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NASA: ISSUES AND CHALLENGES

HEARING

BEFORE THE

SUBCOMMITTEE ON SCIENCE AND SPACE

OF THE

COMMITTEE ON COMMERCE, SCIENCE, AND TRANSPORTATION UNITED STATES SENATE

ONE HUNDRED NINTH CONGRESS

SECOND SESSION

APRIL 25, 2006

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CONTENTS

	Page
Hearing held on April 25, 2006	1
Statement of Senator Allen	23
Statement of Senator Hutchison	1
Statement of Senator Bill Nelson	2
Statement of Senator Stevens	19
Prepared statement	20

WITNESSES

Griffin, Hon. Dr. Michael D., Administrator, NASA	3
Prepared statement	7

APPENDIX

Response to written questions submitted by Hon. Kay Bailey Hutchison to Hon. Dr. Michael D. Griffin	37

NASA: ISSUES AND CHALLENGES

TUESDAY, APRIL 25, 2006

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

The Subcommittee met, pursuant to notice, at 2:35 p.m. in room SD–562, Dirksen Senate Office Building, Hon. Kay Bailey Hutchison, Chairman of the Subcommittee, presiding.

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

Senator HUTCHISON. Our meeting will come to order.

This is the Science and Space Subcommittee hearing that we have called to hear the Administrator of NASA talk about the issues and challenges, and hopefully begin to focus on the NASA authorization bill that we passed.

I am very pleased that so much has been accomplished since Dr. Griffin became Administrator. I'm especially pleased that your approach is largely that which Congress is supporting in the NASA authorization bill that was originated by this committee and enacted by Congress.

The President's budget request for NASA is a 3.2 percent increase over the 2006 budget. However, of course, the total funding requested for NASA is $1.1 billion less for 2007 than the amount authorized by our legislation in Congress. We don't always get full authorization amounts, and I know we're going to hear from you today, Administrator Griffin, about how the money will be used.

However, the authorization bill was very careful in accelerating the Crew Exploration Vehicle, but also ensuring sufficient funding to return the Space Shuttle to flight and complete the International Space Station. What is concerning to me is that the President's budget request is creating a situation in which the Vision for Exploration and the acceleration of the CEV could do away with many of the other priorities that I think we share. And I don't want that to happen.

Beyond continuing to urge an expanded total funding level for NASA, I have also asked, in the authorization bill, that you seek ways to find funding from other sources. We certainly opened that opportunity by creating the International Space Station as a national lab, the U.S. part of it, and by asking you to work with the Department of Defense to see where we could share the aeronautics budget, instead of duplicating it. And I hope that we will be able to talk a little bit more about that.

I am very, very hopeful that NASA will become a part of the President's Competitive Initiative that he announced in his State of the Union in January. While we are doubling the funding of the National Science Foundation for basic science research, I believe NASA has a role to play, because I think, with the International Space Station and the research capabilities that we have, that NASA's basic sciences should be part of that competitiveness initiative. And, therefore, I'm hoping that we can expand NASA's research partnerships to include the National Science Foundation.

I think we all are in agreement—you, Administrator Griffin, and our Committee—that we have a challenge that must be met. America must stay in the forefront of space exploration and the science initiatives that can go with that. You have a very difficult job. We understand that and appreciate it. We're asking you to create the Crew Return Vehicle. We're asking you to complete the Space Station, and we're asking you to get the Shuttle up there to do it, despite the problems that we saw in the last Shuttle. And we're asking you to stick with the basic science research that is so important for our future competitiveness.

So, I know it's a big job, and I hope that you have the tools to do it by adding other contributors and cooperating with other agencies so that everything doesn't have to come out of NASA's hide.

So, I thank you for being here today and working with us. I certainly enjoyed being at the 25th anniversary of the first Shuttle with you, in Houston. It was a wonderful event. Senator Nelson, you would have loved it, too. And I think that it just showed how far we've come and how important it is that we stay the course.

Thank you.

And now, I would like to call on my Ranking Member, Senator Nelson, our Senate's only actual spaceflight semi-astronaut.

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

Mr. NELSON. Well, thank you, Madam Chairman.

And, Dr. Griffin, welcome. It's really good to have someone of your stature as the leader of our country's space program. I am grateful for your public service, particularly at such a difficult time for NASA. It's good that someone is at the helm, leading, allocating dollars, making decisions, sometimes under severe time pressure. But the consequences of your decisions, and the consequences of our decisions in trying to assist you, are going to be enormous in how so much of America is going to be affected in the future. When I was a boy growing up in the shadow of the Cape, we knew all of the early astronauts' names. It, of course, was during the Cold War; and so, we had, clearly, a national mission in our competitiveness with the Soviet Union. But, by the decisions that were made, and by the leadership that was offered at that time—first, by a President who said, "We're going to the moon and return, in 9 years," backed up with an Administrator of NASA, Jim Webb, who had a singular purpose, and that was to bring all the resources to bear. We did it. What was so remarkable was—not only the spin-offs, which we often forget, that came out of the space program. When you build something that is to be highly reliable, that is light in weight and small in volume, and the technological revolution in

microminiaturization that came from that. It also had a phenomenal impact on the education system of this country. Suddenly kids were interested in going into math and science and engineering. And, of course, you know the statistics today, just from a quantity standpoint, of the greater number of engineers that are being produced in China and in India than in America. That worries me for the future not only for us to be globally competitive, but also to be the technological leader in this global competition.

And so, I merely give you an additional charge, which is, in leading our space program, there's a lot more to what Senator Hutchison has so eloquently stated, the necessity of completing that International Space Station and keeping the gap between the CEV and the retirement of the Shuttle at a minimum, and protecting the workforce, a workforce that is very experienced, that you don't want to lose all that corporate memory. There's even a greater goal, and that is to reignite the imagination of the American people, and especially its young people, to want to be involved in technological matters, because that will carry us into continued leadership in the global competition.

So, thank you, Madam Chairman, for this opportunity to make a statement.

Senator HUTCHISON. Thank you.

Administrator Griffin?

STATEMENT OF HON. DR. MICHAEL D. GRIFFIN, ADMINISTRATOR, NASA

Dr. GRIFFIN. Thank you, Senator Hutchison, Senator Nelson, members of the Subcommittee, I appreciate your inviting me here to discuss NASA's Fiscal Year 2007 budget request and our progress in carrying out our mission of space exploration—let me interrupt to say thank you for—thank you for being here, sir—our progress in carrying out our mission in space exploration, scientific discovery in aeronautics research within the resources provided.

NASA carries out this Nation's greatest technical challenges, and we cannot do it alone. We need the help of the Congress. So, let me begin by thanking this committee, and especially Senator Hutchison and Senator Nelson, for your leadership in shepherding through Congress the NASA Authorization Act of 2005. This was a landmark piece of legislation for NASA, and I am profoundly grateful to the Congress for the passage of this visionary Act.

The national priorities articulated in the Authorization Act are a lasting legacy to the crew of the Space Shuttle *Columbia* and a testament to the leadership in both the White House and Congress who realized in the aftermath of the *Columbia* tragedy that while our national goals for space exploration must fulfill existing commitments to the International Space Station, we must also commit ourselves to new, bolder journeys to the Moon, Mars, and beyond. I have a copy of that Act hanging on the wall just outside my office at NASA. This endorsement by the Congress of the Vision for Space Exploration will help to sustain this long journey over the years and decades.

But our wishes alone do not make this Act a reality. The NASA Authorization Act sets clear and achievable goals, but, I must be honest with you, these goals are difficult and not without risk. We

have a lot of hard work before us, and we need the help of the Congress and of this committee to achieve them.

For that reason, I ask for your specific help as we try to address each of the 50 or so reporting requirements also specified in the Act. You have my pledge to keep this committee fully informed. But the reports for which you have asked must be consistent with what we know technically at the time of the report, as well as the best cost estimates we have at that time. Further, NASA is in source selection on the Crew Exploration Vehicle (CEV), and we must maintain the integrity of that process with respect to the reports that we do provide.

The other area where I need the help and understanding of this committee is in realizing how much has changed in the years following the Space Shuttle *Columbia* accident. Put simply, the *Columbia* accident in 2003 profoundly changed the course of our Nation's space program, and it profoundly impacted NASA's ability to carry out plans for the International Space Station (ISS), which preceded the accident. We still need to make sure that we can control foam shedding from the Space Shuttle's external tank. We still need to develop a robust space transportation capability to ferry astronauts and cargo to the Space Station and from there onward to our next milestones, the Moon, Mars, and near-Earth asteroids. For this reason, I need your support in bringing the Crew Exploration and Launch Vehicles online not later than 2014, and possibly sooner.

