approved by the President in December 2007. In fiscal year 2009, we will conduct a key test to advance our understanding of aircraft aging and durability, and develop algorithms to optimize the use of crowded airspace and airports. We will continue work on blended-wing-body aircraft, which may reduce fuel consumption and emissions, as well as aircraft noise. Additionally, NASA's Aeronautics Research Mission Directorate continues to strengthen partnerships with academia, industry, and other Government agencies to accomplish its strategic goals.

NASA's commitment to its exploration objectives is clearly reflected in the fiscal year 2009 budget request. As assembly of the Space Station nears completion, NASA will increasingly focus its efforts on continuing the development of the Orion Crew Exploration Vehicle and Ares I Crew Launch Vehicle. This budget request maintains Orion initial operational capability in March 2015, and full operational capability in fiscal year 2016, though we are striving to bring this new vehicle on line sooner. In fiscal year 2008, we will see the completion of the formulation phase for major elements of the Constellation program; both Orion and Ares I will undergo their preliminary design reviews. We will conduct the first Ares ascent development flight test with the Ares I-X in the Spring of 2009, and we will continue to conduct research and develop and test technologies through the Advanced Capabilities Human Research and Exploration Technology Development Program. The Lunar Reconnaissance Orbiter (LRO)/Lunar Crater Observation Sensing Satellite (LCROSS), an important part of NASA's lunar exploration strategy, is on track for

launch at the beginning of fiscal year 2009. The Agency is also requesting \$173 million to provide incentives for entrepreneurs—from big companies or small ones—to develop commercial transport capabilities to support the International Space Station. With more than \$2.6 billion in NASA funds available over the next five years to purchase cargo and crew services to support Space Station operations, our objective and strong preference is to use these funds to purchase these services from American commercial companies wherever possible.

While I would prefer that the United States have domestic alternatives to purchasing crew transport services from Russia, I am glad that the Russians are our partners and have such capabilities, because the consequences if they were not available are far worse. If NASA astronauts were not onboard the Space Station, our National Laboratory in space simply would not survive. If there is no Space Station, there is no market for the commercial providers we are trying to help bring into existence, and our international partnership would simply fall apart. So, in order to keep these objectives viable, NASA may need to obtain additional crew and cargo transport services from our international partners if U.S. commercial services are not yet demonstrated and available.

In the area of Space Operations, NASA's fiscal year 2009 budget request will allow us to continue to expand the Space Station, complete the supporting truss structure and solar arrays, and deliver the final component of the Japanese laboratory. This will round out the set of three space laboratories aboard the Station, with one each from the United States, Europe, and Japan. In addition, fiscal year 2009 will mark another milestone for the International Space Station Program—for the first time, the Station will be able to support a full-time crew of six astronauts. With three major scientific facilities available to them, these larger crews will be busy as Station kicks off a new era in microgravity research aboard this National Laboratory in orbit. Critical to these achievements, the Space Shuttle is scheduled to fly five times in fiscal year 2009. During fiscal year 2009, NASA also plans to launch payloads on eight expendable launch vehicles. Fiscal year 2009 will also see the consolidation of the Deep Space, Near-Earth, and Space Communications networks into a unified Space Communications and Navigation (SCaN) architecture within the Space Operations Mission Directorate.

NASA is continuing to transition from the Space Shuttle to new Exploration systems, and will need a complement of critical tools and authorities necessary for the transformed Agency to execute its mission. This transition is the largest and most daunting since the end of the Apollo program and the beginning of the Space Shuttle program. It dictates that we obtain the authorities needed to ensure sufficient support in the future. We hope to discuss the details of these legislative requests with Members of Congress in the weeks ahead.

The remainder of my testimony outlines the fiscal year 2009 budget request for NASA in greater detail.

SCIENCE MISSION DIRECTORATE

In 2007, NASA successfully launched four new orbital and planetary science missions (THEMIS, AIM, Phoenix, and Dawn), almost 20 suborbital science missions, and two major airborne Earth science campaigns. This past year also saw the first test flights of the Stratospheric Observatory for Infrared Astronomy (SOFIA) 747 airborne infrared observatory, as well as the provision of rapid-response airborne remote sensing aid to the California wildfire emergencies. In addition, 2007 was a year of remarkable scientific discovery about the Earth, the Sun, the planets and the universe. For example, data from the Ice, Clouds, and land Elevation Satellite (ICESat), the Gravity Recovery and Climate Experiment (GRACE), and other satellites have provided dramatic new insights on ice sheet changes in Greenland and Antarctica. The Solar TERrestrial RELations Observatory (STEREO) satellites (A and B) have provided the first three dimensional images of the sun and the structures of the heliosphere. These new 3-D views, along with unprecedented observations from Hinode (Solar-B), NASA's Time History of Events and Macroscale Interactions during Substorms (THEMIS) mission, and the Aeronomy of Ice in the Mesosphere (AIM) satellite are revolutionizing knowledge of the variable Sun and its interactions with the Earth. Also, the Cassini spacecraft radar imagery of Titan revealed large lakes of methane in Titan's North polar region, indicating a hydrological cycle. Finally, a new map provides the best evidence to date that normal matter, largely in the form of galaxies, accumulates along the densest concentrations of dark matter. Mapping dark matter's distribution in space and time is fundamental to understanding how galaxies grew and clustered over billions of years.

NASA's fiscal year 2009 budget request provides \$4.44 billion for the Agency's Science portfolio to study the Earth, our Sun and its heliosphere, our solar system, and the Universe. This funding enables NASA's Science Mission Directorate (SMD) to start major new missions, to increase research and analysis funding, and to operate and provide ground support for 55 operating science missions, including 13 Earth science mission extensions. It provides support for over 3,000 current operating research and analysis grants, while continuing to develop high priority missions in Earth Science, Heliophysics, Planetary Science and Astrophysics, consistent with the priorities established by the NRC's decadal surveys.

The fiscal year 2009 budget request for Earth Science provides \$1.37 billion to help us better understand the Earth's atmosphere, lithosphere, hydrosphere, cryosphere, and biosphere as a single connected system. In addition to 14 operating missions, the request includes funding for seven missions in development. The Landsat Data Continuity Mission and Ocean Surface Topography Mission (to launch in 2008) continue the decades-long time series of land cover change and ocean surface height data, respectively. Glory targets the impact of aerosols on climate. The National Polar-orbiting Operational Environmental Satellite System (NPOESS) Preparatory Project (NPP) paves the way for the future national weather system and continues essential measurements from the NASA Earth Observing System (EOS), Aquarius, and the Orbiting Carbon Observatory (OCO), set to launch in 2008. Aquarius and OCO will make the first-ever global measurements of ocean surface salinity and atmospheric carbon dioxide, respectively. The request specifically increases funding for OCO and the Aquarius missions to maintain development schedules. The Global Precipitation Measurement (GPM) mission will extend the rainfall measurements made by the Tropical Rainfall Measuring Mission (TRMM) to the global scale. The request retains the GPM core mission launch readiness date. With respect to Glory, the development estimate included in the fiscal year 2009 request represents cost growth of more than 30 percent from NASA's baseline development estimate, which, under the terms for Major Program Activity Reports under Public Law 109-555, will require explicit Congressional authorization in the next 18 months to continue.

The budget request responds to the Earth Science Decadal Survey by establishing a funding wedge of \$910.0 million over the budget runout to initiate five new Earth Decadal Survey missions for launch by 2020, while continuing to implement seven precursor missions for launch between 2008 and 2013. NASA will continue to contribute to the President's Climate Change Research Initiative by collecting data sets and developing predictive capabilities that will enable advanced assessments of the causes and consequences of global climate change.

The Heliophysics budget request of \$577.3 million will support missions to understand the Sun and its effects on Earth, the solar system, and the space environmental conditions that explorers will experience, and to demonstrate technologies that can improve future operational systems. The request increases budgets for Sounding Rockets, Research Range, and Research and Analysis to achieve a more robust level of small payload opportunities. In addition to supporting 16 currently operational missions, the request supports the Interstellar Boundary Explorer (IBEX) mission focused on the detection of the very edge of our solar system and the Coupled ion-Neural Dynamics Investigation (CINDI) "Mission of Opportunity" that will provide new insight on the Earth's ionospheric structure, both of which are planned for launch in 2008. In early fiscal year 2009, the Solar Dynamics Observatory (SDO) to study the Sun's magnetic field is planned for launch, and the Geospace Radiation Belt Storm Probes (RBSP) mission will begin development. RBSP will improve our understanding of how the Earth's radiation belts are formed and how solar output modifies the Earth's Van Allen radiation belts. Further, the 5-year budget funds a new Solar Probe mission, which has long been sought by the U.S. scientific community and is recommended highly in the most recent Heliophysics decadal survey.

The Planetary Science budget provides \$1.33 billion to advance scientific knowledge of the solar system, search for evidence of life, and to prepare for human exploration. The budget supports an array of eight currently operating spacecraft and rovers traveling to or now studying Mercury, Mars, the Asteroid Belt, Saturn, and Pluto, in addition to a series of instrument missions of opportunity. The budget request augments Lunar Science to include a series of small robotic lunar satellites to begin development in fiscal year 2009 and initiates an outer planets flagship mission, planned for launch in 2016 or 2017. The request includes continuation of funds for all five of NASA's operating Mars missions, the development of a Mars Science Laboratory for launch in 2009, a Mars Scout mission in 2013, expanding U.S. participation on the ESA/ExoMars mission by selecting two instrument Missions of Opportunity for study and technology development, a Mars mission in 2016. and an

increase in Mars research funds. The Mars Program has been directed, consistent with National Research Council advice, to begin exploring concepts for a Mars Sample Return mission, to launch no earlier than 2020. With the New Horizons spacecraft continuing on its way to Pluto, the request realigns the New Frontiers Program's Juno Mission to Jupiter to be consistent with a 2011 launch date, and funds initiation of the next New Frontiers mission. An open competitive solicitation for the next mission is planned for release near the end of this calendar year. The request continues support for the operating Discovery mission and for the development of the new Gravity Recovery and Interior Laboratory (GRAIL) Discovery mission, the latter of which will use high-quality gravity field mapping of the Moon to determine the moon's interior structure.

The Astrophysics budget provides \$1.16 billion to search for answers to fundamental questions about how the universe works, how we got here, and whether we are alone. The request supports a restart of the Nuclear Spectroscopic Telescope Array (NuSTAR) Small Explorer with a launch date of no-earlier-than 2011, increases funding for sounding rocket payloads, balloon payloads, detector technology and theory, and initiates the Joint Dark Energy Mission (JDEM) in fiscal year 2009. The Astrophysics suite of operating missions includes three Great Observatories (Hubble Space Telescope, Chandra X-Ray Observatory and the Spitzer Space Telescope), which have helped astronomers unravel the mysteries of the cosmos. The request will support the Gamma-ray Large Area Space Telescope (GLAST), which is now planned for launch in May, 2008, to begin a 5-year mission mapping the gamma-ray sky and investigating gamma-ray bursts. It also provides funding for the Kepler telescope, which is planned for launch in February 2009 to detect planets in the "habitable zone" around other stars. SOFIA will begin science operations in 2009, significantly earlier than previously planned. The request supports development of the Wide-field Infrared Survey Explorer (WISE), which will conduct an all-sky survey, and the James Webb Space Telescope, which will explore the mysterious epoch when the first luminous objects in the universe came into being after the Big Bang.

AERONAUTICS RESEARCH MISSION DIRECTORATE

In 2007, the Aeronautics Research Mission Directorate (ARMD) continued to pursue high-quality, 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. ARMD's research also plays a vital role in supporting NASA's space exploration activities. ARMD's program content and direction is consistent with the National Aeronautics Research and Development Policy, as well as the follow-on National Plan for Aeronautics Research and Development and Related Infrastructure that the President approved on December 21, 2007.

A primary goal across all of the programs in ARMD 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 for cooperative partnerships, and the NASA Research Announcement (NRA) process that provides for full and open competition for the best and most promising research ideas. ARMD has established over 35 Space Act Agreements with industry partners and more are in the works. We have ensured that all Space Act Agreements are negotiated so that results of collaborations will be broadly disseminated. To date, NASA has selected 346 proposals for negotiation of award through the NRA process from more than 70 different universities and 60 different companies and non-profits. NASA investment in NRAs will increase steadily from fiscal year 2009 (\$72 million) through fiscal year 2013 (\$100 million).

We have also strengthened our partnerships with other Government agencies. For example, NASA and the Joint Planning and Development Office (JPDO) have established quarterly reviews to ensure close coordination, and NASA participates in all major JPDO planning activities. In addition, NASA and the Federal Aviation Administration have developed a joint program plan for the Aviation Safety Information Analysis and Sharing (ASIAS) effort with well defined roles and responsibilities. Also, NASA and the United States Air Force have established an Executive Research Council that meets at least twice a year to ensure close coordination and collaboration. Lastly, NASA and the Army have signed a Memorandum of Understanding to coordinate research efforts on rotorcraft.

In fiscal year 2009, the President's budget for NASA requests \$446.5 million for Aeronautics Research. ARMD is directly addressing the fundamental research chal-

lenges that must be overcome in order to enable the JPDO vision for the Next Generation Air Transportation System (NextGen).

NASA's Airspace Systems Program 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. In fiscal year 2009, NASA's budget request will provide \$74.6 million for the Airspace Systems Program to conduct trajectory analyses for service-provider-based automated separation assurance with time-based metering in an environment with two to three times capacity and with delay and separation comparable to or better than that achieved today. In addition, the Airspace Systems Program will develop algorithms to generate robust, optimized solutions for airport surface traffic planning and control. These surface models will be developed as a basis for the optimized use of super-density airports, integrated airport clusters, and terminals where demand for runways is high.

NASA's Fundamental Aeronautics Program conducts research in all aeronautics disciplines that enable the design of vehicles that fly through any atmosphere at any speed. The fiscal year 2009 budget request, amounting to \$235.4 million, will enable significant advances in the Hypersonics, Supersonics, Subsonic Fixed Wing, and Subsonic Rotary Wing projects that make up the Fundamental Aeronautics Program. These projects focus on creating innovative solutions for the technical challenges of the future: increasing performance (range, speed, payload, fuel efficiency) while meeting stringent noise and emissions constraints; alleviating environmental and congestion problems through the use of new aircraft and rotorcraft concepts; and facilitating access to space and re-entry into planetary atmospheres. A wide variety of cross-cutting research topics are being pursued across the speed regimes with emphasis on physics-based multi-disciplinary analysis and design, aerothermodynamics, materials and structures, propulsion, aero-servo-elasticity, thermal protection systems, advanced control methods, and computational and experimental techniques.

The fiscal year 2009 budget request for NASA's Aviation Safety Program is \$62.6 million. The four projects within the Program (Integrated Intelligent Flight Deck, Integrated Resilient Aircraft Control, Aircraft Aging and Durability, and Integrated Vehicle Health Management) will develop cutting-edge tools, methods, and technologies with close coordination among them to improve the intrinsic safety attributes of current and future aircraft that will operate in the NextGen. In fiscal year 2009, the Program will demonstrate aircraft engine safety and reliability improvements using advanced sensing technologies and new methods for modeling engine gas flow characteristics. In addition, ballistic tests will be used to study the effect of aging on the impact resiliency of composite fan-blade containment structures for aircraft engines. Multiple flight and simulation tests will evaluate technologies to protect aircraft during hazardous situations. For example, simulations will evaluate technologies enabling aircraft to land safely even when flight control surfaces are partially damaged or malfunctioning, and flight tests will examine forward-looking, multi-frequency radar systems for early detection of potential hazardous icing.

Finally, NASA's Aeronautics Test Program (ATP) will continue to safeguard the strategic availability of a critical suite of aeronautics test facilities that are deemed necessary to meet Agency and national aeronautics needs. The fiscal year 2009 budget request for the ATP is \$73.9 million, which will enable strategic utilization, operations, maintenance, and investment decisions for major wind tunnel/ground test facilities at Ames Research Center in California, Glenn Research Center in Ohio, and Langley Research Center in Virginia, and will support specific aircraft and test bed aircraft at Dryden Flight Research Center, also in California. ARMD has established the National Partnership for Aeronautical Testing with the Department of Defense to pursue a coordinated approach to managing DOD-NASA aeronautical testing facilities. In fiscal year 2009, ATP will continue to reduce the deferred maintenance associated with its facilities and will also invest in new test technologies ensuring a healthy set of facilities and the new capabilities needed for future programs. In addition, ATP plans to continue off-setting the user rates for its facilities through the funding of a portion of the indirect costs resulting in competitive prices. Simultaneously, the Program will continue to move toward 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 capability.

EXPLORATION SYSTEMS MISSION DIRECTORATE

In 2007, the Exploration Systems Mission Directorate (ESMD) delivered as promised and will continue to do so in 2008. Major development work is underway; contracts are in place, and our future Exploration plan is executable. By the end of 2008, ESMD will see its first spacecraft launched from the NASA Kennedy Space Center. This Lunar Reconnaissance Orbiter (LRO) and the Lunar Crater Observation Sensing Satellite (LCROSS) will help NASA scout for potential lunar landing and outpost sites. Additionally, in 2008, NASA will continue to plan how best to transition any needed Shuttle workforce and infrastructure to the Constellation program.

The fiscal year 2009 budget request of \$3.5 billion for Exploration will support continued development of new U.S. human spaceflight capabilities and supporting research and technologies, and will enable sustained and affordable human space exploration after the Space Shuttle is retired at the end of fiscal year 2010. The budget request provides stable funding to allow NASA to continue developing our next-generation U.S. human spaceflight vehicles while also providing research and developing technologies for the longer-term development of a sustained human presence on the Moon. Budget stability in fiscal year 2009 is crucial to maintaining a March 2015 Initial Operational Capability for the Orion Crew Exploration Vehicle and Ares I Crew Launch Vehicle. There is minimum flexibility through 2010, so Congressional support for budget stability is critical. Additionally, NASA will continue to work with other nations and the commercial sector to coordinate planning, leverage investment, and identify opportunities for specific collaboration on lunar data collection and lunar surface activities in support of Exploration objectives.

The fiscal year 2009 budget request for Constellation Systems Program is approximately \$3 billion. The Constellation program includes funding for the Orion and Ares, as well as for ground operations, mission operations, and extravehicular activity projects and a dedicated in-house effort for systems engineering and integration. Last year, the Constellation program made great strides and it will continue to do so in 2008. We have tested real hardware; we have tested landing systems; and we have logged thousands of hours in wind tunnels. So far, NASA engineers have conducted almost 4,000 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 NASA's first scheduled demonstration test flight for Ares I, known as Ares I-X, are scheduled for spring 2009 and will lay the ground work for maturing the Ares I final design.

Constellation has an integrated schedule and we are meeting our early milestones. In fact, all major elements of the Orion and Ares vehicles were placed under contract by the end of 2007. Currently, NASA has civil servants and contractors on board for the Constellation program serving at all ten Agency Centers, as well as in more than 20 States. In 2008, NASA will continue efforts to define the specific work the Agency's Centers will perform in order to enable astronauts to explore the Moon. Preliminary work assignments covering elements of the Altair human lunar lander and lunar surface operations, as well as the Ares V, were announced in October 2007.

During 2007, ESMD completed a series of key project review milestones, including a System Definition Review for the Orion project in August and for the Ares I project in October. During these reviews, each project examined how its proposed requirements impact engineering decisions for the functional elements of the system. The Orion and Ares I teams are currently assessing design concepts, and are moving toward finalized reference designs that meets their requirements. This reference configuration will be the starting point for the design analysis cycle that leads to Preliminary Design Reviews for the Orion and Ares I projects, in turn leading to an integrated stack review by the end of December 2008. A Preliminary Design Review is a crucial milestone, during which the overall program verifies that the preliminary design meets all requirements within acceptable risk limits and within the cost and schedule constraints.

In fiscal year 2009, NASA is requesting \$173 million for the Commercial Crew and Cargo Program and its associated projects. Full funding is essential to maintaining NASA's promised \$500 million investment in this program to spur the development of U.S. commercial space transportation services to and from the Space Station, while also providing substantial savings to the taxpayer compared to NASA Government-owned and operated capabilities. On February 19, 2008, NASA announced that the Agency had signed a Space Act Agreement with a new funded partner, Orbital Sciences Corporation of Dulles, Virginia. Technical progress continues to be made by our other funded partner, SpaceX, of El Segundo, California, as well by as several of our unfunded partners.

The Agency's fiscal year 2009 budget request provides \$453 million for activities in ESMD's Advanced Capabilities theme, which seeks ways to reduce the risks for human explorers of the Moon and beyond by conducting research and developing and maturing new technologies. In 2008, NASA's Human Research Program will focus on the highest risks to crew health and performance during exploration missions. We also will develop and validate technologies that serve to reduce medical risks associated with human spaceflight. For example, NASA will continue its work to understand the effect of space radiation on humans and to develop effective mitigation strategies. During 2008, NASA also will continue to research ways to reduce the risks to future explorers. Research onboard Space Station will include human experiments, as well as biological and microgravity experiments. In 2009, the Advanced Capabilities Exploration Technology Development program will conduct a range of activities, including testing prototype ablative heat shield materials; throttleable Lox Hydrogen engines suitable for a human lunar lander; and lightweight life support systems for Orion. The program also will deploy and test advanced environmental monitoring systems on the Space Station to advance the safety of crewmembers, and will continue to test in-situ resource utilization technologies as well as life support and cryogenic fluid management.

In response to Congressional direction contained in the Explanatory Statement accompanying the Consolidated Appropriations Act, 2008 (Public Law 110-161), ESMD will fund in 2008 a robotic lander project managed by NASA's Marshall Space Flight Center as a pathfinder for an anticipated network of small science landers based on requirements for NASA's expanded lunar science program. The first lander mission is planned to fly in 2013-2014. NASA's Exploration Systems and Science Mission Directorates will continue to work together combining resources to ensure that the goals of the science lander are achieved.

NASA's LRO and the LCROSS have a planned launch later this year from Kennedy Space Center. These dual-manifested spacecraft are in the assembly, integration, and test phase and are making excellent progress toward launch. The knowledge generated by these missions will enable future outpost site selection and new information about resources within the permanently shadowed craters at the lunar poles. The LRO/LCROSS missions represent NASA's first steps in returning to the Moon.

Lastly, facility, infrastructure, property, and personnel transitions from Space Shuttle to Constellation continue to be a major activity. NASA transition activities are focused on managing the evolution from current operations of the Space Shuttle to future operations of Constellation and emerging commercial services, in a safe, successful and smooth process. To date, NASA has met all of its milestones and disposition targets. This joint effort between the Space Operations Mission Directorate and ESMD includes the utilization and disposition of resources, including real and personal property, personnel, and processes, to leverage existing Shuttle and Space Station assets for NASA's future Exploration activities. Formalized Transition Boards are working to successfully achieve this outcome. An initial Human Spaceflight Transition Plan was developed in 2006. An updated NASA Transition Plan, supported by key metrics, is being refined and will be released this year.

SPACE OPERATIONS MISSION DIRECTORATE

The Space Shuttle and Space Station programs both enjoyed a highly successful and productive year in 2007. The Space Shuttle flew three missions during the year, continuing the assembly of the Station and expanding its capabilities. The June 2007 flight of *Atlantis* on STS-117 added a truss segment and new solar arrays to the starboard side of the Station to provide increased power. In August, *Endeavour* brought up another truss segment, supplies, and became the first Orbiter to use a new power transfer system that enables the Space Shuttle to draw power from the Station's solar arrays, extending the duration of the Shuttle's visits to Space Station. On the same mission, STS-118, teacher-turned-astronaut Barbara Morgan conducted a number of education-related activities aboard the Space Station, inspiring students back on Earth and realizing the dream of the Teacher In Space Project for which she and Christa McAuliffe trained more than two decades ago. In October 2007, *Discovery* flew the STS-120 mission, which added the Harmony node to the Station and featured a spacewalk to disentangle a snagged solar array.

The STS-120 mission paved the way for Station astronauts to conduct a series of ambitious spacewalks and operations using the Station's robotic arm to move the Pressurized Mating Adapter-2 and Harmony node in preparation for the addition of the European Columbus laboratory and the Japanese Kibo laboratory in 2008. These spacewalks are particularly challenging and impressive, as they are carried

out entirely by the three-person Expedition crews, without benefit of having a Shuttle Orbiter, with its additional personnel and resources, docked to the Station.

NASA continues to expand the scientific potential of the Space Station in 2008, a year in which we are delivering and activating key research assets from two of our International Partners. In February, Shuttle *Atlantis* delivered the European Columbus laboratory during STS-122; the recently completed STS-123 mission featured the delivery by Shuttle *Endeavour* of the experiment logistics module portion of the Japanese Kibo laboratory, along with the Canadian Special Purpose Dexterous Manipulator, or Dextre. Dextre, the final component of the remote manipulator system provided by Canada, will act as the “hand” on the robotic arm, allowing astronauts to conduct operations and maintenance activities from inside the Space Station, rather than via spacewalks. In May, STS-124 will deliver the pressurized module component of the Kibo lab, and in late summer, the crew of STS-125 will become the final Shuttle crew deployed to a non-Station orbit, as they conduct the last Hubble Space Telescope servicing mission from the Space Shuttle. This mission will outfit the telescope with the Cosmic Origins Spectrograph and the Wide-Field Camera 3, as well as replace components to extend Hubble’s operational life.

The Space Shuttle fiscal year 2009 budget request of approximately \$3 billion would provide for five Shuttle flights to support assembly of the Space Station. This would include the flight of the Japanese Kibo laboratory’s Exposed Facility, and the delivery of the final Station Truss segment.

The fiscal year 2009 budget request includes about \$2.1 billion for ISS International Space Station activities, reflecting the presence of a permanent six-person crew and three major research facilities aboard Station.

After the Space Shuttle retires at the end of fiscal year 2010, NASA will use alternative means to transport cargo and crew to the Space Station. The Agency’s first choice for such services is domestic, commercial capability, the development of which is the focus of the Commercial Orbital Transportation Services (COTS) effort. ESMD is funding the first phase of COTS under the Commercial Crew and Cargo Program, which will demonstrate this capability via funded and unfunded Space Act Agreements. SOMD will manage the second phase of the effort, covering actual cargo—and potentially crew—delivery services to the Space Station. Until such time that operational commercial means are available for resupplying the Station, NASA will look to its international partners to provide cargo resupply capability, much of which will be provided as part of the partners’ contributions to the International Space Station Program. NASA has contracted with Roscosmos to provide Soyuz and limited cargo services through the end of fiscal year 2011, as permitted under the Iran, North Korea and Syria Non-proliferation Act of 2005 (Public Law 109-112). NASA is monitoring the progress of potential domestic commercial providers to develop cargo and crew transportation services to the Space Station, and the Orion project is on track to reach its Initial Operational Capability in March 2015. The Administration is considering options to maintain a U.S. crew presence aboard the Space Station after the retirement of the Shuttle and before the advent of Orion. Purchasing crew transportation services domestically is NASA’s preferred method to meet the needs of the Space Station. Another option may be to seek relief from the provisions of the Iran, North Korea, and Syria Non-Proliferation Act of 2005 for additional Soyuz services to keep a U.S. crew presence on the Space Station until either domestic commercial crew transportation services, or Orion, become available. We will keep the Congress fully informed of our plans.

NASA remains focused on, and committed to, flying out the remaining Space Shuttle missions safely and completing the assembly of the Space Station. Beyond those aims, one of the challenges NASA faces as we approach the end of the Shuttle era is the smooth disposition of personnel and infrastructure. SOMD and ESMD have been working hand-in-hand to ensure that needed skills and facilities are retained and put to productive use during the development and operational phases of the Orion, Ares I, and Ares V projects. In fiscal year 2009, the Agency’s transition milestones will include the transfer of Pad 39B and Mobile Launch Platform #1 to Constellation, after the Hubble Servicing Mission. In addition, the Space Shuttle Program is reviewing whether the Space Shuttle *Atlantis* will be retired in fiscal year 2008 or used to conduct existing missions within the planned manifest.

The Space Flight Support Program’s fiscal year 2009 budget request of \$733 million would help mitigate out-year costs associated with the Delta II launch pads. The request also reflects the consolidation of the Agency’s space communications projects into the Space Communications and Navigation Program. Finally, it includes funding for the development of two satellites to replenish the Tracking and Data Relay Satellite System, planned for launch in 2012 and 2013.

EDUCATION

The fiscal year 2009 budget request for Education totals \$115.6 million and furthers NASA's commitment to Science, Technology, Engineering, and Mathematics (STEM) education. NASA's primary objectives for Education are to: (1) contribute to the development of the Nation's STEM workforce through a portfolio of initiatives for students at all levels; (2) attract and retain students in STEM disciplines while encouraging them to pursue higher education that is critical to NASA's workforce needs; and (3) engage Americans in NASA's mission through strategic partnerships with STEM education providers.