We also need your support for our effort to leverage the capabilities of commercial industry to demonstrate potentially cheaper means to deliver cargo, and, later, crew, to the International Space Station. After successful demonstrations, NASA hopes to established arms-length commercial transactions for delivery service to the ISS.

While the primary emphasis of NASA's research on the Space Station is to prepare for future missions to the Moon, Mars, and beyond, NASA is conducting a certain amount of research, along with our government and commercial partners, for other scientific benefits. However, Senator Hutchison, as we've discussed with you and your staff, it can be difficult to divide research according to sharply defined exploration and non-exploration purposes. But, having said that, I've reviewed NASA's research plans, and I believe we're fully complying with the NASA Authorization Act's requirements as to the funding specified for non-exploration ISS research. We're also making plans to solicit additional partnerships with other government agencies and the commercial sector to conduct research onboard the Space Station.

But, let me be clear, we can only realize the potential of the Space Station if we have a robust space transportation capability to ferry crew, experiments, and equipment to and from the Station. Our emphasis over the next 5 years should be to assemble the Station with the Shuttle while working aggressively to develop these new space transportation capabilities.

While the NASA Authorization Act sets clear goals for the entire Agency, we simply can't afford to do everything that our many constituencies would like us to do. I am truly sorry that this is so, but it is a fact. We must strike a careful and appropriate balance of re-

sources in NASA's budget consistent with the priorities specified. NASA carries out all of its missions—space exploration, science, and aeronautics research—with a go-as-you-can-afford-to-pay approach. NASA's topline request of $16.8 billion in Fiscal Year 2007 is roughly six-tenths of a percent of the overall Federal budget. By comparison, NASA's budget at the height of the Apollo program, including science and aeronautics research, represented 4.4 percent of Federal outlays. In terms of workforce at the height of the Apollo program, NASA employed over 400,000 contractors, civil servants, scientists, technicians, and engineers. Today, NASA employs approximately 75,000 people on its various programs.

I'm not trying to be nostalgic for the past in pointing out these facts; I'm trying to be realistic. NASA can't do everything on its plate, but we can be guided by, and we can implement, the key priorities specified by the Congress and the White House and as informed by the scientific community.

For many reasons, friends of mine who worked for NASA or in industry during the Apollo era, and who helped bring the Shuttle online 25 years ago, have called the next decade for NASA the greatest technical and management challenge the Agency has faced. I believe they are right. Fulfilling our commitments with the International Space Station, retiring the Shuttle by 2010, developing the Crew Exploration and Launch Vehicles to carry out missions to the Moon, Mars, and beyond, are goals as challenging as those NASA faced two generations ago.

At the same time, we're also making plans for a Shuttle servicing mission to Hubble and building our Nation's next great observatory, the James Webb Space Telescope. We're conducting our stewardship of the Nation's Earth science research with satellites like the soon-to-be-launched Cloudsat and CALIPSO, which are currently on the pad at Vandenberg, and we're also building the next Mars robotic landers and laboratories. NASA's science program still remains one of our Nation's greatest achievements. But in view of our fiscal constraints, we must defer some missions that we would prefer to do now, but simply can't afford at this time. We will continue to maintain a robust portfolio of missions and research within the $5.33 billion budget requested for the Science Mission Directorate in Fiscal Year 2007.

In aeronautics research, NASA is developing a national policy and a plan with the White House and other Federal agencies, including DOD and FAA, which dedicates us to the mastery and intellectual stewardship of the core competencies of aeronautics in all flight regimes. This plan will focus our research efforts on those areas appropriate to NASA's unique capabilities. We hope to provide this plan, which will inform future budget resource decisions to the Congress by December.

Let me speak plainly to the Agency's greatest challenge, transitioning from the Space Shuttle to the Crew Exploration Vehicle. The most important strategic decision we made last year was to use a Shuttle-derived launch architecture. And I want to thank you for endorsing that approach in the Authorization Act. Next, we're addressing the workforce, launch infrastructure, contracting, and affordability issues in the weeks, months, and years ahead. We have a lot of work to do.

To be clear, NASA will not need as many engineers and technicians on the shop floor to operate and maintain the CEV and Crew Launch Vehicles (CLV) as we do today with the Space Shuttle. The CEV and CLV are designed to be simpler and cheaper to operate than the Shuttle. For this reason, many of our highly specialized human spaceflight engineers and technicians will need to transition to projects such as commercial crew/cargo transport services, heavy-lift launch vehicle development, and the Lunar Lander. Change is hard. But if we don't act now to bring it about, we will not develop the space program that we want to have.

I recall firsthand the damage suffered by our Nation's space program by the unintended loss of critical expertise during the gap between Apollo and the Shuttle, between 1975 and 1981. When major cutbacks occurred in NASA operations in the early 1970s, the area around Kennedy Space Center suffered greatly, with 13 percent unemployment, and over 1,000 repossessed homes as former Apollo workers walked away from homes for which there was no one to buy. The expertise we lost in this era was never regained.

We must not repeat these mistakes of the 1970s as we proceed to retire the Shuttle and transition to the Crew Exploration Vehicle. This must be a safe and orderly transition. We have our work cut out for us in flying the Shuttle until 2010 to complete the Space Station and to effect this transition. We will need the help of Congress during this critical time. You can expect to see more from us on our transition plans in the months and years ahead.

This year, in addition to dealing with foam shedding from the external tank, the Space Shuttle program is also recovering from damage by Hurricane Katrina, to the Michoud Assembly Facility in Louisiana, and Stennis Space Center in Mississippi. I want to thank members of this committee for their support for NASA in these trying times. We're asking for Congress's help in the Administration's emergency supplemental request. We're asking the Congress to provide NASA with the flexibility—not new money in appropriations, but the flexibility to move up to $50 million to pay back the Space Shuttle and Space Station accounts, which were used to pay for Katrina recovery efforts last fall. As we make a more complete assessment of the recovery and repair costs from the hurricane, we will keep the Committee informed of our plans and how we would use this flexibility. I look forward to working with you to address that issue.

In conclusion, Senator Hutchison, Senator Nelson, Senator Stevens, Members of the Committee, our Nation has a long journey ahead of us, just as was the case for explorers and scientists throughout history. I would like to leave you with the following thought before taking your questions. Imagine, if you will, a world of some future time, whether 2020, 2040, or whenever, when some other nations or alliances are capable of reaching and exploring the Moon or voyaging to Mars, and the United States cannot, and does not. Is it even conceivable that, in such a world, America would still be regarded as a leader among nations, never mind "the leader"? And, if not, what might be the consequences of this for the global balance of economic and strategic power? Are we willing to accept those consequences?

In the end, these are the considerations at stake when we decide, as Americans, upon the goals we set for, and the resources we allocate to, our civil space program. I believe that the NASA Authorization Act answers these questions with a balanced set of goals that America seeks from its space program. And now we must implement those goals.

Thank you for you consideration and your leadership in helping to answer them.

[The prepared statement of Dr. Griffin follows:]

PREPARED STATEMENT OF HON. DR. MICHAEL D. GRIFFIN, ADMINISTRATOR, NASA

Madam Chair and Members of the Subcommittee, thank you for this opportunity to appear today to discuss NASA's plans as represented in the President's FY 2007 budget request for NASA. I will outline the highlights of our budget request and discuss the strategic direction for NASA in implementing the priorities of the President and Congress within the resources provided. The President's FY 2007 budget request for NASA of $16,792 million demonstrates his commitment to the Vision for Space Exploration and our Nation's commitment to our partners on the International Space Station. The FY 2007 budget request is a 3.2 percent increase above NASA's FY 2006 appropriation, not including the $349.8 million emergency supplemental for NASA's recovery and restoration efforts following Hurricane Katrina. However, let me put NASA's budget into perspective. NASA's budget is roughly 0.7 percent of the overall Federal budget. This is a prudent investment to extend the frontiers of space exploration, scientific discovery, and aeronautics research. With it, we enhance American leadership, our safety and security, and our global economic competitiveness through the technological innovations stemming from our space and aeronautics research programs. Our Nation can afford this investment in NASA.