NASA is committed to ensuring that its future workforce is fully prepared to handle a variety of challenging scientific and technical careers. NASA's Office of Education encourages student interest in STEM through the Agency's missions, workforce, facilities, and innovations in research and technology. The fiscal year 2009 budget request reflects a balanced portfolio of investments which takes into account Congressional priorities, the NASA Strategic Plan, and recommendations from the National Research Council, as well as the priorities of the education community. NASA Education is the critical link between the Agency's scientists and engineers and the education community. NASA Education translates the Agency's missions into educational materials, services, and opportunities for students and learners of all ages. NASA strives to support the role of educational institutions, which provide the framework to unite students, their families, and educators for educational improvement.

In 2008, NASA's Office of Education will continue to collaborate with Agency Mission Directorates and field Centers to assist educators in promoting scientific and technical literacy while attracting and retaining students in STEM disciplines and careers. NASA Education will also continue its work with other Federal agencies engaged in educational activities, along with public and private partners to leverage the effectiveness and reach of its efforts.

CROSS-AGENCY SUPPORT

The fiscal year 2009 budget request for activities within Cross-Agency Support includes funding for developing and maintaining NASA's technical capability including the Agency's vital mission support functions. Cross Agency Support provides a focus for managing technical capability and Agency mission support functions. This budget area consists of three themes: Center Management and Operations; Agency Management and Operations; and, Institutional Investments. Cross Agency Support is not directly identified or aligned to a specific program or project requirement but is necessary to ensure the efficient and effective operation and administration of NASA.

The most significant change is in the area of Agency Management and Operations. Agency Management and Operations provides for the management and oversight of Agency missions and functions and for the performance of many Agency-wide activities. Agency Management and Operations is divided into five programs: Agency Management; Safety and Mission Success; Agency Information Technology services; Innovative Partnerships Program; and, Strategic Capabilities Assets Program.

—The fiscal year 2009 budget request provides \$414.6 million for Agency Management which sponsors and supports an executive-based, Agency-level functional and administrative management agenda. Agency Management delivers policies, controls, and oversight across a range of functional and administrative management service areas and also provides for independent technical assessments of Agency programs. It delivers strategic planning services. It assesses and evaluates NASA program and mission performance. It sponsors and directs the Institutions and Management agenda in procurement, human capital, real property and infrastructure, security and program protection, diversity, equal opportunity, and small business. Agency Management also provides for the operational costs of Headquarters as an installation, including salaries, benefits, training and travel requirements of the Headquarters workforce, as well as the resources necessary to operate the Headquarters installation.

—The fiscal year 2009 budget request provides \$163.4 million for the Agency's Safety and Mission Success support activities required to strengthen and enable the fundamental and robust cross checks applied on the execution of NASA's mission. The engineering; safety and mission assurance; and health and medical independent oversight and technical authority which are essential to NASA's success and were established in direct response to the *Challenger* and *Columbia* shuttle accident board recommendations for independent funding of these efforts. The Safety and Mission Success program directly supports NASA's core

values and serves to improve the likelihood for safety and mission success for NASA's programs, projects, and operations. The Safety and Mission Success program includes the corporate work managed by the offices of the Chief, Safety and Mission Assurance (including the NASA Safety Center), Chief Engineer (including the NASA Engineering and Safety Center), the Chief Health and Medical Officer, and the Director of the Independent Verification and Validation Facility.

- The fiscal year 2009 budget request for Agency Information Technology services is \$163.9 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. In fiscal year 2009 significant emphasis will be placed on consolidation of networks and network management, improved security incident detection, response and management, further consolidation of desktop/laptop computer services, data center assessment for consolidation, and application portfolio management leading to consolidation. NASA is using an enterprise architecture approach to assess current assets, capabilities and costs for services and developing requirements, projects and procurements for transition to the desired consolidated state. Additionally, the underlying infrastructure and systems to instill strong authentication and access to information systems in alignment with HSPD-12 will progress significantly in fiscal year 2009. Critical work will continue under the Integrated Enterprise Management Program to improve business processes by minimizing data redundancy, standardizing information and electronic data exchanges, and processing. Also, NASA will continue participation in several Federal E-Government initiatives and Lines of Business to improve services to citizens and gain efficiencies across the Government.
- The fiscal year 2009 budget request for Innovative Partnerships Program activities is \$175.7 million. This program provides leveraged technology investments, dual-use technology-related partnerships, and technology solutions for NASA. This program also facilitates the protection of NASA's rights in its inventions and the transfer of that technology for commercial application and public benefit. In addition, the Innovative Partnerships Program implements NASA's Small Business Innovation Research and Small Business Technology Transfer Programs which seek out high-technology small businesses to address key technology needs for NASA. The program also manages a Seed Fund to address technology needs through cost-shared, joint-development partnerships. The Centennial Challenges Program, which is also managed by the Innovative Partnerships Program, consists of prize contests to stimulate innovation and competition in new technologies for solar system exploration and other NASA mission areas. NASA has already benefited from Centennial Challenge competitions, and last year awarded \$450,000 in prize money for the Astronaut Glove Challenge and Personal Air Vehicle Challenge. The Innovative Partnerships Program also transfers NASA technology for public benefit, as documented in NASA's annual "Spinoff" publication. "Spinoff 2007" documented 39 new examples of how NASA innovation has been successfully transferred to the commercial market place and applied to areas such as health and medicine, transportation, public safety, consumer goods, homes and recreation, environmental and agricultural resources, computer technology, and industrial productivity.
- Finally, NASA is requesting \$28 million in fiscal year 2009 for the Strategic Capabilities Assets Program, a focused activity designed to ensure that critical Agency capabilities and assets for flight simulation, thermal vacuum testing, arc jet testing, and microgravity flight services are available to NASA missions when needed. Strategic Capabilities Assets Program assets are also used by other Government agencies, industry, and academia to improve the Nation's position in the global market place as well as its defense capabilities. The Strategic Capabilities Assets Program budget request covers the direct and associated costs required to sustain key test capabilities and assets including operating staff, preventive maintenance, subsystem repairs, and component replacements required to keep the assets in "ready for testing" condition. Incremental costs to conduct specific tests are borne by individual programs and reimbursable customers. The Aeronautics Research Mission Directorate budget request includes \$73.9 million for the Aeronautics Test Program (e.g. wind tunnels and flight testing) and the Science Mission Directorate budget request includes \$41.9 million for High-End Computing Capability (e.g. the *Columbia* super computer), which are also managed as Strategic Capabilities Assets. Centralized management at the Agency-level allows NASA to better prioritize and make strategic investment decisions to replace, modify, or disposition these capabilities and assets.

CONCLUSION

NASA has a lot of hard work ahead, but the Agency continues to make steady progress in managing its challenges. We are deploying our workforce to carry out the great task before us. Last fall, the Agency assigned new leadership roles and responsibilities for exploration and science missions to NASA's ten field Centers across the country in order to help restore the core technical capabilities across the Agency as we transition from the Space Shuttle to new capabilities. I ask your continued help to ensure that this Nation maintains a human spaceflight capability.

In a short span of years, we have already taken long strides in the formulation of strategies and programs that will take us back to the Moon and on to Mars and other destinations in our solar system. Indeed, a generation from now, astronauts on Mars will be flying and living aboard hardware America is funding and designing today, and will be building in the near future. This is a heady legacy to which we can aspire as we develop the next U.S. human space exploration vehicles. The foundation of this legacy will include work we plan to carry out in fiscal year 2009.

As I said earlier in my testimony, NASA is committed to executing the exciting programs and projects within the President's fiscal year 2009 budget request. Having reached a steady state on a balanced set of priorities, we now have a sense of purpose to make steady progress toward achieving our goals for continued leadership in space exploration, scientific discovery, and aeronautics research.

Chairman Mikulski, with your support and that of this Subcommittee, we are making the right strategic choices for our Nation's space program. Again, thank you for the opportunity to appear before you today. I would be pleased to respond to any questions that you may have.

PRESIDENT'S FISCAL YEAR 2009 BUDGET REQUEST SUMMARY BY APPROPRIATION ACCOUNT

[Budget Authority, in millions of dollars]

By theme	Fiscal year—						
	2007	2008	2009	2010	2011	2012	2013
Science	4,609.9	4,106.2	4,441.5	4,482.0	4,534.9	4,643.4	4,761.6
Earth Science	1,198.5	1,280.3	1,367.5	1,350.7	1,250.9	1,264.4	1,290.3
Planetary Science	1,215.6	1,247.5	1,334.2	1,410.1	1,537.5	1,570.0	1,608.7
Astrophysics	1,365.0	1,337.5	1,162.5	1,122.4	1,057.1	1,067.7	1,116.0
Heliophysics	830.8	840.9	¹ 577.3	598.9	689.4	741.2	746.6
Aeronautics	593.8	511.7	446.8	441.8	482.4	486.1	467.7
Exploration	2,869.8	3,143.1	3,500.8	3,737.7	7,048.2	7,116.8	7,666.8
Constellation Systems	2,114.7	2,471.9	3,048.2	3,252.8	6,479.5	6,521.4	7,080.5
Advanced Capabilities	755.1	671.1	452.3	484.9	568.7	595.5	586.3
Space Operations	5,113.8	5,526.2	5,774.7	8,872.8	2,900.1	3,089.9	2,788.8
Space Shuttle	3,315.3	3,266.7	2,981.7	2,983.7	95.7	.....	.....
International Space Station	1,469.0	1,813.2	2,060.2	2,277.0	2,176.4	2,448.2	2,143.1
Space and Flight Support	329.2	446.3	² 732.8	612.1	628.0	641.7	645.4
Education	115.9	146.8	118.6	126.1	123.8	123.8	123.8
Cross-Agency Support	2,949.9	3,242.9	3,299.9	3,323.9	3,363.7	3,436.1	3,511.3
Center Management and Operations	1,754.9	2,013.0	2,045.6	2,046.7	2,088.0	2,155.3	2,211.6
Agency Management and Operations	971.2	830.2	945.6	945.5	939.8	950.5	961.3
Institutional Investments	223.8	319.7	308.7	331.7	335.9	330.4	338.3
Congressionally Directed Items .....	.....	80.0	.....	.....	.....	.....	.....

PRESIDENT'S FISCAL YEAR 2009 BUDGET REQUEST SUMMARY BY APPROPRIATION ACCOUNT—
Continued

[Budget Authority, in millions of dollars]

By theme	Fiscal year—						
	2007	2008	2009	2010	2011	2012	2013
Inspector General	32.2	32.6	35.5	36.4	.....	38.3	39.2
Fiscal Year 2008 Rescission ² ..	.....	(192.5)	.....	.....	.....	.....	.....
NASA Fiscal Year 2009	16,285.0	17,309.4	17,614.2	18,026.3	18,460.4	18,905.0	19,358.8

¹ Deep Space and Near Earth Networks Transfer \$256 million to SFS in fiscal year 2009.

² Fiscal year 2008 Appropriation rescinded \$192.475 million in prior-year unobligated balances, effectively reducing fiscal year 2008 authority. Not included in totals.

Fiscal year 2008 budgets are the enacted levels per the fiscal year 2008 Appropriation as shown in the Agency's fiscal year 2009 Budget Estimates. Totals may not add due to rounding.

2008 budgets include all direct costs required to execute the programs. Indirect costs are now budgeted within Cross-Agency Support.

SPACE TRANSPORTATION SYSTEM

Senator MIKULSKI. First of all, I know this was your oral testimony, which was more of a rhetorical document than a budget statement. So, we will put into the record your full testimony to the subcommittee, which I think went into very specific detail. We have the written testimony, which I know was vetted by OMB and powers that be, and it outlines the budget aspects that we want.

We too agree with your statement that says we must not make promises we cannot keep and carefully consider any new missions to ensure that they are affordable. Dr. Griffin—this is not directed at you, but really your predecessor and the White House—I agree with that. So, when they embarked upon the Mars mission, for which the Congress was not critical, they never gave us any money. So, we are very frustrated that we were given an assignment without the money and falling upon us to come up with the money.

So, I would agree with the premise let us not make promises we cannot keep and consider the affordability of any new missions. Well, we were given a new mission. A promise was made just like the promise was made on the Space Station. We got all those international partners involved, and now we wonder how in the hell are we going to get there. So we are cranky. We are not cranky with you, but we are cranky because we keep feeling like we are being set up and then it comes to us.

So we note your question about leadership, but we are not in here to finger-point today. We are into pinpointing our path forward. But I want to set the record straight, that a promise was made to go to Mars, but no money was given to us. The Gehman Commission outlined—and it cost NASA \$2-plus-billion to return to space and return to space in a way that was safe for our astronauts, which always needs to be a national obsession. And no money back for the replacement costs paralleling the *Challenger*. So those for us are the big issues.

We went to the Space Station at the request of President Bush I and we have sustained that. And we have had difficulty paying for it since in two administrations. Now, this one gave us a Mars mission without the wallet.

So we appreciate your observation. We presume it is not a lecture. And number three, we are cranky because we keep getting missions and no wallet, and I know you must feel the same way.

That takes us, though, to really the heart of what you are saying which is a reliable space transportation system. That goes to the transportation system to replace the Shuttle because without a reliable transportation device, we cannot do any of the things, whether it is the return to the Moon or beyond.

Could you share with us because everyone is deeply concerned about the gap? I would like to go through some of the questions about the gap. I am going to say two things. One, colleagues both here and in the House are saying, well, why do we not give them more money and close the gap? So, I am going to ask if that is a realistic possibility if money were not the problem, just with sound engineering principles.

And then number two, as you know, there are some members in the House who are raising the concept of extending the life of the Shuttle until 2015.

So, let us go with acceleration. What could we, putting money aside, because I will come back to show me the money because that is what this is—can we accelerate or close that gap in a prudent way and not just be throwing money at it? And then what you think of the idea of extending the Shuttle until 2015.

Dr. GRIFFIN. Yes, of course, Senator Mikulski. Thank you. Let me start out by saying just for the record that if anything in my oral statement came across as presuming to lecture the Congress, that was not my intent. I was calling for the leadership that I know that you know we need and have provided, but certainly not lecturing the Congress.

But to answer the specifics of your questions, with regard to closing the gap, at this point with 65 percent statistical confidence, we are budgeted to deliver Orion and Ares for operational capability to the Space Station in March 2015. We have been asked by your colleagues in the Senate, as well as your colleagues in the House, if that could be improved. We have answered for the record, and I will give you the outlines of that answer now. At a cost of about \$2 billion total over the next couple of years, it would be possible to bring March 2015 back into, let us say, the late fall of 2013. So we could improve the schedule by about 15 to 16 months at this point at a cost of \$2 billion.

In general, as a rough guide for your planning, every \$100 million extra that is put into the program improves the schedule by just about 1 month. So on the record, that is the best we have been able to determine.

Senator MIKULSKI. It seems like about \$1 billion a year.

Dr. GRIFFIN. Yes, ma'am. That is correct. Now, we cannot, for any amount of money, get back earlier than the fall of 2013.

Senator MIKULSKI. So using \$1 billion as a rule of thumb per year, even if we came up with \$5 billion—highly unlikely—you could not—

Dr. GRIFFIN. The earliest technically achievable date at this point—

Senator MIKULSKI. Would be 2013.

Dr. GRIFFIN [continuing]. Given the water over the dam behind us, would be late 2013.

Senator MIKULSKI. Okay.

EXTENDING THE SPACE SHUTTLE LIFETIME

Dr. GRIFFIN. Now, in answer to your second question, my opinions about extending the lifetime of the Shuttle, my opinion is we should not do that. They are founded on several different principles. The first is that as I believe we all now know and as Admiral Gehman pointed out in the CAIB report, the Shuttle is an inherently risky design. We currently assess the per-mission risk as about 1 in 75 of having a fatal accident. If one were to do as some have suggested and fly the Shuttle for an additional 5 years, say, two missions a year, the risk would be about 1 in 12 that we would lose another crew. That is a high risk. We have elected as a Nation—the administration has decided and the Congress has concurred, and I believe that concurrence was absolutely correct—that we will complete the Space Station. But it is not being done without risk. To fly the Shuttle after the Space Station is completed for any significant length of time I believe would incur a risk I would not choose to accept on behalf of our astronauts.

Now, flying the Shuttle after the 2010 retirement date has other effects. It costs about \$3 billion a year. You, ma'am, referenced just a few moments ago that our request this year to fly the Shuttle was \$3 billion. I would rather see, if my opinion were being sought, extra money made available, if that were the case, to accelerate existing systems. If extra money were not made available, and the \$3 billion had to come out of hide—as you mentioned, the return to flight costs of \$2.7 billion was taken out of hide. If that were done again, every \$100 million that comes out of the new systems extends their schedule for 1 month. On the back end of the program, we lose 1½ months. So if you delay *Constellation* by 1 year today, in order to fly the Shuttle for another year, then you delay *Constellation* by 1½ years on the back end. So you do not ever narrow the gap. You extend the gap if you fly the Shuttle longer.

Senator MIKULSKI. Well, that is an important thing. So, trying to keep the Shuttle going beyond the current designated time is high risk—

Dr. GRIFFIN. Yes, ma'am.

Senator MIKULSKI [continuing]. High expense.

Dr. GRIFFIN. Yes, ma'am.

Senator MIKULSKI. And the very goal we want to have, which is not to have a gap, we once more exacerbate.

Dr. GRIFFIN. Yes, ma'am.

RETURN TO FLIGHT

Senator MIKULSKI. I got it.

Did Admiral Gehman, when he looked at the return to flight as part of the review after the accident, look at this possibility?

Dr. GRIFFIN. Well, they did. Around pages 209 and 210 of volume I of the CAIB report, they devoted considerable discussion to the future of the Shuttle. I happen to have a few of those quotes with me. I am given to using them in speeches for just these purposes.

But Admiral Gehman pointed out—and I will quote for the record here—“because of the risks inherent in the original design of the Space Shuttle”—and I will skip a couple of points that do not matter—“it is in the Nation's interest to replace the Shuttle as

soon as possible as the primary means of transporting humans to and from Earth orbit.”

Admiral Gehman also points out that “there is urgency in choosing the design after serious review of a concept of operations for human space flight and bringing it into operation as soon as possible. This is likely to require a significant commitment of resources over the next several years. The Nation must not shy from making that commitment.”

Senator MIKULSKI. Well, of course, we will look to the wisdom of working with their authorizers and you. But based on our conversations, both in preparation for this hearing and here, I really could not support the extension of the Shuttle to 2015.

What I want to do is, working on a bipartisan basis, see what we can do to prudently, both from an engineering and technology perspective and from a fiscal perspective, accelerate. Look to see if we cannot find the funds to accelerate closing the gap and the framework that I believe NASA already is thinking about and could do. So, we would have a plan A which would be to close the gap to 2013, which in and of itself would be pretty terrific. And plan B would be to stay the course, which would be the minimum threshold.

So from my perspective, again, working with Senator Shelby, Senator Nelson, Senator Hutchison, those of us involved, really the authorizing and so on, our goal would do that. I cannot speak for my colleagues, but speaking for myself, I would not envision trying to keep the Shuttle going. I think the risk is inherent and the national goals are not that which we want to accomplish.

RELYING ON RUSSIAN “SOYUZ” SERVICES

That takes me to using the *Soyuz*. Whatever it is, we are currently relying on the *Soyuz*. So could you tell us where we are? Do we not have some treaty issues? I mean, you and I are not State Department wonks here, but do we not have kind of anti-proliferation compliance? As a member of the Intelligence Committee, I cannot be out of compliance with proliferation issues. Where are we with that? And what is required and where are we? And can the subcommittee help facilitate this?

Dr. GRIFFIN. Thank you. Yes. They are excellent questions there. First, we need Russian *Soyuz* services today at a minimum for crew rescue capability on board the station. The Shuttle is not a lifeboat. So until we have a qualified replacement system, Orion and Ares, qualified for 6 months of flight and therefore can serve the lifeboat function, we will be dependent upon the Russian *Soyuz* system for crew rescue from station.

Second, after the retirement of the Shuttle in 2010, the only mechanism for crew transport will be the Russian *Soyuz* system.

To your point out treaty obligations, we have the INKSNA, the treaty that I mentioned and to which you referred, for control of space technology and missile technology proliferation, which prevents the purchase of certain goods and services from Russia for the Space Station program. We are currently operating under an exemption to that treaty. It ends on December 31, 2011. So until the end of 2011, we can purchase Progress cargo delivery services and *Soyuz* crew transport services. There is about a 3-year lead

time for the Russians to produce a new *Soyuz*. So, if in 2012 we wish to have crew transportation for ourselves and our partners to whom we have treaty obligations, then by around early 2009, hopefully sooner, we need to have agreements in place with Russia. To accomplish that, I need to furnish to the Congress, within a very short period of time, a request from the administration for a continued exemption to the treaty.

IRAN, NORTH KOREA, SYRIA NON-PROLIFERATION ACT (INKSNA)

Senator MIKULSKI. Well, yes. Again, going back to my opening statement, this is a year of transition. Our new President does not take office until January 20 or 21, and we need to have this done in this current administration. It would be the hope of this subcommittee, working with our colleagues on Foreign Relations, Senators Biden and Lugar, who are experts on the proliferation issue—we would like to move this.

When do you think we can expect a request from the administration?

Dr. GRIFFIN. I believe, Senator Mikulski, that it is imminent. We have spoken with them just yesterday. The last elements of coordination within the White House are ongoing as we speak. We are working with them to get that to the Congress as quickly as we can.

Senator MIKULSKI. Well, over the next few weeks, we will be meeting with Secretary Rice on a variety of issues. So if we get bogged down, this subcommittee would like to offer a way of working with you and the administration to get it unstuck and over here for review by Senators Biden and Lugar so that we can move ahead with this. Okay?

Dr. GRIFFIN. Thank you very much.

“SOYUZ” LAUNCH CAPABILITIES

Senator MIKULSKI. Now, this though then goes to COTS. So right now we can accelerate, if we put in \$2 billion, to 2013. We have got the *Soyuz*. What is the astronaut capability of the *Soyuz* to take people up, not the rescue mission, but what is the max number of astronauts they can take up?

Dr. GRIFFIN. Well, the crew capacity on a given *Soyuz* launch is three. So obviously to sustain a crew of six, we need two *Soyuz* systems flying in rotation to maintain the crew of six that we go to in April 2009.

Senator MIKULSKI. And how much are the Russians charging us per flight? Did they talk about that yet? Because they now have a monopoly.

Dr. GRIFFIN. Yes, they do. Our current contract calls for payments for *Soyuz* seats and progress flights through the end of 2011 of \$780 million.

COMMERCIAL ORBITAL TRANSPORTATION SERVICES

Senator MIKULSKI. And that will go back and forth. Well, we will go into that in more detail.

Let us go to COTS. Could you outline what the budget request for COTS is? What do you think we buy for it, and do you think

that is sufficient? And is COTS an answer in terms of beefing up COTS to take people up there where we would have our own kind of version of a *Soyuz*, in other words, not the full go to the Moon and so on, but really a Space Station vehicle which COTS is? Can you share with us those views? Because there is a lot floating around that COTS could be the answer to the gap.

Dr. GRIFFIN. COTS, commercial orbital transportation services, is a program that I initiated upon rejoining NASA on this occasion. I did so because I believe very strongly—I believe two things, that we need a strong Government development program for Orion and Ares to guarantee that we have the capability to get to Earth orbit again and to go to the Moon, as Admiral Gehman discussed. But I also believe that we need to stimulate, wherever possible as a matter of Government policy, provide rewards for the development of commercial capability available for purchase by the Government, but on an arm's length basis.

So the purpose of the program was to provide some, not all, of the money necessary for new systems development to reach Earth orbit, allowing companies to use that leverage of Government funds to seek other investment, and to bring to bear new capabilities.

We are focusing on initially cargo because I just want to be clear with everybody. We actually have a mechanism to get crew to the Station with the *Soyuz* system, but unless we can bring some new commercial capabilities online, we really have no cargo resupply. So actually of the two, the most important COTS capability to me right now is cargo, and I must be honest about that.

However, COTS is a program with four different phases to it, and phase D is human transportation. And yes, we would very much like to see a capability developed from U.S. commercial suppliers to provide crew transport to and from the Space Station, and I do believe that can be a solution going forward.

I do not believe that even with their best efforts and even if more money were provided, that COTS crew transportation capability will arrive in time to be available after the Shuttle retires or even by the end of the current contract with Russia in 2012. So I do not believe that it will be available.

Senator MIKULSKI. So what you are saying is there is no silver bullet or there is no magic potion available to close the gap.

Dr. GRIFFIN. Ma'am, I do not know of one.

Senator MIKULSKI. So extending the life of the Shuttle is not a reasonable option.

COTS, which is very promising technology—its first priority is cargo because that is what is needed to sustain the astronauts when we get them up there. Without a cargo vehicle, the cost is prohibitive. We cannot use *Soyuz* for cargo at the cost of the *Soyuz*, and I do not think it would be big enough for cargo.

Dr. GRIFFIN. That is correct.

Senator MIKULSKI. So we need COTS to do the sustainability of the astronauts.

At the same time, sure, COTS has promise, but you want to make sure that what is firmly in place is the cargo capability, but while they are developing their technologies, of course, we would look forward to possibilities of adding a human element. But that is an add-on to the mission.

Do I have it down right?

Dr. GRIFFIN. Yes, ma'am.

Senator MIKULSKI. What I am really getting to is people are fishing around—not fishing. I should say searching. That was not a good use of the word. Genuinely searching because of the gap. And like everything else we do in this Government, we have regrets about, oh, why was this not all thought about. But we are where we are.

So what you are saying is that right now the only reliable transportation system after 2010 will be *Soyuz*. So we have to work with the Russians, get our treaty in place, et cetera. We have got to keep COTS on track no matter what because that is the cargo. Even during the gap, we can sustain our American presence, and we will have an American vehicle in space. So it will not be like we are just sitting on the tarmac.

Am I correct?

Dr. GRIFFIN. Yes.

Senator MIKULSKI. But there is no magic potion to close the gap. The only prudent fiscal way to go is accelerate Ares and Orion by 2 years and, at the same time, keep COTS on track so we have the cargo capability. So, from the standpoint of fiscal reality and engineering sensibility, that would be the way to go.

Dr. GRIFFIN. Ma'am, I think you have it perfectly.

SPACE SHUTTLE WORKFORCE TRANSITION

Senator MIKULSKI. Well, the reason I took such a long time in asking these questions is there are a lot of ideas in the ethers out here and I wanted to be able to do that.

Now, my last question on this is what is the plan for the workforce transition when the Shuttle is retired? And I am talking about at Kennedy. It is of deep concern, of course, to our two colleagues from Florida. You know, we ask people to go into science and engineering. There have been people who have been working at Kennedy. They have given their life's work through good times and wrenching times. We remember the brave way they responded during Hurricane Katrina to keep everything in place. I mean, it is a wonderful talented, group of people, and we do not want to leave them hanging by their thumbs.

Dr. GRIFFIN. Well, we do not, and I know that your colleagues from Florida are concerned. But I too am concerned. I am the Administrator of this agency, and that is my workforce. So I am concerned as well.

Before I answer your question about what our plans are, I would like to note a positive thing for the record, if I might. I just received word that the planned docking of the European automated transfer vehicle, which is a cargo delivery vehicle to the Space Station in support of European obligations to the partnership, just successfully docked with the Space Station for the first time on its maiden flight. This accomplishment of an automated rendezvous and docking is the first by any nation other than Russia and brings our European partners fully on line as full partners in the Space Station. It is a magnificent accomplishment for the partnership.

Senator MIKULSKI. We salute our European colleagues.

Dr. GRIFFIN. I think they deserve every bit of that.

Now, to answer your question about our workforce, we are obligated to the Congress for a report twice a year. Every 6 months we must report on our transition plans to retire Shuttle and bring Ares and Orion online. We submitted the first of those per requirement on Monday, and it showed, among the contractor community at Kennedy Space Center, over the years the worst case scenario of a reduction of some 6,400 or so jobs over the years following retirement of the Shuttle.

Now, for the record, I must point out to this subcommittee that those projections are projections which are obtained by forecasting the job reductions from retirement of the Shuttle, but they do not forecast the job increases as we bring on a future lunar development program. So as we begin to get out of Shuttle and station operations, we are fairly well able to forecast who we will lose, but—

Senator MIKULSKI. But is that the same workforce?

Dr. GRIFFIN. Well, it will not be the same people. It will be a different skill mix.

Senator MIKULSKI. That is what I mean.

Dr. GRIFFIN. The Shuttle workforce, in terms of Shuttle operations, will be a much smaller operational workforce for Ares and Orion. That was a goal of retiring the Shuttle.

When we put new work down at Kennedy Space Center, it will, in some respects, require different kinds of skills. So we have the option—the companies have the option of retraining people, but many people will be moving in to take other jobs and new people will be moving in to take new jobs.

Senator MIKULSKI. Well, Dr. Griffin, this is a conversation I really want to have Senator Shelby participate in and also our space authorizing team, Senator Nelson. We know that Senator Landrieu is deeply concerned about the Michoud issue where I think we estimate that there could be 1,000 more there.

Really then, what do we anticipate and what is it really going to take? Are we looking at retirements and therefore a steady glide path? Are we looking at retraining? Because we will have to give you money to do retraining as we are doing that. And we have got to look at how we are all moving in the same way. Just as you have your engineering plans and you have your critical path, we need to have the same critical path for our social—I hate to use the term “social” engineering, but our social plan, which is who is going to leave, who is going to stay to do the job they are doing, who is going to be retrained, what are we bringing on, and then how is this going to be paced and what is it then you would need from us with the workforce issues because we need people as well as our technology.