On January 14, 2004, President George W. Bush announced the Vision for Space Exploration to advance U.S. scientific, security, and economic interests through a robust space exploration program. NASA is grateful to the Congress for endorsing this Vision last December in the NASA Authorization Act of 2005 (Pub. L. 109–155) and providing guidance and expectations for us in carrying out the Agency's missions of space exploration, scientific discovery, and aeronautics research. NASA is also appreciative of the action by the Committees on Appropriations and Congress in providing regular FY 2006 appropriations for the Agency totaling $16,456.8 million—essentially the level of the President's FY 2006 request before application of rescissions—including a strong endorsement for the Vision for Space Exploration, timely development of the Crew Exploration Vehicle (CEV) and Crew Launch Vehicle (CLV) and support for NASA's other core programs. To that end, NASA is implementing the priorities of the President and Congress within the resources available. NASA carries out its missions with a "go as you can afford to pay" approach where we assume NASA's top line budget will grow at the moderate rate laid out in the President's 2007 budget request. NASA's Strategic Plan and FY 2007 Congressional Budget Justification, provided to the Congress in February, reflect those priorities and describe how NASA is implementing those policies into practice by describing our programs, projected resources, and workforce needs.

As part of his FY 2007 budget request to Congress, the President proposed the American Competitiveness Initiative, or ACI, to encourage American innovation and strengthen our Nation's ability to compete in the global economy. Many have asked why NASA is not a part of the ACI. My response is that it is the mission of NASA to pioneer the future of space exploration, scientific discovery, and aeronautics research, while the ACI is focused on bolstering the Nation's economic competitiveness in areas such as information technology and nanotechnology. NASA contributes to the Nation's competitiveness through all of the cutting-edge exploration, science, and aeronautics investments accomplished by our Mission Directorates. As part of the President's Vision for Space Exploration, NASA expects to spawn entire new industries in this Nation. Furthermore, NASA's education and training initiatives are designed to enhance math and science education, as well as to provide research opportunities at the university level. We are currently reviewing our portfolio of education programs to assess opportunities for potential collaboration at the invitation of the Department of Education, National Science Foundation, and other Federal agencies. NASA can offer opportunities and inspiration to students as no one else can. For example, a University of Colorado—Boulder student-built experiment on

the New Horizons mission is currently being activated and will be operated by university students all the way to Pluto and beyond.

Implementing the Vision

Later this year, NASA will continue the assembly of the International Space Station (ISS) with the minimum number of Space Shuttle flights necessary to fulfill our commitments to our international partners before the Space Shuttle's retirement in 2010. The commitment of resources in the President's budget has shown our international partners that NASA and the United States are good partners through thick and thin and this commitment will encourage them to team with us in future endeavors of space exploration and scientific discovery. NASA has consulted with our international partners on the configuration of the ISS, and is working closely with them to determine the crew size and logistics necessary during this assembly period as well as the period following the retirement of the Space Shuttle. The heads of space agencies from Canada, Europe, Japan, Russia and the United States met at Kennedy Space Center on March 2, 2006, to review ISS cooperation and endorse a revision to the ISS configuration and assembly sequence. The partners reaffirmed their agencies' commitment to meet their mutual obligations, to implement six person crew operations in 2009, and to conduct an adequate number of Space Shuttle flights to complete the assembly of ISS by the end of the decade. The partners also affirmed their plans to use a combination of transportation systems provided by Europe, Japan, Russia, and the United States in order to complete ISS assembly in a timeframe that meets the needs of the partners and to ensure full utilization of the unique capabilities of the ISS throughout its lifetime. The FY 2007 budget request provides the necessary resources to purchase *Soyuz* crew transport and rescue for U.S. astronauts as well as needed Progress vehicle logistics support for the ISS from the Russian Federal Space Agency. Likewise, the FY 2007 budget request provides necessary funds for U.S. commercial industry to demonstrate the capability to deliver cargo and/or crew to the ISS. If such cost-effective commercial services are successfully demonstrated, NASA will welcome and use them.

The next return to flight test mission, STS–121 commanded by Colonel Steve Lindsey, will confirm that we can safely return the Space Shuttle to its primary task of assembling the ISS. We have continued to reduce the risk associated with the release of foam debris from the external tank by eliminating the liquid hydrogen and the liquid oxygen protuberance air load ramps. We are now working toward a July launch, which is the next available lighted launch window as mandated for STS–121. The window is open from July 1 through July 19. NASA will launch when ready. Pending the results of this test flight, I plan to convene my senior management team for space operations as well as my Chief Safety and Mission Assurance Officer and my Chief Engineer in order to determine whether the Space Shuttle can safely conduct a fifth servicing mission to the Hubble Space Telescope in 2007–2008. NASA's FY 2007 budget provides the necessary resources to conduct this mission.

In previous budget requests, NASA reported only placeholder budget estimates for the Space Shuttle for FY 2008–2010. The Agency's management focus on return to flight efforts of the Space Shuttle resulted in NASA deferring this analysis until the FY 2007 budget. As I testified before Congress last year, NASA's estimates of the budget shortfall required to safely fly out the Space Shuttle with the minimum number of flights necessary to complete ISS assembly and meet our international partner commitments were $3–5 billion. With the FY 2007 budget runout, NASA has added $2.4 billion to the Space Shuttle program and almost $1.5 billion to the International Space Station in FY 2008–2010 compared to the FY 2006 budget runout. There is no "new money" for NASA's top line budget within the budget projections available given our Nation's other pressing issues, so, working with the White House, NASA provided sufficient funds for the Space Shuttle and ISS programs to carry out their missions by redirecting funds from the Science and Exploration budgets.

There are several strategic implications behind this decision. Foremost among them is that our Nation will keep its commitment to our international partners on the ISS. Thus, with limited resources, we made some difficult decisions. Leadership means setting priorities of time, energy, and resources, and I have tried to make these decisions with the best available facts and analysis. The plain fact is that NASA simply cannot afford to do everything that our many constituencies would like the Agency to do. We must set priorities, and we must adjust our spending to match those priorities. NASA needed to reallocate budgeted funds from the Science and Exploration budget projections for FY 2007–2011 in order to ensure that enough funds were available to properly support the Space Shuttle and the ISS. Thus, NASA cannot afford the costs of starting some new science missions at this time. It is important to know that NASA is simply delaying missions, not abandoning

them. With the limited resources available, I believe that fulfilling our commitments on the International Space Station and bringing the Crew Exploration Vehicle (CEV) online in a timely manner, not later than 2014 and possibly much sooner, is a higher priority than these science missions during this period.

There are several reasons not to delay the CEV farther. First and foremost is increased risk to the Vision due to an extended gap in our Nation's ability to launch humans into space after we retire the Space Shuttle in 2010. I experienced firsthand the stagnancy in the aerospace industry that existed during the gap in human spaceflight between the end of the Apollo program and the first flight of the Space Shuttle in 1981, and I know that our Nation's space program suffered greatly from the unintended loss of critical expertise. Our Nation's space industrial base withered. A longer gap in U.S. human spaceflight capabilities will increase risk and overall costs and lead to even more delays in pursuing the Nation's vision. Equally important, the U.S. may risk a perceived, if not a real loss of leadership in space exploration, if we are unable for an extended period to launch our astronauts into space when other nations are establishing or building on their own abilities to do so. An extended gap in U.S. human spaceflight capabilities also increases our risk posture to adequately maintain and utilize the ISS and, unless a commercial capability arises to transport our astronauts, NASA would continue to be reliant on the Russian *Soyuz*.

Thus, further delays in the CEV are strategically more damaging to our Nation's space program than delays to these other science missions. I stand by my decision regarding how to implement the priorities of the President and Congress within the resources provided, and I will work closely with our stakeholders in Congress and the scientific community to make sure they understand my rationale. Some of our stakeholders will not agree with my position, but it is important for everyone to understand the rationale. These are difficult decisions, but we must balance the competing priorities for our Nation's civil space and aeronautics research endeavors with the limited resources available.

If the funds budgeted for Exploration Systems were to be used to provide additional funds for Science missions, additional Aeronautics Research, or other Congressionally-directed items, I must advise the Congress that such redirection of already-budgeted funds will directly impact NASA's ability to effectively and efficiently transition the workforce and capabilities from the Space Shuttle to the new CEV systems. Funds available to carry out this transition are already lean, with little management reserve or margin for error. This transition from the Space Shuttle to the CEV is NASA's greatest management challenge over the next several years, and we will need everyone's help within NASA, industry, and our stakeholders to make the transition successful.