So, let us schedule that after we complete our hearing.

OVERALL SCIENCE BUDGET

Moving on, though, I want to go now to science. NASA’s budget shows a flat science budget this year and also for the next 5 years. Some are winners like Earth science and planetary science. Others seem to not do as well, astrophysics and heliophysics.

Is where we are on the budget enough to meet our existing obligations to science and continue the development of new ones? In

other words, we have things underway, whether it is Hubble—I worry about ICESat.

You know what everybody is excited about, of course, is the mission to our own planet Earth. I have been meeting with people. Senator Boxer has too in her global warming initiatives. Every scientist or environmental minister is crazy about NASA and also about the National Science Foundation (NSF) and about National Oceanic and Atmospheric Administration (NOAA). Because of our size, our scope, and our talent, we have become the indispensable nation in terms of the science that we do for our planet. Therefore, anything that we are going to do to solve the problems of our planet has to be rested on that.

So we worry about that and do we have enough to do what we are doing? Could you comment on it? Because we see you and NOAA, working with the NSF and National Institute of Standards and Technology, we save lives and we are saving the planet.

And what an incredible role of public diplomacy. You and I are sitting here talking about treaties with the Russians on making sure we do not proliferate, but those school kids in Australia or South Africa or Southeast Asia are looking at the same Hubble as the south Baltimore kids. The Danish environmental minister is looking at the Hubble stuff the way they are looking at the NOAA stuff over in India.

So we know that Secretary Rice thinks she is the diplomat, but so is NASA. And we view Hubble as one of our first technological diplomats.

So, my point is that where are we in terms of what we continue to do and in these new missions.

Dr. GRIFFIN. Well, Senator, although you did not ask, I could not agree with you more about the value of our space program as an instrument of positive American image and diplomacy in the world. Truthfully, over 60 percent of our science missions are done on a collaborative basis with other nations. Sometimes we supply an instrument. Sometimes we supply the major part of the spacecraft. But either way the collaborations that we do work, and they work for the United States and for everyone in the world.

Now, our science budget. I need to say a couple of things. First of all, our science budget as a fraction of our portfolio is around 32 percent this year, and it is at historically high levels. So science is well funded at NASA. It is not growing as much as we would like until 2011 when we retire the Shuttle. Science resumes its growth at the top line starting in 2011.

As you noted yourself, in these current years, our entire NASA top line growth is only 1.8 percent, and so for science to be slightly less than that is not a major difference between the agency's top line and the science portfolio top line.

We are budgeted to meet the commitments that we have made, everything from Hubble and James Webb down to the Mars science lab and other things in other divisions of our science portfolio. We are budgeted to meet the commitments we have made to you.

Certainly it is always possible, just as in our human space flight program, more money will buy more product. And there are always more new and interesting and fascinating science missions to do.

But we have a rich plate of missions, and I believe that we are adequately funded to execute the ones we have said we will execute.

Earth science did receive an increase this year I think in respect to the Earth science decadal. That is something we wanted to do. I was one of the people calling for a decadal 3 years ago and now we have one, and we are pleased with it. We have revamped our Earth science portfolio to respect that decadal. But at the same time, astrophysicists and planetary scientists and heliophysicists also have decadal surveys, and we try to honor those missions as well.

EARTH OBSERVING SENSORS

Senator MIKULSKI. Well, first of all, that is heartening to hear, and know that we have just a great passion about this.

I know you are so busy.

You know, there are things I want to talk about with both science and education. Let me come back to I think a very poignant moment.

The National Academy of Science. This goes to what they tell us they are concerned about. According to the National Academy, 40 percent of the Earth-observing sensors that are now in orbit will cease to function by the end of the decade unless they are replaced. And my question is, well, what does that mean? And what is NASA's plan to replace those sensors and satellites? In other words, do we have the money to even continue to do the pretty spectacular work we are already doing?

Dr. GRIFFIN. Right. We are in a difficult period right now. If you look at the sensor level on Earth sciences for climate research and environmental monitoring, we are in a difficult period because, as you know, the Department of Defense, the NOAA, and NASA NPOESS program being executed by the Air Force encountered some severe cost problems. And so the NPOESS spacecraft have been descope. This has been the subject of other hearings before other committees of this Congress.

Senator MIKULSKI. I know.

Dr. GRIFFIN. And so the climate research sensors that were originally planned to go on NPOESS will now not fly on NPOESS. Now, we have known this for over 1 year. We have been scrambling to try to find ways to remanifest those climate research sensors on other missions, and we are doing that. But the recovery plan from the NPOESS descope of climate research sensors cannot happen instantaneously. Moreover, NASA was not budgeted for these additional climate research sensor flight opportunities because that budget went to NPOESS.

So in the White House and at NASA, by all means, we do recognize the seriousness of the concern about replacing the climate research sensors on orbit today. That was one of the originally intended purposes of NPOESS and we are having to find other ways to do it. And we are working that plan as aggressively as we are able.

NATIONAL POLAR-ORBITING OPERATIONAL ENVIRONMENTAL SATELLITE
SYSTEM (NPOESS)

Senator MIKULSKI. Well, the subcommittee and its staff would like to have an ongoing conversation with you about this. First of all, we are very concerned about NPOESS.

Dr. GRIFFIN. Yes, ma'am.

Senator MIKULSKI. We have raised it and it has been an enormous challenge. Of course, our overall satellite capabilities are of growing concern.

But let me go to our accountability issue, and then we will conclude shortly. The Congress is going to have a commemorative ceremony noting the melancholy event that occurred 40 years ago tomorrow with the assassination of Dr. King. Both the House and Senate will gather for just a moment of reflection and really renewal to a commitment against violence in the world.

NASA has informed us that of 12 science missions that are under development, 4 are over budget and 8 are behind schedule. We would like to talk with you about that in more detail as we look at this, one, maintaining the schedule but also where those four missions are over budget. We are not going to go into that because, again, I want to join my colleagues.

I know Senator Shelby wanted to also ask about aeronautics and about education. The aeronautics is part of the NASA mission in education. So, we will follow up with aeronautics as we talk about it when we come together. Education, of course, continues to be such a major role at NASA.

CHAIRMAN'S CLOSING REMARKS

And I just want to tell you a story before we conclude about what your NASA Goddard people did that was so spectacular. We, in Baltimore, are the home to the National Federation of the Blind. It is their global headquarters.

Some years ago, a wonderful Ph.D. by the name of Dr. Zabrowski, who just passed away, wanted to move the blind into the future and the new economy. Over 40 percent of all blind people live below poverty level because they do not have access to education that often takes them into the new careers. So, they did that. And one of the things they wanted to do was see if blind kids could have access to information about astronomy.

On a modest grant of \$50,000 from Goddard, working with the National Federation of the Blind, the Goddard Genius Club, and the Smithsonian Institution, we have now produced a textbook for blind kids, for middle school and high school, on astronomy. It is called "Touching the Invisible Sky." And when you see this book—have you seen it?

Dr. GRIFFIN. I have seen it, ma'am. It is incredible.

Senator MIKULSKI. It is incredible. The text is in Braille, but the pictures of the Hubble and other cosmic photographs are in these raised images that is having a profound impact.

And when I went to Dr. Zabrowski's memorial service and told the gathering over 600 people about this book and presented a copy in behalf of all of us to their library—but it will be widely disseminated—the audience response was overwhelming. And the response

afterwards, as people came up, parents were talking about they do not know if their kids will be astronomers, but they know that they could go into science. They could go into technology. If you are blind, you can hear very well. There are jobs and everything from national security to other things.

So, you know, this is really about changing lives, transforming lives, and so on. And NASA is doing such great work. If we take the time for a modest \$50,000 and transform opportunities for blind children—and once again, it will happen not only for our kids here in our own country, but this will go to south Baltimore and South Africa and so on. I mean, I think this is what we are all about.

So, we want to go to the Moon and we want to get out there to Mars, return our astronauts safely. And we want to see what we can do to help you.

So, I think we have covered our testimony today. I was kind of doing double dutch here. We will continue our conversations with you.

We hope to have our bill ready. We view the President's request as the minimum threshold. We are going to see what other ways, given our allocation, we can add to this to accelerate our capabilities of closing the gap, as well as improving our science and aeronautics capability and see what we can do. I also will pursue adding that amendment for another \$1 billion as emergency funding.

So, since there are no further questions—and do not think that because my other colleagues are not here they are not interested. Many are chairing their own hearings on our accelerated schedule, and others are involved in the mortgage foreclosure.

ADDITIONAL COMMITTEE QUESTIONS

So, since there are no further questions—and Senators may submit questions for the subcommittee's official record.

[The following questions were not asked at the hearing, but were submitted to the Department for response subsequent to the hearing:]

QUESTIONS SUBMITTED BY SENATOR RICHARD C. SHELBY

ROBOTIC LUNAR LANDER

Question. I am pleased to see the budget request has a proposed lunar robotic lander mission for the Moon. This proposal comes on the heels of funding provided by this committee that followed recommendations from the National Research Council.

Can you expand on what this mission will entail and how the workload will be distributed and managed for this mission?

Answer. The Science Mission Directorate (SMD)-sponsored Lunar Science Program Office at Marshall Space Flight Center (MSFC) will provide program management for the Lunar Science Program, consisting of a small-sat lunar orbiter and a series of mini-landers. The Lunar Science Program Office will establish a mini-lander project, also to be located at MSFC, using the capabilities of the LPRP office to conduct a phase A and begin Phase B. In fiscal year 2008–2009, the focus of the mini-lander project will be on defining the mini-lander design through Preliminary Design Review. As appropriate for the missions, SMD will define significant roles for the Applied Physics Lab (APL), Ames Research Center (ARC), the Goddard Space Flight Center (GSFC) and the Jet Propulsion Laboratory (JPL).

Question. When do you anticipate this mission and will be ready to go to the moon?

Answer. The first two mini-landers, which will be developed by MSFC and the APL, are envisioned to be launched in the 2013–14 timeframe. Further definition will be undertaken as part of the Pre-Phase A identified in the previous question.

Question. Is there potential for these landers to be the first in a series of similar missions?

Answer. It is envisioned that these landers will be the backbone nodes of an International Lunar Network providing a series of standardized seismic, heat flow, and other scientific measurements (provided by both the United States and international partners). In addition, Exploration Systems Mission Directorate (ESMD) and SMD will cooperate on the definition of key enabling technologies that might be suited for flight on one or more of the mini-landers.

EDUCATION CUTS

Question. How can we take the ACI model and apply it to NASA education programs to encourage students to want to become future scientists and engineers?

Answer. NASA Education is taking steps that align with the ACI model to encourage students to enter STEM fields.

The following activities reflect direct action based on the recommendations of the ACI:

- Pursuant to Conference Report accompanying the America Competes Act, NASA is required to submit to Congress and the President an annual report describing the activities conducted pursuant to Section 2001 of the America COMPETES Act, including a description of the goals and the objective metrics upon which funding decisions were made. NASA will submit the first of these reports in January 2009.

- Also pursuant to Section 2001, NASA will submit a plan for assessing the effectiveness of the Agency’s science, technology, engineering, and mathematics education programs in improving student achievement, including with regard to challenging State achievement standards.

- NASA is utilizing the Undergraduate Student Research Program to support basic research projects on STEM subjects.

- NASA is also leading the interagency ISS Education Coordination Working Group, with its concept plan, “An Opportunity to Educate: ISS National Laboratory,” which was submitted to Congress on June 20, 2008. The Working Group is also in early discussions with other interested agencies that are not formal participants.

Pursuant to direction included in the Explanatory Statement accompanying the fiscal year 2008 Consolidated Appropriations Act, NASA’s Office of Education will soon release a competitive solicitation to the university community, based upon recommendations from Earth Science and Application from Space: National Imperatives for the Next Decade and Beyond, prepared by the National Research Council in 2007.

- The solicitation will address innovative opportunities for educating students on global climate change with a special component focusing on teacher education preparation (pre-service).

NASA is also pursuing other interagency activities that will facilitate the enhancement of its STEM education program.

- NASA Education serves on the Education Subcommittee of the National Science and Technology Council (NSTC) Subcommittee on Science, which is providing a report based on the Academic Competitiveness Council recommendations.

- The Office of Education also represents the Agency on the Interagency Aerospace Revitalization Task Force, a group of federal agencies with a vital interest in strategic planning for STEM education to strengthen the science and technology workforce.

EPSCOR AND SPACE GRANT FUNDING

Question. Are these reductions because the programs are ineffective in their objectives?

Answer. NASA has not de-emphasized its education program nor reduced these two projects being ineffective in their objectives. Though the 2009 request for NASA education is a reduction of \$31.2 million from the 2008 enacted budget, it reflects the reality of addressing increasing mission operational requirements within limited funding.

Each program area in the Agency was impacted by the need to redirect funding. The overall Office of Education’s budget reduction was further influenced by “Results Not Demonstrated” rating in last year’s OMB Performance Assessment Rating Tool (PART) analysis due to the agency not providing sufficient data indicating the

program's effectiveness. Baseline data and results have now been submitted to OMB for review. Education is and will continue to be a fundamental element of NASA's activities reflecting a diverse portfolio of Higher Education, Minority University Research and Education, Elementary & Secondary/Education, and Informal Education Programs.

For Space Grant, the quantitative change between the fiscal year 2009 and fiscal year 2008 budgets in DIRECT dollars is a decrease of \$6.9 million. The Space Grant two tiers of alliances (35 states and 17 states) are funded at \$730,000 and \$535,000; respectively, in fiscal year 2008. As with all projects, the request includes agency administrative full costs that include corporate general and administrative costs, which are determined by the Office of the Chief Financial Officer (OCFO), as well as project-specific costs. For fiscal year 2008 Space Grant, the corporate general and administrative costs are approximately \$7.6 million. Final allocations are dependent upon the passing of the NASA Appropriation and subsequent approval of the NASA Operating Plan. Funds will be apportioned to the Space Grant consortia in a pro rata manner consistent with 35 Designated consortia and 17 Program Grant/Capability Enhancement consortia.

Question. Are there better places for us to focus our resources for education funding, and if so, what education programs do you believe work the best at NASA?

Answer. NASA's Agency goals in education are outlined in both the 2006 NASA Strategic Plan and the NASA Education Strategic Coordination Framework: A Portfolio Approach.

All of NASA's education efforts are part of an integrated Agency-wide approach to human capital management. Within the NASA Strategic Plan, education is identified as a crosscutting function that supports all of the Agency's strategic goals and objectives.

For the fiscal year 2009 budget, Education used a defined process to create a balanced portfolio of investments to address the NASA Strategic Plan, recommendations from the National Research Council (NRC), and education community priorities.

Each project within the portfolio is mapped to one of the following Outcomes as defined in the NASA Strategic Plan and the Education Strategic Portfolio Coordination Framework:

- Outcome ED-1: Contribute to the development of the STEM workforce in disciplines needed to achieve NASA's strategic goals through a portfolio of programs.
- Outcome ED-2: Attract and retain students in STEM disciplines through a progression of educational opportunities for students, teachers, and faculty.
- Outcome ED-3: Build strategic partnerships and linkages between STEM formal and informal education providers that promote STEM literacy and awareness of NASA's mission.

Background:

In 2006 and beyond, NASA will pursue three major education goals:

- Strengthen NASA and the Nation's future workforce.*—NASA will identify and develop the critical skills and capabilities needed to ensure achievement of NASA's mission. To help meet this demand, NASA will continue contributing to the development of the Nation's science, technology, engineering, and mathematics (STEM) workforce of the future through a diverse portfolio of education initiatives that target America's students at all levels, especially those in traditionally underserved and underrepresented communities.
- Attract and retain students in STEM disciplines.*—NASA will focus on engaging and retaining students in STEM education programs to encourage their pursuit of educational disciplines and careers critical to NASA's future engineering, scientific, and technical missions.
- Engage Americans in NASA's mission.*—NASA will build strategic partnerships and linkages between STEM formal and informal education providers. Through hands-on, interactive educational activities, NASA will engage students, educators, families, the general public, and all Agency stakeholders to increase Americans' science and technology literacy.

10 HEALTHY CENTERS

Question. One of the challenges in running NASA is keeping a workforce and the agencies aging facilities running and operating efficiently. You have mentioned in the past of maintaining 10 healthy and productive centers. Not all centers are the same in their health, in fact, some will likely be healthier than others.

Can you give this committee an idea of which centers, in your opinion, are healthier and which ones are not quite as healthy?

Answer. Achieving the Agency's Space Exploration mission is a challenge requiring NASA to draw on all of its expertise and resources. Mission success will depend on ten strong, healthy centers. NASA's Strategic Management Council (SMC) has developed a set of attributes that define strong, healthy Centers as:

- Centers strategically positioned, configured, and operated to support NASA's Mission.

- Centers that are prepared to execute programs and project responsibilities successfully and are prepared to adjust or adapt to changes necessary for future Center and Agency success (i.e., Centers doing the right job with the right number of competently prepared people supported by the right mix of state-of-the-art facilities and the right budget.)

The indicators of strong and healthy centers can be grouped into two major categories:

- Human Capital*.—The ability to productively utilize the NASA workforce and to adjust workforce size and skills to meet current and future mission requirements and sustain the operations of the center.

- Physical Capital*.—The quality and utilization of mission and center institutional assets (facilities, buildings, etc.) required to meet not only NASA programmatic goals, but also to sustain national interests while providing for safe and stable center operations.

Human Capital.—NASA plans to assign important spaceflight development activities in exploration and science to all of the Centers. Workforce planning has been more effectively integrated into the annual budget process and the assignment of work to the NASA workforce is supported through a high level of collaboration between the programs and the Centers. Where work demand exceeds available workforce at a center, it is shifted to centers where workforce is available. In the out-years of the budget planning horizon, ARC, GRC, LaRC and DFRC have a small amount of workforce available that have not yet been planned to identified program demand and funding. However, matching work assignments to this workforce is a manageable challenge that we expect to resolve as we complete the development of our fiscal year 2010 budget. An additional measure of workforce health is its scalability. NASA can adjust the size of its workforce through strategies such as buyout and early retirement incentives, hiring controls, and expanded use of non-permanent workforce; i.e., term appointments. At the monthly Baseline Performance Review, NASA senior leadership reviews key workforce metrics to monitor Center workforce health and make adjustments as needed.

Facilities.—The condition of NASA facilities are approximately consistent from Center to Center. Facilities condition varies from Center to Center by 0.7, rated on 0 to 5.0 scale.

Question. If there are centers that are struggling to be healthy, would it not be fair to consider converting a less healthy center into some other instrument that NASA could utilize like a federally funded research and development center (FFRDC)?

Answer. There are currently no large differences in Center health across the Agency, primarily due to the efforts of NASA's leadership over the past three years in assigning exploration and science development work to strengthen and maintain a healthy workforce balance. NASA will continue to face challenges but intends to work proactively and strategically to mitigate issues. In 2004–2005, NASA investigated the possibility of converting the operations and management of some NASA Centers to other organizational models such as FFRDCs, Government Corporations or university consortia. At that time, several Centers had significant issues that contributed to their unhealthy state. Since then, the goal of 10 healthy Centers has been developed and maintained, and NASA is not currently pursuing other organizational models for its Centers.

EXPLORATION ACTIVITIES

Question. You have already touched on what is currently happening in with the Ares and Orion programs. These programs are integral to maintaining our Nation's manned spaceflight activities.

Can you provide us an update on where we are in the schedule?

Answer. NASA's Constellation program has moved beyond being just a mere concept on paper; we are making real progress. We have tested hardware; we have tested landing systems; and we have logged thousands of hours in wind tunnels. So far, the Ares I project has conducted more than 4,000 hours of wind tunnel testing on subscale models of the Ares I to simulate how the current vehicle design performs in flight. These tests support development of the J-2X engine for the Ares I and the Earth Departure Stage of the Ares V. By December 2007, all major elements

of the Orion and Ares vehicles were placed under contract. This year, Constellation will be busy with hardware activities which include fabrication of the First Stage Development Motors 1 and 2 for Ares I; complete construction of the Upper Stage Common Bulkhead Demonstration article and also deliver the first Ares I-X demonstration test flight hardware to KSC in October 2008. Orion will be just as busy, culminating the year with a test of its launch abort system at the U.S. Army's White Sands Missile Range (WSMR) in New Mexico.

All activities are progressing to support all planned design reviews. The Ares I and Orion projects recently completed their Systems Definition Review (SDR) and the Preliminary Non-Advocate Reviews that confirmed NASA is employing a strong systems engineering approach to refine the current program requirements and the requirements were properly allocated down to the projects. Orion and Ares I Projects are currently proceeding toward their individual Project level Preliminary Design Reviews (PDR) by the end of the year. These reviews provide opportunities to confirm that the subject activities, products, and process control requirements have been adequately flowed to—and implemented within—the Projects. The Projects, along with the program, are tracking all products required for PDR to insure all data is available on time and at the appropriate maturity level.

Question. Are there any technical issues that NASA is aware of today that will cause the current schedule to slip and make the gap between the Shuttle retirement and Ares and Orion even longer?

Answer. NASA is very confident in the capability of our government and contractor Constellation team, to accomplish this complex system acquisition. We are not dependent on the development of exotic new technologies to make this program a reality. Our challenge is the integration of complex systems that must work together. Issues have and will inevitably arise, but none are expected to delay the Initial Operating Capability of Ares and Orion, set for March 2015.

NASA is continuing the design process for the Orion and is pleased with the progress made so far. The current design configuration establishes a robust vehicle and meets the weight requirements, including meeting the more demanding lunar configurations. However, NASA recognizes that the design is still young and much work remains to be done to complete it. Some of the key areas NASA is following closely with Orion are:

- Crew support for safety;
- Ensuring the vehicle adequately supports the crew in the event of contingency landings when the crew may have to spend an extended period of time in the vehicle prior to recovery by ground support teams;
- Landing scenarios assessment;
- The assessment of mass threats and opportunities against the Orion PDR configuration; and
- Understanding the vulnerabilities of the vehicle design and understanding the Loss of Crew and Loss of Mission probabilities.

Question. What would it take to make these systems come on-line sooner, or are we at a point where no matter how much additional funding is provided, the successful launch of the Constellation vehicles cannot be accelerated?

Answer. Full funding of NASA's fiscal year 2009 budget request for Constellation is needed so that we can continue successful transition between the Shuttle and the Orion and Ares I. The fiscal year 2009 budget request supports Orion IOC in March 2015 at a 65 percent cost confidence and full operational capability (FOC) in fiscal year 2016, though NASA is working to bring this new vehicle online sooner.

In preparation for NASA's fiscal year 2010 budget submission to Congress next year, NASA is beginning to make several new assessments of the program plans, budget available and schedule for the Orion and Ares vehicles. Although those calculations are not final, NASA believes that acceleration to September 2014 IOC may be possible if additional funding for these vehicles beyond what is projected in the fiscal year 2009 Presidential Budget Request were made available.

FINANCIAL SYSTEMS

Question. For several years now this committee has asked about NASA's financial systems. NASA has a recent track record of failing its independent audits. We keep being reassured that the financial system was being improved.

Can you point to any improvements in the way NASA keeps track of its \$17 billion in funds?

Answer. NASA has two remaining material weaknesses: Financial Systems, Analyses, and Oversight (FSAO); and, Enhancements Needed for Controls Over Property, Plant and Equipment (PP&E) and Materials. The FSAO material weakness addresses multiple entity-wide internal control weaknesses, identified by the agency's

independent auditor. To resolve these issues, NASA has developed a Comprehensive Compliance Strategy (CCS) that focuses on ensuring compliance with Generally Accepted Accounting Principles (GAAP) and other financial reporting requirements. The CCS also covers the standards and requirements necessary to cure deficiencies noted in recent audit and related reports. The CCS serves as the basis for implementing comprehensive proactive corrective actions and provides the guiding principles for executing effective financial management functions and activities with internal control and compliance solutions inherently embedded in the processes.

In the first quarter of fiscal year 2008, NASA undertook an internal review and engaged a nationally-recognized accounting firm to perform an in-depth analysis of requirements for NASA to be in compliance with GAAP and other applicable financial standards, to demonstrate such compliance through auditable evidence, and to operate with robust and comprehensive internal controls. Validation of this framework and plans to implement the required actions to conform NASA policies to this framework were completed in the second quarter of fiscal year 2008. An assessment of the remedial actions necessary is underway, and upon completion of the assessment, timing and phasing for resolution will be determined. The CCS provides the critical path milestones for NASA to resolve the FSAO material weakness.

The Property, Plant and Equipment material weakness is comprised of issues primarily related to the agency's reliance on contractors to "report property values at periodic intervals without robust agency-wide detect controls," and difficulties ensuring the completeness of balances for certain legacy assets.

In November 2007, NASA implemented a new policy and related procedures for identifying the cost of individual assets throughout the asset's acquisition lifecycle. This policy change was based on guidance received from the Federal Accounting Standards Advisory Board (FASAB). These changes support the verification and reconciliation of asset values for those assets developed through new contracts (post November 2007) and certain large pre-existing contracts. For legacy assets, like the Space station and Space Shuttles, NASA does not have the necessary supporting information available to provide auditable book values for the Space Shuttle and the International Space Station (ISS). Together, Shuttle and ISS related assets currently represent over \$14 billion of the total \$20.6 billion PP&E net asset value reported in the September 30, 2007 fiscal year-end financial statements. While certain of the existing Shuttle and ISS assets will be transitioned for use on other NASA programs, much of this issue may become moot with the passage of time, as the Shuttle is to be retired in 2010, and the ISS is being depreciated based upon a 15-year specification life through 2016. While the ISS depreciation schedule naturally leads to 2016 as an outside date for resolution of this issue, NASA is presently developing and evaluating a variety of alternatives with a view to achieving a more timely, albeit still cost efficient and effective, solution for this issue.

Question. Will we see any improvement in how NASA manages its funds so that it is clear to everyone what is happening with taxpayer funds?

Answer. Even though we still have two material weaknesses outstanding, NASA has high confidence in the current data collected and reported in our financial systems from our contractors and NASA facilities. With this data, we are reporting monthly program status to NASA management and Congressional members and staff. We are actively using this information to make decisions daily about the execution of our programs and projects. Our financial systems permit a comprehensive monthly assessment of the execution status of our projects, helping us to identify which projects might require additional funding, and which may be potential sources for funds re-balancing. You will see operating plan requests that are based upon this level of insight.

Our financial systems now provide standard data reports that can be used by senior managers to assess how well projects are using their appropriated funds and to allow managers to make corrections as needed to ensure proper funds management. Starting last summer, we initiated an Agency-wide effort to ensure efficient use of appropriated funds, with a goal of reducing our end of year unobligated balances by over 40 percent. Through better reporting, better funds distribution processes, and better management tools and standards, we expect to achieve this goal by the end of fiscal year 2008.

Question. In your proposed budget for the Shuttle, there is funding identified through fiscal year 2011. For a vehicle that has been around as long as the Shuttle, I find it hard to believe that the program can be completely closed out in that short of time. What is the plan to fund and perform this close out activity?

Answer. Current plans call for Shuttle transition and retirement real and personal property disposition activities (the long-term item in transition and retirement) to be effectively complete (with no further significant budget impacts to ongoing programs) by about the middle of the next decade. Shuttle transition and close-

out began two years ago and the rate of closeout continues to increase as the Shuttle flies out the remaining manifest. The goal, projections, and progress indicate that Shuttle closeout will be well on its way to completion at the end of 2010. NASA will develop estimates for transition and retirement funding needed from 2011 and later during the formulation of the fiscal year 2010 budget. It is important to note that NASA continues to disposition Apollo-era property at a low level even today, thirty-two years after the last flight of an Apollo vehicle.

The in-year resources (i.e., those from fiscal year 2006–10, the end of the Space Shuttle Program) for Transition and Retirement (T&R) activities are already incorporated in the Space Shuttle Program budget line. The out-year costs (i.e., those from fiscal year 2011–15) for T&R activities are being generated now as part of the formulation of the fiscal year 2010 President's Budget request. The budget projection will benefit from trade studies and "what-if" exercises conducted since the development of the fiscal year 2009 request, and will reflect an increasingly mature understanding of Constellation Program requirements. Every time NASA has projected out-year T&R costs, the numbers have decreased. Thus, the Agency didn't want to prematurely commit to a firm set of out-year numbers, since data and trends indicate that transition and retirement costs will be lower than the estimate from 2007. In not "locking in" higher projections, NASA hopes to incentivize people to find the best methods and approaches for the Agency.

Question. What are your observations on the Chinese space program and what does it mean for our Nation?

Answer.

Assessment of Chinese Capabilities to Mount a Human Lunar Mission

Chinese space officials have openly discussed plans to conduct spacewalking demonstrations next year, orbital rendezvous and docking operations by 2010, and a robotic lunar landing mission by 2012. Based upon a careful review of open source information concerning the capabilities of the Shenzhou crew vehicle and the planned Long March 5 rocket, it is my considered judgment that, although China's public plans do not include a human lunar landing, China will have the technical wherewithal to conduct a manned mission to the surface of the moon before the United States plans to return.