Beyond fulfilling our existing commitment, NASA's FY 2007 budget provides the necessary resources to carry out the next steps of the Vision for Space Exploration. The FY 2007 budget provides $3,978 million for Exploration Systems. Last summer, NASA defined the architecture for the exploration systems that will be necessary in carrying forth that Vision, and we notified the Congress of NASA's need to curtail several research and technology activities not directly contributing to the near-term priorities of timely development of the CEV and Crew Launch Vehicle (CLV) based on the results of that exploration architecture study and the limited funds available. I want to thank the Congress for its endorsement of the general architecture plans in the NASA Authorization Act of 2005 (Pub. L. 109–155) as well as the FY 2006 Appropriations Act for NASA (Pub. L. 109–108).

The FY 2007 budget request is sufficient to bring the CEV online no later than 2014, and potentially much sooner. Given the analysis I have today and the need to balance budgets with proposed development work for the CEV and launch vehicles along with the cost estimates for that work, I cannot be more specific for our stakeholders in the White House and Congress at this time about the specific point between 2010 and 2014 when NASA will be able to bring the CEV online. NASA requested industry proposals for the CEV, and we have considerable incentives for an industry bidder to propose a planned development for the CEV as close to 2010 as possible. NASA has begun to evaluate those industry proposals, with a planned contract award in late Summer/early Fall 2006. NASA plans to select one industry contractor team for the design and development of the CEV. Concurrently, NASA will refine its independent cost estimates for the CEV and launch systems as well as find cost savings through workforce synergies and contract efficiencies between the Space Shuttle and CEV launch systems within the budget profile projected in FY 2007. We believe we can find synergies and contract efficiencies by sharing or transferring subsystems, personnel, resources, and infrastructure between the Space Shuttle propulsion elements and the CEV, CLV, and Heavy-Lift Launch Vehicle. I believe that with the FY 2007 budget, NASA and industry have a real opportunity

to make the CEV operational sooner than 2014. I should be able to report a more definitive date for bringing the CEV online by the time we award the CEV contract. Until then, NASA is in the midst of source selection for the CEV procurement, and we are limited in our ability to provide information in this competitive environment involving a multi-billion dollar procurement.

For the CLV, NASA has directed two industry teams to begin initial development of the vehicle's propulsion systems, and to develop designs for the CLV upper stage. The Agency also plans to award design, development, test, and evaluation contracts later this year. NASA is planning a systems requirements review for this project in the fall with a preliminary design review in 2008 in order for this new launch vehicle to be ready for when the CEV comes on-line.

While NASA needed to significantly curtail projected funding for biological and physical sciences research on the ISS as well as various research and technology projects in order to fund development for the CEV, the U.S. segment of the ISS was designated a National Laboratory in the NASA Authorization Act of 2005. Thus, NASA is seeking partnerships with other government agencies like the National Science Foundation, Department of Defense, National Institutes of Health (NIH), Department of Energy, and the National Institute of Standards and Technology as well as the commercial sector to conduct research onboard the ISS. However, the research utilization of the ISS is impacted due to limited cargo and crew transportation. For this reason, NASA's need for investment to spur a commercial cargo and/or crew transportation service is even more compelling.

With respect to funding for non-exploration related life and microgravity research pursuant to direction in Section 204 of the NASA Authorization Act of 2005, the Agency completed an extensive exercise to define exactly what activities should be categorized as ISS research. I have reviewed NASA's investments in non-Exploration related life and microgravity research, and I believe that NASA is complying with the NASA Authorization Act of 2005. Consistent with Section 204 of the Act, of the $238.1 million allocated to ISS Research in FY 2006, $35.7 million (or 15 percent) will be dedicated to non-exploration research.

Scientific Discovery

In 2005, NASA's science missions enjoyed a year of significant achievements. Deep Impact traveled 268 million miles to meet comet Tempel 1, sending its impactor to collide with the comet and providing researchers with the best-ever comet data and images. The Mars twin rovers continue studying the harsh Martian environment, well beyond their expected mission life. Cassini may have found evidence of liquid water erupting from below the surface of Saturn's moon Enceladus. The Mars Reconnaissance Orbiter successfully launched and went into orbit around Mars, to help us better understand the history of water on Mars. The Voyager 1 spacecraft entered the vast, turbulent expanse of the heliosheath, 8.7 billion miles from the sun, where no human-made object has traveled before. The Hubble Space Telescope continues its successful mission of discovery and exploration. Among its many achievements was the discovery that Pluto may have three moons, offering more insights into the nature and evolution of the Pluto system and Kuiper Belt. Through coordination of observations from several ground-based telescopes and NASA's Swift and other satellites, scientists solved the 35-year old mystery of the origin of powerful, split-second flashes of light called gamma-ray bursts. The Tropical Rainfall Measuring Mission (TRMM) provided data to aid our understanding of the changes inside a hurricane, helping scientists re-create storms on computer forecast models, which can assist in the forecasting of future tropical cyclone transformations. On January 19, 2006, we successfully launched the New Horizons Mission, beginning its 9 year journey to Pluto for scientific discovery. On April 25, 2006, CALIPSO (Cloud-Aerosol Lidar and Infrared Pathfinder Satellite Observations) and Cloudsat are scheduled to launch from Vandenberg Air Force Base. Together, they will provide new perspectives on Earth's clouds and aerosols, answering questions about how they form, evolve, and affect water supply, climate, weather, and air quality. Truly, this has been a successful year of science achievements—a trend I expect to continue.

NASA's FY 2007 budget request provides $5,330 million for the Agency's Science portfolio to explore the universe, solar system, and Earth. My decision to curtail the rate of growth for NASA's Science missions is not intended in any way to demonstrate any lack of respect for the work done by NASA Science. On the contrary, NASA's science missions remain one of the Nation's crowning achievements, and NASA is a world leader with 54 satellites and payloads currently operating in concert with the science community and our international partners. My decision to slow the rate of growth for NASA's Science missions is simply a matter of how the Agency will use the available resources within the overall NASA portfolio. In fact, the

Agency's Science budget has grown much faster than NASA's total budget since FY 1993. In 1992, the Science budget represented only 24 percent of the overall NASA budget while it represents 32 percent of the Agency's budget in FY 2007. NASA's Science budget is moderated to 1.5 percent growth in the FY 2007 budget request compared with the amount appropriated for NASA in FY 2006 (in accordance with NASA's Initial Operating Plan provided to the Committee) and then 1 percent per year thereafter through FY 2011.

In the FY 2007 budget, there are some additional budget shifts within the Science portfolio to rebalance the program to better reflect our original science priorities and remain consistent with the FY 2006 Budget Amendment. Within the Science budget, the Solar System Exploration budget provides $1,610 million to fund missions to all solar system bodies and to maintain the Deep Space Network. Mars exploration is kept at roughly its current level of funding which allows missions every 26 months when the Earth and Mars are in planetary alignment. Mars will be the most thoroughly studied planet besides our own Earth. NASA continues a series of openly competed missions for Discovery, New Frontiers, and Scout missions to various planetary bodies in the solar system. Juno, a competitively-selected mission to study Jupiter, is slated to be the next New Frontiers mission, following the New Horizons mission on its way to Pluto after its successful launch in January.

After extensive reviews, NASA has extended the mission operating life of several Earth Science missions including TRMM and Terra, Heliophysics missions such as both Voyager spacecraft, and Astrophysics missions including Chandra and the Wilkinson Microwave Anisotropy Probe.

Aeronautics Research

NASA's FY 2007 request for the Aeronautics Research Mission Directorate is $724 million. Proper stewardship of this funding requires a coherent strategic vision for aeronautics research, which we are working to develop. While I am concerned that our Nation's aviation industry not lose market share to global competitors, NASA's research must benefit the American public by supporting a broad base of aeronautics research. NASA's aeronautics research cannot and will not directly subsidize work to specific corporate interests. There are fundamental questions in aeronautics research needing to be answered, and NASA will focus its aeronautics research on those issues. NASA will take responsibility for the intellectual stewardship of the core competencies of aeronautics for the Nation in all flight regimes, from subsonic through hypersonic flight. We will also conduct the fundamental research that is needed to meet the substantial challenges of the Next Generation Air Transportation System (NGATS), and we intend to work closely with our agency partners in the Joint Planning and Development Office (JPDO).