While initial Chinese mission(s) to the moon would not have the long-term sustainability of our own plans for lunar return, I believe China could be on the moon before the United States can return.

China is prosecuting a fully indigenous program of human spaceflight development. They have adapted the design of the Russian Soyuz vehicle to create their own Shenzhou, which is more spacious, more capable, and better suited for long duration space missions than its Russian antecedent. China plans to conduct its first spacewalks and orbital rendezvous operations in 2008 and 2010, and to build a small space station in the next few years. All of this has been openly announced. Their accomplishments so far give me no cause to doubt their ability to carry out these plans.

With the first manned Shenzhou flight in October 2003 China surpassed by itself the accomplishments of all six U.S. Mercury missions in the early 1960s. The second Shenzhou flight in 2005 demonstrated most of the accomplishments of the first three U.S. Gemini missions in 1965. They will soon demonstrate the rendezvous and docking capabilities pioneered by the United States in the Gemini program in 1966, by docking a Shenzhou spacecraft with another Shenzhou, or with an orbital module left by a prior mission.

These examples illustrate a fundamental difference between the development of the Chinese human spaceflight program, and that of the United States and Russia. Because China can follow established technical paths, they do not have to verify the basic feasibility of their approach. They need only to demonstrate that their systems work as designed to accomplish tasks which are by now well understood. Thus, each step in space can take them to a new capability plateau, eclipsing the equivalent of several pioneering but tentative steps in an earlier era. The United States required twenty-one human spaceflights to reach the moon in the 1960s. China should not need so many.

The second major initiative for which the Chinese have demonstrated significant progress is the development of the Long March 5 launch vehicle. They have conducted several rocket engine tests over the past two years, and plan to conduct demonstration flights in 2008–11. The Chinese have advertised its capability as 25 metric tons (mT) to low Earth orbit (LEO), rivaling or surpassing the largest expendable launch vehicles available today, which have a capacity of approximately 20 mT, or slightly greater. I believe that China's concerted, methodical approach to the Long March 5 development, along with recent construction of a new launch facility on

Hainan Island, puts them on track to bring the Long March 5 online by 2013–14, their stated intention. NASA’s Ares I rocket, which will have similar capabilities, will not be fully functional until March 2015, according to current plans.

Third, China has developed and demonstrated a dual launch processing capability. This capability, together with the 25 mT-to-LEO capacity of the Long March 5, allows China to reach the “tipping point” critical to executing a manned mission to the Earth’s moon. As one possible approach, this can be done by means of two dual-launch sequences.

The first Long March 5 would place, in Earth orbit, a lunar lander similar in size and mass to the Apollo Lunar Module, about 14 mT, together with a lunar orbit injection (LOI) stage weighing 6 mT. With a second Long March 5 launch, the lander and LOI stage would be joined in Earth orbit by a 25 mT Trans-Lunar Injection (TLI) stage. The two payloads would rendezvous and dock automatically, as the Russian Soyuz and Progress vehicles do at the International Space Station today. After docking, the TLI stage would send the combined payload to the moon. Injection into lunar orbit would be accomplished by the LOI stage, leaving the lander poised to wait for a few weeks—or even months if necessary—for the second launch sequence.

The second pair of Long March 5 launches would place in Earth orbit a crewed Shenzhou vehicle and LOI stage with one launch, and a TLI stage with the other. As in the earlier sequence, the Shenzhou would rendezvous and dock with the TLI stage, which would send the combined stack to the moon. The LOI stage would decelerate the Shenzhou into lunar orbit, where it would then dock with the waiting lander. The Shenzhou would differ from today’s Earth-orbital version in two respects. It would require larger propellant tanks to allow it to depart lunar orbit for the return to Earth, and it might require a thicker heat shield to withstand atmospheric entry upon return from the moon. Neither of these modifications presents a significant challenge. The lunar version of Shenzhou would weigh about 11 mT, considerably less than the 14 mT lunar lander, so the delivery of a lunar-capable Shenzhou to lunar orbit presents no difficulty.

After rendezvous, the Shenzhou crew would transfer to the lander, land on the moon’s surface, remain for several days, depart, rendezvous again with the Shenzhou, and return to Earth. (Parameters and assumptions for this scenario are summarized in the attached Technical Notes.)

What is fundamentally different about the dual-launch capability that the Chinese have demonstrated, and could well develop for the Long March 5, is that it enables human lunar missions without requiring a 120 mT class vehicle like the Apollo-era Saturn V, or our planned Shuttle-derived Ares V. This technique is not particularly cost-effective and is not easily scaled to a sustainable operation, but it does offer a path to “boots on the moon” without the development of a heavy-lift launch vehicle.

Apart from the lunar lander itself, this approach requires for its implementation only modest developments beyond the existing Shenzhou and the Long March 5 vehicles. The new elements for a lunar mission are the TLI and LOI stages, which would be essentially the same aside from the size of the propellant tanks employed, and which would utilize the upper-stage engines from the Long March 5, with modest improvements. This is a minor developmental excursion from Long March 5 technology.

China has not announced any intention to develop a human lunar lander. However, I note that China recently launched its first robotic lunar orbiter mission, and has announced plans for a robotic lander by 2012 and a robotic sample return mission in the 2017–2020 timeframe. The developments in communications, tracking, guidance, navigation, and control required to execute robotic lunar orbital and lander missions are identical to those for a manned system, irrespective of whether or not the lander itself is scaleable to human missions. Inasmuch as the design parameters of the Apollo lunar lander are widely known and well within today’s state of the art, the development of a similar vehicle by the Chinese should not present a significant problem.

Pending development of a Chinese manned lunar lander, a fly-by or orbital mission around the moon could easily be executed with the Shenzhou spacecraft and a single pair of Long March 5 launches, as outlined above. Indeed, as a matter of prudent engineering development, I would fully expect China to execute such a mission prior to a lunar landing. This would be completely analogous to the inspirational Apollo 8 mission during the Christmas season of 1968.

Question. What do you think we need to do to maintain our advantage in space exploration and innovation?

Answer. NASA should continue to take all steps necessary to retire the Shuttle, which is planned for the end of fiscal year 2010. Retirement of the Shuttle is a critical step in enabling a smooth transition to NASA’s exploration program. Full fund-

ing of NASA's fiscal year 2009 budget request for Constellation is needed so that we can continue successful transition between the Shuttle and the Orion and Ares I. The fiscal year 2009 budget request supports Orion IOC in March 2015 at a 65 percent cost confidence and full operational capability (FOC) in fiscal year 2016, though NASA is working to bring this new vehicle online sooner. Budget stability in fiscal year 2009 is crucial to maintaining IOC. There is minimum flexibility through fiscal year 2010, so Congressional support for budget stability is critical.

QUESTIONS SUBMITTED BY SENATOR MARY L. LANDRIEU

NASA OPERATIONS AT THE MICHLOUD ASSEMBLY FACILITY (MAF)

Question. Given the vast amount of room in the MAF and the green space outside the facility, are there any expected transfer business opportunities from other NASA facilities to Michoud in the next year?

Answer. Since 2006, NASA has been actively supporting diversification of work being performed at the Michoud Assembly Facility (MAF) for NASA and other organizations, and the Agency will continue to do so. Today, MAF is transitioning from being a single-project (External Tank), government-owned, contractor-operated facility, to one being used for manufacturing by several human space flight projects for the Constellation Program. As part of this transition, Ares I Upper Stage and Instrument Unit work is planned for MAF, as well as Orion Crew Exploration Vehicle manufacturing and Launch Abort System work. After completion of the Space Shuttle manifest in 2010, MAF's major use will be the production of the Ares V heavy lift rocket for Constellation.

For the next year, NASA work at MAF is focusing on: continued External Tank production; initial start-up of Constellation Ares I Upper Stage and Orion manufacturing equipment installations; transitioning to a new base operations contractor; and investigation of "enhanced use lease" opportunities by non-NASA entities.

During calendar year 2008, NASA is conducting the competition to select a new "base operations contractor" to operate and maintain MAF for NASA and non-NASA users. The contractor should be selected during fiscal year 2009. One reason NASA has made the change to the way the facility is operated now, prior to the last Space Shuttle External Tank being completed, is to facilitate the goal of enabling diversification of the work being performed at MAF before the last External Tank is completed. This should partially mitigate the workforce disruption at the end of External Tank production.

NASA continues to refine Constellation plans this year, including plans for Ares V launcher design and development. It is possible that these refinements may accelerate Ares V work at MAF into fiscal year 2012 or fiscal year 2011. If so, NASA will inform the Committee.

Question. How about any in the next 5 years?

Answer. NASA is currently investigating the possibility of adding Ares V manufacturing technology demonstrations to MAF over the next three years, prior to the start of full production of Ares V projects at MAF. These assessments will be conducted incrementally over the next two years, and may or may not result in manufacturing technology work assignments, based on budget availability and conflicts with work already at MAF. If work is added, NASA will inform the Committee.

Layouts for NASA floor space at MAF in the fiscal year 2013-2014 show that the great majority of MAF floor space will be used for manufacturing equipment installation for Ares V Core Stage and Ares V Earth Departure Stage (EDS) production. NASA floor plans show MAF floor space utilized at a very high percentage once Ares V development begins. Because MAF utilization is projected as being high for Ares V, and given the cost to programs of changing equipment locations once established, NASA is not currently considering major but temporary (~two years) allocations of production work from other projects to MAF prior to Ares V development.

NASA is currently refining plans to close out Space Shuttle External Tank production after the last Space Shuttle mission in fiscal year 2010. Work to dispose of materials and tooling no longer required for Space Shuttle production and unneeded for Constellation production will be conducted by a subset of the existing MAF contractor workforce. These plans are expected to be completed by October 2008. When these plans are completed and the amount and duration of work to dispose of External Tank manufacturing equipment is understood, NASA will inform the Committee.

Question. Will you commit to do a thorough review of possible transfer opportunities which may help "bridge" employment at the Michoud Facility? (Yes/no)

Answer. As stated in response to the previous question, NASA is currently conducting a competition to select a new “base operations contractor” to operate and maintain MAF for NASA and non-NASA users. The contractor should be selected during fiscal year 2009. One reason NASA has made the change to the way the facility is operated now, prior to the last Space Shuttle External Tank being completed, is to facilitate the goal of enabling diversification of the work being performed at MAF before the last External Tank is completed. This should partially mitigate the workforce disruption at the end of External Tank production.

NASA is also exploring the potential of “bridge” employment at our impacted facilities, which may take the form of cross-training key Shuttle personnel to work on Constellation projects and/or early builds of some Constellation hardware. Also, in preparation for next year’s budget submission to Congress, NASA is undertaking several programmatic trade studies for how best to plan and organize Constellation work, including the post-2010 flight test program, with an eye toward enhancing our test program and mitigating workforce impacts as we retire the Space Shuttle and transition to new Constellation Systems.

It should also be noted that the first NASA Transition Workforce Report, submitted to the Committee on March 31, 2008, likely overstated the reduction in local employment at MAF because of the assumptions and caveats listed in that report. NASA continues to refine Ares V development planning, including short term manufacturing demonstration tasks, and these refinements may modify internal government estimates of contracted work to be conducted at MAF from fiscal year 2010 to fiscal year 2015. If there are internal estimate changes, these would be reflected in the next update to the NASA Transition Workforce Report in September 2008.

FUNDING FOR CONSTELLATION PROGRAM

Question. How much in additional funding would have to be added to the fiscal year 2009 NASA budget to close or essentially close the gap between Space Shuttle retirement and the start of the Constellation Program?

Answer. Full funding of NASA’s fiscal year 2009 budget request for Constellation is needed so that we can continue successful transition between the Shuttle and the Orion and Ares I. The fiscal year 2009 budget request maintains Orion initial operational capability (IOC) in March 2015 at a 65 percent cost confidence level and full operational capability (FOC) in fiscal year 2016, though NASA is working to bring this new vehicle online sooner. In order to accelerate the Ares I and Orion IOC, and provide for a 65 percent cost confidence level for a September 2014 IOC instead of March 2015, an additional \$350 million in fiscal year 2009 and an additional \$400 million in fiscal year 2010 would be required.

The Agency is considering a number of options for minimizing the period between Shuttle retirement and the availability of a new U.S. crew transport capability, including maintaining an aggressive development schedule for Orion/Ares I. However, keeping the Space Shuttle flying past 2010 is simply not a credible way to address this issue. The Agency cannot continue flying the Space Shuttle while simultaneously and aggressively developing the next-generation exploration systems under the Constellation program. Maintaining even a minimal capability to launch two Shuttle flights per year after fiscal year 2010 would require nearly the same infrastructure and vendor capabilities we have today, at a cost of approximately \$2.7–\$4 billion per year, which would likely come at the expense of Constellation development. In addition, the Constellation architecture is designed to take advantage of Space Shuttle infrastructure, production capabilities, and workforce once they are no longer needed for flying the Shuttle. If the Shuttle were kept flying past 2010, these capabilities could not be released for Constellation’s modification and use. As a result, keeping Shuttle flying past 2010 would only compound the problem of getting Constellation into service and would not reduce the period between Shuttle retirement and the availability of a new U.S. crew transport capability.

SMALL/DISADVANTAGED BUSINESS UTILIZATION EFFORTS

Question. The Marshall Space Flight Center in Alabama currently has a U.S. Small Business Administration (SBA) Procurement Center Representative (PCR) which assists with small business procurement and technical assistance in that area. It is my understanding that this PCR is responsible for Michoud in New Orleans. Please provide information on the specific duties of this PCR.

Answer. Ms. Barbara (Bobbie) Jenkins is the resident SBA PCR assigned to the Marshall Space Flight Center (MSFC), and is the liaison PCR and provides coverage for: the Stennis Space Center, MS, and NASA Shared Services Center (NSSC), which is located on the same campus as Stennis Space Flight Center, MS; Space and Missile Defense Agency in Huntsville, AL; Anniston Army Depot in Anniston,

AL, Fort Rucker, AL, the Naval Facilities Engineering Command PWD Mid-South in Millington, TN, and the Corp of Engineers in Memphis, TN.

Following is a listing of principal duties of this SBA PCR.

The SBA PCR is responsible for representing the SBA at the foregoing assigned installations on all matters pertaining to procurement policy or operations that affect SBA's programs or small business concerns, interest in, or doing business with, these installations. The PCR reviews procurement plans and programs of the installation with the head of the installation or director of procurement. She evaluates their impact on small business and recommends changes to enhance small business participation. She develops individual plans of operation for each installation which will ensure adequate consideration of small business and a fair share of awards to small business.