Across our aeronautics portfolio, NASA is taking a long-term, strategic approach to our research plans to ensure that we pursue the cutting-edge across the breadth of aeronautics disciplines that will be required to support revolutionary capabilities in both air vehicles and the airspace in which they fly. NASA's commitment to technical excellence requires a commitment to rigor and discipline and will not focus on demonstrations that lack the traceability and scalability required for true scientific and engineering advancement. Hence, we are turning away from the four-demo approach proposed last year under the Vehicle Systems Program. Instead, our Fundamental Aeronautics Program will focus on fundamental research that addresses aeronautics challenges in areas such as aerothermodynamics, acoustics, propulsion, materials and structures, computational fluid dynamics, and experimental measurement techniques. The Fundamental Aeronautics Program will generate data, knowledge, and design tools that will be applicable across a broad range of air vehicles in subsonic (both fixed and rotary wing), supersonic, and hypersonic flight.

In the Aviation Safety Program, NASA is developing strategic research plans, ensuring that the research conducted will lead to capabilities and technologies for improving safety consistent with the revolutionary changes anticipated in air vehicles foreseen in the future. The focus will be vehicle-centric, with areas of research that include vehicle health management, resilient aircraft control, aging and durability challenges, and advanced flight deck technologies.

In the Airspace Systems Program, NASA will conduct the fundamental research required to bring about the revolutionary capabilities articulated in the JPDO's vision for the NGATS. Our research will focus on the development of future concepts, capabilities, and technologies that will enable major measurable increases in air traffic management effectiveness, flexibility, and efficiency.

In addition to the Aeronautics Research Mission Directorate's three research programs, NASA is committed to preserving as national assets those aeronautics test facilities which are deemed mission critical and necessary to meet the needs and requirements of the Agency and the Nation. NASA has established the Aeronautics

Test Program (ATP), a component of the Shared Capability Assets Program (SCAP), as a long-term, funded commitment by NASA to retain and invest in test capabilities that are considered important to the Agency and the Nation. ATP's purpose is to ensure the strategic availability of the requisite, critical suite of wind tunnel and ground test facilities which are necessary to meet immediate and future national requirements.

As part of our overall portfolio, NASA program managers and researchers will work closely and constructively with industry, academia, and other government entities to enhance our Nation's aeronautics capability. In this vein, as a principal member of the interagency JPDO, NASA has established investment priorities that directly address the research and development needs of the NGATS which will enable major increases in the capacity and mobility of the U.S. Air Transportation System. NASA also plans to collaborate closely with industry and academia through the use of competitive research awards and Space Act agreements on prospective research work in line with the critical thrust areas of the Aeronautics program that will enable numerous commercial aviation and scientific applications. Our goal is to focus our total research investments on fundamental aeronautics questions that need to be answered, and that will benefit the broader community of academia, industry, and government researchers. We will transition the achievements from NASA's Aeronautics research and technology for use by both Government and industry. Additionally, and in line with the refocused program's priorities, NASA will leave to others work more appropriately performed or funded by other Agencies or the private sectors.

In accordance with the NASA Authorization Act of 2005 (Pub. L. 109–155) and the FY 2006 Science, State, Justice, Commerce, and Related Agencies Appropriations Act (Pub. L. 109–108), NASA and the Office of Science and Technology Policy have been jointly developing a National Aeronautics Research and Development Policy which will establish a long-term policy and guidance for future aeronautics research and development activities. This policy will establish the appropriate role for Federal investment in U.S. aeronautics research: near- and far-term, high-priority objectives; roles and responsibilities of the multiple agencies involved; and, guidance on related infrastructure and workforce challenges.

Cross-Agency Support Programs

In the FY 2007 budget, NASA proposes a new direct budget category for programs that cut across NASA's portfolio of space exploration, scientific discovery, and aeronautics research. These Cross-Agency Support Programs include: NASA's Education programs funded at $153.3 million; Advanced Business Systems, or more commonly known as the Integrated Enterprise Management program, is called out as a separate program rather than being budgeted from within Corporate and Center General and Administrative accounts and is funded at $108.2 million; NASA's Innovative Partnership Program, including Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR), has been transferred from Exploration Systems so that these partnerships may better address Agency-wide needs and is funded at $197.9 million. Also, the Shared Capabilities Assets Program is funded at $32.2 million (with additional funding located in the Mission Directorates) and will ensure that NASA's unique facilities (e.g., wind tunnels, rocket engine test stands, high-end computing, thermal vacuum chambers, and other capital assets) are adequately managed with agency-level decisionmaking to address NASA's and the Nation's needs.

NASA's Education budget request sustains our commitment to excellence in science, technology, engineering and mathematics (STEM) education to ensure that the next generation of Americans can accept the full measure of their roles and responsibilities in shaping the future and meeting the workforce needs to implement the Vision for Space Exploration. NASA will continue to provide innovative programs that use STEM resources (NASA content, people, and facilities) to inspire the next generation of explorers and innovators. I have outlined three primary goals for our education investments: (1) strengthening NASA and the Nation's future workforce; (2) attracting and retaining students in the STEM pipeline; and, (3) engaging Americans in NASA's mission through partnerships and alliances. The greatest contribution that NASA makes in educating the next generation of Americans is providing worthy endeavors for which students will be inspired to study difficult subjects like math, science, and engineering because they too share the dream of exploring the cosmos. These students are our future workforce. Our education investment portfolio is directly linked to our overall workforce strategy.

NASA Workforce Strategy

The Vision for Space Exploration is a unique endeavor that will last many generations. The NASA management team has been working to build NASA as an institution having ten healthy field Centers known for technical excellence. We continue to define program management and research roles and responsibilities for each Center in order to carry out NASA's missions of space exploration, scientific discovery, and aeronautics research. All of our centers must contribute to NASA's primary missions. We are beginning the process of assigning specific research programs and projects to appropriate NASA Centers. We are not done, but we are taking the necessary steps to make it happen.

We have many challenges in the Agency, but none more important than the technical excellence of NASA's workforce. Likewise, we are beginning to address the problems posed by the aging of NASA's facilities and physical assets. The overall objective is to transform the composition of NASA's workforce so that it remains viable for the long-term goals of NASA's missions. We have a lot of work cut out for us in the coming months and years ahead in assigning these program responsibilities and rebuilding the Agency's technical competence in performing cutting-edge work. NASA has been addressing the challenge of mitigating the number of civil service employees in the Agency that are not currently assigned or supporting NASA programs (the so-called "uncovered capacity") through a number of means, which were addressed in a draft report, shared with the Subcommittee in February in compliance with the NASA Authorization Act of 2005. The final workforce report, reflecting input from our unions, was submitted to the Subcommittee on April 13. NASA will conduct a reduction in force of our civil servants only as an action of last resort consistent with our statutory constraints. Instead, NASA is focusing its efforts to solve its uncovered capacity workforce problems through a number of other actions, including the assignment of new projects to research Centers that will strengthen their base of in-house work, the Shared Capability Assets Program that should stabilize the skills base necessary for a certain specialized workforce; the movement of certain research and technology development projects from certain centers not suffering from uncovered capacity problems to centers that are; retraining efforts at field centers so that the technical workforce can develop new skills; and the pursuit of reimbursable work for projects and research to support other government agencies and the private sector through Space Act Agreements.

NASA's Financial Management

Earlier this month, NASA notified the Committee that it had two violations of the Antideficiency Act. The violations resulted from the Agency's failure to request from the Office of Management and Budget timely reapportionment of Congressionally-approved FY 2004 funds and timely apportionments of unobligated balances carried over from FY 2004 to FY 2005. The Agency has corrected the errors without the need for additional appropriations. The Agency has also identified the root cause of these errors and has addressed them through its aggressive staff training and process improvements.

NASA has continued to make progress in addressing its other financial management and reporting challenges. The Office of Management and Budget has recently provided feedback to NASA affirming the Agency's progress. The Agency finalized a Corrective Action Plan addressing financial weaknesses identified in NASA's 2005 financial audit. The plan was delivered to the Congress, specifically at the request of the Subcommittee on Space and Aeronautics of the Committee on Science and the Subcommittee on Government Management, Finance and Accountability of the Committee on Government Reform, on February 15, 2006. It incorporates the expert advice of NASA's Inspector General. In addition, we have reviewed the plan with the Office of Management and Budget. This Corrective Action Plan provides an integrated, cross-NASA approach to resolving the Agency's outstanding deficiencies. Implementation of these corrective actions is reviewed regularly by the NASA Deputy Administrator. While these corrective actions will require some time to implement, NASA remains committed to improving its financial management and reporting.

Impact of Earmarks on NASA's Mission

NASA pioneers the future in space exploration, scientific discovery, and aeronautics research. In order to carry out this mission, NASA awards peer-reviewed science grants and conducts competitively-selected procurements to select research and development projects to benefit the public based on the priorities of the Congress, President, and scientific community. NASA is implementing these priorities within the resources provided. NASA's FY 2006 appropriation totals $16.623 billion, including $349.8 million in emergency supplemental appropriations for Hurricane Katrina recovery at NASA facilities in Louisiana and Mississippi. Within this FY

2006 appropriation is a total of $568.5 million in directed funding for 198 discrete site-specific and programmatic Congressional interest items, a record high in both dollar amount and number of individual items. These Congressional interest items are offset by reductions within NASA's budget, to ongoing and planned NASA programs. Earmarks have increased by a factor of more than 30 in number and almost 8 in dollar value since FY 1997, when NASA was earmarked $74 million, for 6 discrete items. The growth of these Congressional directions is eroding NASA's ability to carry out its mission of space exploration and peer-reviewed scientific discovery.

In formulating our budget, NASA prioritizes activities to achieve an integrated package of programs and projects to best achieve the priorities that have been provided us by both the President and the Congress. The redirection of funding erodes the integrity of our plans, has resulted in delays and/or cancellation of planned activities, and may conflict with timely development of the CEV. In FY 2006, as a result of earmarks, NASA had to redirect a significant portion of many planned budgets. Fully 50 percent of the planned Education program required redirection, 16 percent of the Innovative Partnerships Program, 5 percent of the Exploration Systems budget, and 4 percent of the Science budget. Further, the scientific community bases its research priorities on a peer-review process. Congressional site-specific earmarks circumvent this process for setting research priorities within the science community and erode the integrity of that process. Site specific earmarks to institutions outside of NASA exacerbate the problems of NASA's "uncovered capacity" workforce, where NASA civil servant scientists and engineers do not have funds for their own research and development projects. As stated in the President's ACI, "The rapidly growing level of legislatively directed research funds undermines America's research productivity." NASA seeks the assistance of this Committee and Congress in reducing earmarks in the FY 2007 budget process.

NASA's Next Steps

For the last three decades, NASA and the Nation's human spaceflight program have been focused on the development and operation of the Space Shuttle and the ISS. In its final report, the *Columbia* Accident Investigation Board (CAIB) was very forthright in its judgment that these goals are too limited to justify the expense, difficulty, and danger inherent to manned spaceflight, given the limitations of today's technology. The CAIB was equally forthright in calling for a national consensus in the establishment of a program having broader strategic goals. The Vision for Space Exploration is that endeavor. The Congress has endorsed it, and NASA is working to implement it. But to effect these changes, NASA must engage in a major transformation—taking the capabilities we have throughout the Agency and restructuring them to achieve a set of goals for the 21st century that we have outlined earlier this month in our 2006 NASA Strategic Plan. This is an enormous challenge, but we have begun to transform our entire organization to foster these changes and to enhance a positive, mission-driven culture.

The CAIB was also clear in its assessment that the lack of open communication on technical and programmatic matters was a direct cause of the loss of *Columbia.* We have understood and embraced this assessment, and are absolutely and completely committed to creating an environment of openness and free-flowing communication. However, NASA still has to make a number of improvements in its internal communications as well as how we communicate externally to our stakeholders, the scientific community, and the public. NASA is making a concerted effort to address all problems in this area.

For America to continue to be preeminent among nations, it is necessary for us also to lead in space exploration, scientific discovery, and aeronautics research. It is equally true that great nations need allies and partners. The spirit of innovation and the muscle of government and industry are needed to turn the Nation's Vision for Space Exploration into reality. These journeys to the ISS, the Moon, Mars, or even Pluto are the most difficult things our Nation does. June Scobee Rodgers, the widow of Dick Scobee, Commander of the Space Shuttle *Challenger* on that ill-fated day twenty years ago, recently noted, "Without risk there's no discovery, there's no new knowledge, there's no bold adventure . . . the greatest risk is to take no risk." We must continue our journey. America, through NASA, leads the way.

Once again, thank you for the opportunity to testify today. I would be pleased to respond to any questions that you may have.

National Aeronautics and Space Administration--President's FY 2007 Budget Request

(Budget authority, $ in millions)	FULL COST							Chapter Number
By Appropriation Account By Mission Directorate By Theme	FY 2005	Operating Plan 1/18/06 FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	
Science, Aeronautics, and Exploration	**9,050.7**	**9,721.3**	**10,524.4**	**10,594.4**	**11,136.4**	**11,747.0**	**15,526.4**	
Science	**5,501.6**	**5,253.7**	**5,330.0**	**5,383.1**	**5,437.1**	**5,491.5**	**5,546.4**	
Solar System Exploration	1,720.5	1,582.3	1,610.2	1,598.6	1,840.4	1,899.6	1,846.7	SAE SMD
The Universe	1,474.9	1,507.9	1,509.2	1,500.9	1,307.9	1,276.1	1,309.7	SAE SMD
Earth-Sun System	2,306.2	2,163.5	2,210.6	2,283.7	2,288.9	2,315.8	2,390.0	SAE SMD
Exploration Systems	**2,209.3**	**3,050.1**	**3,978.3**	**3,981.6**	**4,499.8**	**5,055.9**	**8,775.1**	
Constellation Systems	422.3	1,733.5	3,057.6	3,067.6	3,612.9	4,083.8	7,698.4	SAE ESMD
Exploration Systems Research & Technology	898.9	692.5	646.1	632.2	605.1	679.2	764.6	SAE ESMD
Human Systems Research & Technology	888.1	624.1	274.6	281.8	281.8	292.8	312.1	SAE ESMD
Aeronautics Research	**962.0**	**884.1**	**724.4**	**731.8**	**732.4**	**722.8**	**722.7**	
Aeronautics Technology	962.0	884.1	724.4	731.8	732.4	722.8	722.7	SAE ARMD
Cross-Agency Support Programs	**377.8**	**533.5**	**491.7**	**497.9**	**467.1**	**476.8**	**482.2**	
Education Programs	178.9	162.4	153.3	152.4	153.1	154.0	153.3	SAE CASP
Advance Business Systems (IEMP)	0.0	156.3	108.2	106.9	73.8	78.5	80.6	SAE CASP
Innovative Partnerships	198.9	214.8	197.9	205.5	206.2	209.7	212.9	SAE CASP
Shared Capabilities	0.0	0.0	32.2	33.1	33.9	34.7	35.5	SAE CASP
Exploration Capabilities	**7,114.4**	**6,869.7**	**6,234.4**	**6,680.4**	**6,442.3**	**6,242.9**	**2,896.7**	
Space Operations	**7,114.4**	**6,869.7**	**6,234.4**	**6,680.4**	**6,442.3**	**6,242.9**	**2,896.7**	
International Space Station	1,591.3	1,753.4	1,811.3	2,200.3	2,255.6	2,197.1	2,360.8	EC SOMD
Space Shuttle*	5,049.2	4,777.5	4,056.7	4,087.3	3,794.8	3,651.1	146.7	EC SOMD
Space and Flight Support	473.9	338.8	366.5	392.8	392.0	394.7	389.2	EC SOMD
Inspector General	**31.3**	**32.0**	**33.5**	**34.6**	**35.5**	**36.4**	**37.3**	IG
TOTAL	**16,196.4**	**16,623.0**	**16,792.3**	**17,309.4**	**17,614.2**	**18,026.3**	**18,460.4**	
Year-to-Year Change**			3.2%	3.1%	1.8%	2.3%	2.4%	

* Includes emergency supplemental of $349.8 million in FY 2006.
** Not including emergency supplemental of $349.8 in FY 2006.
Totals may not add due to rounding.

Senator HUTCHISON. Thank you very much for the statement and for working with us on the authorization bill, because I do think it was a landmark that we passed it, the first one in 5 years, and this Committee led the way, and we want to continue to do so.

I want to ask you, along the lines of the authorization bill, what kinds of opportunities do you see for outside-NASA funding for some of the research projects that we hope would be more of the basic science research, as opposed to just the human spaceflight research?

Dr. GRIFFIN. There, I think, are opportunities. We, at NASA, were pursuing those in the period of time before we lost *Columbia.* I think it will come as no surprise to you, Senator, and to this Committee, that when we lost *Columbia,* those efforts were shut down rather abruptly. We are now reinstating those. We have an agreed-upon plan with our international partners to finish the Station, a plan supported by this administration and this Congress, that utilizes, appropriately, the Shuttle flights we have left. In parallel with that, we are restarting our efforts to seek both commercial partnerships, as well as partnerships within DOD and other Federal agencies to utilize the Station. With luck, and with effort on our part, those initiatives will begin to bear fruit around the time that we have a larger crew complement aboard the Station to be able to do the research and transportation systems which can help us out.