The SBA PCR takes appropriate action to resolve policy and/or procedural deviations which have significant adverse impact on contract awards to small business anticipated or made by the installation. The PCR reviews types and classes of items to determine which ones can be set-aside for small businesses.

The SBA PCR reviews all significant procurements not set-aside by class action or unilateral action on the part of the installation and takes appropriate action to facilitate individual set-aside action on procurements on which research indicates the expectation of sufficient small business competition.

In some cases, the PCR may also review procurements that have been set-aside for small business to see if they might be suitable for the 8(a) Program or for HUBZone, service-disabled veteran-owned, or women-owned small business; and, if so, the PCR takes appropriate action on a case-by-case basis to facilitate a more targeted set-aside.

As required by Section 8(d) of the Small Business Act (Public Law 95-507), the PCR reviews pre-award proposed subcontracting plans submitted by apparent successful bidders and offerors. The PCR advises the contracting officer if plans provide maximum practicable opportunities for small business in accordance with the statute and regulations. If not, the PCR negotiates with contracting officer to resolve differences.

The SBA PCR develops technical data on specifications and specialized equipment necessary to produce items on which there is limited or no small business competition so as to provide small firms with the opportunity to compete. The PCR reviews local regulations and instructions which have an impact on small business concerns to ensure conformity with the Federal Acquisition Regulations (FAR) and brings deviations that are harmful to small business to the attention of proper procurement officials for correction.

The SBA PCR appeals unwarranted rejections or withdrawals of set-asides to the commanding officer or to the head of the installation, and suspends procurement until the set-aside issue is resolved. If not resolved at the installation level, the PCR prepares and documents files for set-aside appeals to the Agency headquarters level by the SBA Administrator.

The SBA PCR personally develops small business sources for procurements on which such competition is needed or initiates action for other SBA offices to develop such sources. The PCR takes action to assure that competent small business concerns are included on the source list for negotiated procurement.

The SBA PCR studies the history of sole source procurement and recommends specific components for direct competitive purchase by the Government, either through component breakout or breakout under the high dollar spare parts procedures. The PCR studies individual sole source procurement and recommends that complete specifications and drawings be obtained from the sole source contractor when the Government has purchased the rights to them, that competitive procurements be made, and that sources furnished by SBA be given the opportunity to compete.

The SBA PCR conducts interviews with representatives of small business concerns and advises them how and where to sell their products to the Government. She directs them to the cognizant purchasing offices, and, when appropriate, arranges for these firms to contact the proper SBA representative, Certificate of Competency Specialist, Commercial Market Representative, Size Specialist, or Small and Disadvantaged Business Specialist.

The SBA PCR participates in the establishment of small business award goals at installations for which she is responsible. The PCR evaluates the rationale on which goals are based and negotiates with procurement officials for the raising of targets when data warrants such action.

The SBA PCR conducts periodic seminars for interested small businesses, either alone or with other Federal agencies, to provide an update for the small business

community in the area regarding changes in procurement regulations and/or policies which affect them.

The SBA PCR is responsible for the screening, identification, and referral of all procurements to be used in the 8(a) programs nationally at the installations covered.

Question. Does this PCR also cover the Stennis Space Flight Center in Mississippi?

Answer. Yes, as noted above, Ms. Jenkins also covers the Stennis Space Flight Center.

Question. Please provide information on the status and whether there is any demonstrated success of current Michoud small business utilization efforts.

Answer. The attached chart contains the actuals of the two major contracts currently being performed at Michoud Assembly Facility by the Lockheed Martin Corporation. As reflected in the chart, on the External Tank contract, Small Businesses are receiving 21 percent of the total contract value, which equates to \$471.2 million, and on the Facility Operations contract, Small Businesses are receiving 21.3 percent of the total contract value, which equates to \$42.3 million. Lockheed is exceeding the negotiated small business goals for both of these contracts.

LOCKHEED MARTIN CORPORATION MICHLOUD ASSEMBLY FACILITY EXTERNAL TANK AND CONSOLIDATED FACILITY CONTRACTS

	Awarded to SB of total award		Facility NNM04AA02F	Percent Achieved
	Amount	Percent		
Current Contract Amount	\$2,247.7	.....	\$98.4	.....
Small Business	\$471.2	21.0	\$42.3	21.3
Small Disadvantage Business	\$109.3	4.9	\$22.5	11.3
Woman Owned Small Business	\$71.5	3.2	\$2.6	1.3
HUBZone .....	.....	.....	\$ .4	.2
Veteran Owned Small Business .....	.....	.....	\$14.8	7.5
Small Disadvantage Veteran Owned Small Business .....	.....	.....	\$ .2	.1

Note: The external tank contract is NAS8-00016, and the facility contract is NNM04AA02F. Lockheed Martin provides this support to MSFC at the Michoud Assembly Facility in New Orleans. These are MSFC contacts.

ENHANCED USE LEASE AUTHORITY

Question. Describe the estimated workforce impact of the expanded Enhanced Use Lease authority on the ability to provide additional employment opportunities at Michoud over the next five years.

Answer. Enhanced Use Leasing (EUL) will support NASA's efforts to develop underutilized real property at the Michoud Assembly facility (MAF), offsetting job losses from the sunset of the External Tank project. EUL will provide a benefit that will assist in marketing and developing new tenants. It will also allow NASA more flexibility in using the income to help reduce the cost of maintaining this national asset.

MAF is playing a major role in the Constellation program including the manufacture of the Orion Command Module structure, the Service Module structure, and the Ares I Upper Stage at MAF. Starting in 2012, manufacturing of Ares V Boost Stage, and Ares Earth Departure Stage are planned for MAF as well. There is significant potential and incentive for private entities to locate on the site to take advantage of common pursuits. Enhanced Use Leasing can support and provide a vehicle for these pursuits. Commercial use of the space, by tier 2, 3, or 4 Space program suppliers is expected. The proximity of suppliers can increase their understanding of NASA program requirements and ease product delivery, expanding the skill base and workforce pool needed to execute NASA's next generation of vehicles.

While it is too early to project workforce estimates, NASA's keen interest in preserving the talented workforce at MAF will be key to EUL developments. Enhanced Use Lease will allow MAF to either reduce or avoid increases to its facilities overhead burden and to develop revenue streams for sustaining certain facilities and infrastructure.

NASA MAF has met with other Federal and NASA EUL implementers, such as the Department of Energy Oak Ridge National Laboratory, to discuss their business model for developing their science and technology park. MAF has specific, unique capabilities which can be utilized or expanded by EUL partners. These capabilities include extensive infrastructure for design, manufacturing, and testing of extremely large aerospace structures; their transportation and handling including a deep-

water port; and the specialized environmental permits, wastewater treatment capability, and compliance management for large vehicle manufacturing.

Question. Does NASA recommend any additional steps that can be taken by the State of Louisiana to take full advantage of this expanded authority at Michoud?

Answer. As the Senator is aware, MAF hosts the National Center for Advanced Manufacturing (NCAM), a Federal, State, and University sponsored partnership. The NCAM is currently involved in discussions with the State to assess workforce retraining and benefit strategies to make sure the current MAF workforce can have full access to proper training to attract potential new tenants.

ADDITIONAL BRIDGE EMPLOYMENT EFFORTS

Question. I would be interested if NASA could provide some specific recommendations for priority areas that Congress and the State of Louisiana can work with NASA to provide significant "bridge" employment to help retain workers at the Michoud facility.

In particular, are there any other Federal government programs, such as those at the Economic Development Administration, the Small Business Administration's Historically Underutilized Business Zone (HUBzone) Program, or Department of Labor assistance programs which could help the economic impact of workforce reductions at the Michoud Facility?

Please provide any additional areas that the Congress and/or State of Louisiana could help provide bridge employment at the Michoud facility.

Answer. NASA does not have a recommendation at this time. Lockheed-Martin, the prime contractor at the Michoud Assembly Facility (MAF) for the Space Shuttle Program External Tank, is investigating employee placement and potential new "within the company" work assignments to MAF as a facility user following the end of External Tank production. NASA will continue to investigate alternate business opportunities for the MAF workforce skill types and identify these to the Committee and Lockheed-Martin when known. NASA will investigate, during fiscal year 2009, assistance from other Federal Government programs to affect economic impact from MAF work changes.

QUESTIONS SUBMITTED BY SENATOR DIANNE FEINSTEIN

Question. The Western United States depends upon information collected by the thermal infrared instrument (TIR) on the NASA Landsat satellite to measure and monitor water supply and use. However, I understand that you have stated that building the TIR will delay the launch schedule for Landsat 8. Other than funding, are there any other factors that would preclude you from building the TIR and including it on Landsat 8 without delaying the scheduled launch?

Answer. There are no substantial technical challenges associated with adding a thermal infrared (TIR) instrument to the Landsat Data Continuity Mission (LDCM). The challenges are in cost and schedule. TIR is not in the LDCM cost baseline, as the LDCM conceptual design did not include a requirement for thermal imaging. The schedule challenge arises from the risk of lengthening the potential data gap between Landsat 7 and LDCM, although NASA's current schedule projections for LDCM regardless of whether it flies a TIR indicate that the mission will not be ready for a July 2011 launch as originally planned.

Question. NASA facilities and contractors in California are helping to develop and build the Orion Crew Exploration Vehicle for the Constellation Program; and many key components for the Space Shuttle program. The current shuttle fleet is scheduled to be retired in 2010, leaving the United States without domestic capacity for manned space flight. What level of funding is needed to restore NASA's manned space flight capacity before 2015?

Answer. Full funding of NASA's fiscal year 2009 budget request for Constellation is needed so that we can continue successful transition between the Shuttle and the Orion and Ares I. The fiscal year 2009 budget request maintains Orion initial operational capability (IOC) in March 2015 at a 65 percent cost confidence level and full operational capability (FOC) in fiscal year 2016, though NASA is working to bring this new vehicle online sooner. In order to accelerate the Ares I and Orion IOC, and provide for a 65 percent cost confidence level for a September 2014 IOC instead of March 2015, an additional \$350 million in fiscal year 2009 and an additional \$400 million in fiscal year 2010 would be required.

The Agency is considering a number of options for minimizing that gap, including maintaining an aggressive development schedule for Orion/Ares I. However, keeping the Space Shuttle flying past 2010 is simply not a credible way to address this issue. The Agency cannot continue flying the Space Shuttle while simultaneously

and aggressively developing the next-generation exploration systems under the Constellation program. Maintaining even a minimal capability to launch two Shuttle flights per year after fiscal year 2010 would require nearly the same infrastructure and vendor capabilities we have today, at a cost of approximately \$2.7–\$4 billion per year, which would likely come at the expense of Constellation development. In addition, the Constellation architecture is designed to take advantage of Space Shuttle infrastructure, production capabilities, and workforce once they are no longer needed for flying the Shuttle. If the Shuttle were kept flying past 2010, these capabilities could not be released for Constellation's modification and use. As a result, keeping Shuttle flying past 2010 would only compound the problem of getting Constellation into service and would not reduce the period between Shuttle retirement and the availability of a new U.S. crew transport capability.

Question. The United States faces an imminent gap in both cargo and crew carriage to the International Space Station after retirement of the Shuttle in 2010. If NASA were to pursue domestic carriage through the exercise of the COTS Capability D (manned) option, how quickly could this occur, how much would Capability D cost over what period of time, and when is the soonest date that a domestic, commercial provider could become available?

Answer. NASA estimates that industry would require a development period of between 3–6 years until a fully operational Capability D for crew transportation and rescue services would be available. Even if Capability D becomes operationally available during this timeframe, NASA will still need to purchase Russian Soyuz crew transportation and rescue services to fill any gap between Shuttle retirement and the projected Capability D operationally available date. NASA prefers to purchase U.S. commercial crew transportation and rescue services once they have been demonstrated rather than purchase Russian Soyuz services.

Credible industry proposals for Capability D would need to take into consideration an extended development period, major financial investments, and high infrastructure costs. In order for NASA to initiate the first phase of a Capability D option, funding on the order of a few hundred million dollars per partner would have to be made available through the development period. NASA estimates that an industry partner would have to spend well over \$1 billion in the development of Capability D, either from company reserves or from outside investments in addition to the NASA funding. NASA believes that a co-investment approach would appropriately balance the government's contribution with the desire to stimulate the market and ensure commitment from industry for a follow on procurement of demonstrated crew transportation services. This approach would be consistent with the current funded Space Act Agreements with SpaceX and Orbital Sciences Corporation for development and demonstration of cargo delivery.

Question. Are you confident that the Joint Dark Energy Mission that results from NASA's competition will be within the range of all of the explicit scientific objectives and expectations laid out by the National Research Council in its report on "Beyond Einstein" missions?

Answer. Yes. From the National Academies' National Research Council's major findings, a Joint Dark Energy Mission (JDEM) mission will set the standard in the precision of its determination of the distribution of dark energy in the distant universe. By clarifying the properties of 70 percent of the mass-energy in the universe, JDEM's potential for fundamental advancement of both astronomy and physics is substantial. A JDEM mission will also bring important benefits to general astronomy. In particular, JDEM will provide highly detailed information for understanding how galaxies form and acquire their mass.

NASA will use the National Academies' National Research Council's report and other related reports in preparing the Announcement of Opportunity (AO) for JDEM science investigations. Potential to meet JDEM science objectives will be a principal selection criterion. NASA continues to work with ESA and others to prepare for future missions such as LISA and Con-X to meet additional objectives of NASA's Physics of the Cosmos program which include the Beyond Einstein science.

Question. The proposed budget transfers the space communications networks from Science to Space Operations. What is the purpose of this transfer and will funding for these activities be fully maintained after the transfer?

Answer. The consolidation of the Agency's Space Communications and Navigation (SCaN) activities under a single management organization will move NASA away from individual solutions, providing instead an integrated, efficient and effective approach to meeting NASA's evolving SCaN needs. As part of this consolidation, NASA transferred all budgetary matters related to SCaN to this new organization, presently known as the SCaN Program Office (within the Space Operations Mission Directorate). The SCaN Program Office will draw on the commonality in the hardware, software and operations in the existing networks to integrate all of these net-

works under a single architecture, capable of meeting all of NASA's growing SCaN needs. The efficiency that NASA can achieve from this integration will provide the Agency with more effective SCaN services into the future and will enable the leveraging of cost savings into upgrading and modernizing the aging SCaN infrastructure. NASA anticipates that all existing activities will not only be maintained, they will also be enhanced to more effectively enable NASA's spaceflight and exploration missions.

SUBCOMMITTEE RECESS

Senator MIKULSKI. The subcommittee stands in recess until April 10 when we will take testimony from the Attorney General. Thank you very much.

[Whereupon, at 11:05 a.m., Thursday, April 3, the subcommittee was recessed, to reconvene subject to the call of the Chair.]