Senator HUTCHISON. Is the National Science Foundation and perhaps the Department of Energy, are those two also on the horizon for potential partnerships for the Space Station research?

Dr. GRIFFIN. We will be talking to all of the Federal R&D agencies, as well as some of the significant commercial players that we were speaking with in earlier years, and trying to reinvigorate those efforts.

Senator HUTCHISON. Let me ask you, in your opening statement you mentioned commercial possibilities for launch and for taking crew back and forth. What is the timetable that you envision that you might be able to test that? And is it what you're looking at to close the gap between 2010 and 2014, or is it a different timetable?

Dr. GRIFFIN. No, you are exactly right, Senator. We are looking for commercial capability. With our money, we are looking to stimulate the development of commercial capability to help bridge the gap between 2010 and, at the latest, 2014, for the CEV, and also to continue on beyond, because we believe that if we can use some of our money as seed funding to help stimulate the growth of that commercial capability, that we will save money in basic cargo, and, later, crew transportation services, that can be applied to more far-reaching things, where NASA should properly be involved.

Senator HUTCHISON. So, your goal is 2010——

Dr. GRIFFIN. My goal is 2010, or as soon thereafter as we can make it. Currently, we're in source selection on that effort, I don't yet know what the offerors are offering. But as soon as we do, we will, believe me, be happy to work with your committee on this. This is my initiative, and it is one that I hold close. I'm asking for the Committee's support in sustaining that commercial initiative.

Senator HUTCHISON. Well, let me say, for one committee person, that I think that is a very good proposal, if it can actually work, because something Senator Nelson and I have been united on is not having a gap. And we know we've been pushing and, sort of, trying to get blood out of a turnip, if you will. But if there is the capability for Americans to go into space between 2010 and 2014, I will feel much more secure. So, I hope that you will continue to keep us up to date on that.

Dr. GRIFFIN. Senator, you have no stronger advocate than I for the preservation and protection of our U.S. human spaceflight capability. I share those goals. We have devoted as much of our resources to that effort as we believe we prudently can. Consistent with the fact that finishing the Space Station with the Space Shuttle has to be our first priority, as you, yourself, have stated, and frankly, the budget resources for that did not exist in our budgets when I came onboard. We have fixed that, but, to some extent, it has been at the expense of the CEV.

Senator HUTCHISON. Senator Nelson?

Senator BILL NELSON. Madam Chairman, I would defer to the Chairman of the Committee.

The CHAIRMAN. Go right ahead.

Senator BILL NELSON. Well, thank you.

The 4-year gap worries me because it goes back to the initial plan, 2014. We know, on the basis of the experience with the Space Shuttle, that it was supposed to fly in 1978, but it didn't fly for another 3 years. And if that were to occur with the CEV, then we're

down for 6 or 7 years. Furthermore, who knows what the geopolitics of access to space with humans is going to be in the year 2015. Do you have any way of shortening it?

Dr. GRIFFIN. Sir, the budget I've recommended, and that the administration has supported and put forth and is being brought to this Committee, balances, if you will, the hard choices that have to be made by each of our different portfolios—science, aeronautics, Shuttle, Station, exploration. The only way to narrow the gap between the retirement of the Shuttle and the operational capability of the CEV would be to put more money from some other source into that. We really cannot take money from the Shuttle and Station. We might, after 25 years of experience, regret that the Shuttle and the Station cost what they cost. And we resolve, all of us, to do better next time. But we cannot claim, after 25 years, that we don't know what they cost. We do know what they cost. And we have now budgeted for that. But there's no money to be found there.

We have done what we desperately did not want to do, which was to take $2.2 billion from science and $1.6 billion from exploration to make sure that we did fund, adequately, the Shuttle and Station. And aeronautics is funded at less then $1 billion, so that is not a place to go, as well.

So, within my constraints, Senator, I must respectfully say that I believe I have put together the best-balanced program that I know how to give you. And, regrettably, it features a several-year gap between Shuttle retirement and CEV operational use.

Senator BILL NELSON. The budget that has been put forth is already more than a billion dollars less than the amount that was authorized by the Congress in the NASA authorization bill. So, what if we gave you another billion dollars. How would you allocate that?

Dr. GRIFFIN. That's not a question that I would want to answer off the top of my head, because we made many reductions across the board in NASA, all of them to things that all of us would like to do. So, I would want to take that question for the record and say what we would do.

[The information referred to follows:]

We sought, in our budget request, to achieve the necessary balance of priorities over the 5-year budget horizon, and I think we got it right given the constraints we had. Given the current budget constraints facing the Nation, we do not believe that NASA's budget should be increased above the requested level. If NASA were to receive more funding to our top-line, there are some key factors I would use for deciding where to provide those funds.

1. Preserve the Integrity of the President's Request

The first priority would be to preserve the integrity of the President's budget request. In formulating our budget, NASA prioritizes activities to achieve an integrated package of programs and projects to best achieve the priorities that have been provided us by both the President and the Congress. There are items that threaten to erode that integrity in the course of the appropriations process, such as earmarks and rescissions. Last year, as an example, content that was planned in the President's request had to be reduced $778.6 million to accommodate rescissions and fund Congressional interest items. NASA seeks the assistance of the Congress in reducing earmarks in the FY 2007 budget process, but, should there be earmarks or rescissions this year, additional topline funding would be used to avoid otherwise necessary reductions to content in the President's request.

2. Restore Funding Borrowed for Hurricane Recovery

NASA borrowed $100 million in FY 2005 funds from the Shuttle and International Space Station (ISS) programs to provide immediate support of hurricane recovery efforts in the Gulf region before any supplemental funds were provided. The Space Shuttle and ISS Cargo/Crew program requirements for those funds still remain. The intent was to eventually repay these programs for this initial outlay of funds, and NASA has repaid $20 million of the amount borrowed. NASA is seeking transfer authority in the pending supplemental that would allow us to repay more of these FY 2005 funds.

3. Avoid Adding New Content That Is Not Affordable in the Budget Runout

If we had a higher top-line, and funds were available in excess of what would be needed for items one and two, we would have to re-look at the balance of our portfolio. However, we would need to do so with a 5-year perspective, not just the 1-year view. The plain fact is that NASA simply cannot afford to do everything that our many constituencies would like the Agency to do. We must set priorities, and we must adjust our spending to match those priorities. I will not start new projects for which I know I do not have sufficient funding in the outyears—that would not be responsible, and has caused NASA problems in the past by putting too much on our plate.

4. Assess Priorities and Portfolio Balance, and Then Allocate Remaining Funds

Consistent with the priorities of both the President and those enacted by the Congress through the NASA Authorization Act of 2005 (Pub. L. 109–155), NASA would assess our portfolio and determine the most effective allocation of funds. Consistent with item three, the effect of these funds would not be to start new activities that would create unfunded outyear liens for NASA. The use of these funds therefore, would primarily be to increase the health of ongoing activities rather than create new ones.

Senator BILL NELSON. OK. I wish you would because if the Congress were to appropriate according to the authorization, the NASA authorization, then it would be in excess of a billion dollars more than your request. You are constrained by OMB, and you have, with some emotion, stated how difficult it has been, given your constraints.

Well, let's talk about a more optimistic outlook. You apparently feel quite optimistic about a Shuttle manifest on 16 or 17 flights to complete the Space Station. Why don't you share with the Committee your outlook.

Dr. GRIFFIN. Yes, Senator, I'm pleased to do that.

Our return-to-flight sequence was always offered as two flights, because we knew there was a lot that we did not know about foam shedding from the external tank, and there is no facility on the ground which can be used to test it. It must be test flown. We experienced an unwanted and unplanned loss of a major chunk of foam from the STS–114 flight. Otherwise, the tank really did pretty well. We believe we've fixed that. We are looking at other areas on the tank. In fact, I mentioned to you that the decision meeting on exactly what our final configuration for the tank will be, and our selected launch date will be this Thursday—and I'll be happy to share that with you or your staff when we've made that.

We believe we will be in good shape to fly, this July. We believe that, when we fly, we will fly well. When we fly, and fly well, we believe that we will be back in shape to execute Shuttle flights at our historical and average rate over the last 25 years, which, including downtime for two accidents, is more than four and a half flights per year, on average, including downtime. We now have three orbiters that are essentially fresh from depot maintenance.

So, we believe that once we are successfully returned to flight, we will easily be able to complete 16 flights for Station assembly and one flight for Hubble servicing. If that picture changes, if our engineers are surprised again, I will be absolutely open and forthcoming with this Committee and our other national stakeholders, and we will discuss the problem. But, right now, we believe we're in good shape to get back to flying and to finish the Station.

Senator BILL NELSON. Just to conclude that thought, share with the Committee how important, in your mind, it is that we utilize this investment by completing the Space Station and the scientific goals that you expect to achieve.

Dr. GRIFFIN. Well, I believe it's important—and I've been on record on this—I believe it's important to complete the Station, for several reasons, reasons going beyond the science. But, very specifically, we will use the Station to study more carefully the effects of zero gravity on humans in space, in preparation for longer voyages of exploration.

Most crucially to me, as an engineer, we will use the Station as a place to learn how to live and work in space. When we talk about setting forth on voyages to Mars 20 years from now, we need to know many things that we do not know. I've often used this analogy in a speech, so bear with me, if you will. Suppose someone were to ask the Navy today to put a crew onboard a submarine, seal the hatch up, tell them to leave port and not return for 2 and a half years, "You can't surface, and you can't catch any extra food." How do you think they'd do? We can't do that today. Until we can successfully conduct that experiment, we're not ready to go to Mars. And the Space Station is the place where we're going to learn how to do that.

Also, the United States made commitments—and this is extraordinarily important—as a leader among spacefaring nations, with 15 of those nations, to execute the Space Station program. The President has very forthrightly said that he believes the Vision for Space Exploration should involve partnership with other nations. How? I ask myself, how can we expect other nations to partner with us and hope that we will keep our word in another 15 or 20 years if we don't keep it today?

So, for those reasons, I believe it is important, was important, and will be important to finish the Station, consistent with our promises.

Senator BILL NELSON. Thank you.

Senator HUTCHISON. Senator Stevens?

STATEMENT OF HON. TED STEVENS, U.S. SENATOR FROM ALASKA

The CHAIRMAN. Well, thank you very much, Madam Chairman. If you would just put my statement—opening statement at the beginning of the hearing, I'd appreciate it.

Senator HUTCHISON. Without objection.

[The prepared statement of Senator Stevens follows:]

PREPARED STATEMENT OF HON. TED STEVENS, U.S. SENATOR FROM ALASKA

I am delighted to see Dr. Griffin here again, a little over a year since we confirmed him as NASA Administrator. It has been a busy year, for him and for the Committee.

We passed and enacted the first reauthorization bill for NASA in 5 years, and put the Congress on record in support of the Vision for Exploration.

We authorized funding levels that were carefully drawn up to help NASA meet the challenges of shifting to the new Vision with a minimum of disruption to important ongoing programs in human exploration and to other important NASA programs in Space Science, Earth Science, and Aeronautics Research.

Unfortunately, the White House asked for over a billion dollars less than we authorized, so we are seeing some of those disruptions we had hoped to avoid.

This has placed many challenges on you, Dr. Griffin, in trying to divide a smaller piece of the budgetary pie, and you have been asked here to tell us about those challenges and how you are dealing with them.

We will also be looking into steps we might be able to take in the Congress to help you meet some of those challenges, and I look forward to working with you to see if, together, we can find some helpful answers.

The space program is an important part of our Nation's ability to keep our competitive edge, and to stimulate interest in science and education, and we will be addressing those issues in future hearings and in legislation we may be considering in the future.

Thank you for your service at NASA, and I look forward to your testimony today.

The CHAIRMAN. I'm interested in——

Senator HUTCHISON. And thank you—I want to say, Mr. Chairman, how supportive you have been of NASA and space in the full Committee, and I really appreciate it, because I think the initiatives that we're making have made a huge difference already, and will have a lasting impact. So, thank you.

The CHAIRMAN. Well, you're very generous.

Dr. Griffin, I'm interested in your concept of the private-sector participation. But do you envision a partnership or—a true partnership or just contractual relationships with the private sector?

Dr. GRIFFIN. I think we could contemplate both of those. And I would hope for both of those. But the first thing that I believe that NASA, frankly, needs to learn to do is to learn how to conduct and conclude an arms-length commercial transaction with a supplier of services that we need.

I've used this analogy before, as well, but if you'll bear with me, I'll use it again. In the growth of aviation—and you are a pilot, and you know aviation as well as anyone—this Nation never had any trouble distinguishing two facets of aviation. In one facet, the government participated in the development of the arts and sciences of aviation, and bought airplanes, and built its own airplanes from commercial suppliers—or from suppliers; and in other areas, the U.S. Government bought services, tickets, or cargo space on airplanes.

In developing space, we, at NASA—frankly, in the Defense Department—have largely relied upon buying hardware rather than contracting with industry to provide services that we need. Some of that has been the historical nature of the development, and some has been cultural.

Now, for the first time, with the International Space Station, we have a market, if you will, sir. We have a regular, steady market for goods and services and, later, when they have the capability, crew rotation, a market that I can turn over to industrial suppliers, if they can be made to exist. They don't exist right now. But, by

providing the seed money that I've referred to in my earlier statement as an incentive to accompany investment on the part of the commercial operators themselves, we might be able to create this capability.

The analogy that I would use would be the difference between the government buying a tanker aircraft and the government buying a ticket for its personnel to fly in a commercial version of that same aircraft. That's what I'm striving for, sir.

The CHAIRMAN. Well, you're right, I've lived through the process of the development of the aviation community, particularly the military side, and I can distinctly remember, as a young boy, going out and watching the fly-off at the Los Angeles Airport, where the companies made the airplanes and competed with one another for the contract with the Federal Government. That has changed now, because we design the airplane, and then they compete to, really, produce it. Aren't we missing something, in terms of space? It does seem to me there's a link to the Space Station. And that is totally Federal, right? There's no competition from the private sector that, is there?

Dr. GRIFFIN. No, you're——

The CHAIRMAN. Do you contemplate any?

Dr. GRIFFIN. No, sir. The International Space Station, our space platform, is a Federal development——

The CHAIRMAN. I'm talking about the access to it——

Dr. GRIFFIN. Current access——

The CHAIRMAN.—in terms of the Shuttle. Are you——

Dr. GRIFFIN. Current access to it is entirely Federal, yes, sir.

The CHAIRMAN. Do you contemplate offering an opportunity to the private sector to develop that access?

Dr. GRIFFIN. That is exactly what we are contemplating, sir. That is exactly what we are contemplating.

The CHAIRMAN. And what's the timeframe for that?

Dr. GRIFFIN. I'm hoping, this spring, to conclude Space Act agreements for demonstrations of this capability with one or more potential suppliers, and, if those demonstrations go well, to be able to transition to actual commercial contracts for service by these suppliers, initially for cargo, and then, if it works well, later for crew, in the next 5, 6, 7 years.

Senator HUTCHISON. 2010?

Dr. GRIFFIN. Am I——

The CHAIRMAN. 2010.

Dr. GRIFFIN. Am I being—am I being clear, sir?

The CHAIRMAN. Yes. I—well, I had missed that connection, because it does seem to me that that is where we could lead the world, with the ingenuity of our private sector, if it were stimulated and they really believe that we're going to make that broad jump.

Dr. GRIFFIN. That's exactly right. And with the Space Station, I have a known and predictable market that they can serve. So, the commercial suppliers, if we can help bring them into being, will not have to worry that the government will decide, next month or next year, not to launch.

The CHAIRMAN. Well, let me make a——

Dr. GRIFFIN. We can't not launch, because we have to supply the Station.

The CHAIRMAN. Just one other question to take it beyond that. And that is, do you contemplate that the private sector could contract with the private providers of the access to take private experiments to Space Station?

Dr. GRIFFIN. Yes, sir. That could follow, as well. Absolutely. That is my hope. Further, I hope that by the time we are ready to return to the Moon, that there will be such capability in existence that we can hire, if you will, to help with certain parts of the effort.

The CHAIRMAN. Let me ask just one question here. I'm sure you're familiar with Norm Augustine's report on *The Gathering Storm,* and NASA used to be, really, the bright spot in our horizon for attracting bright young people to study science and technology, et cetera.

Do you feel NASA still has that role?

Dr. GRIFFIN. Absolutely, sir. Absolutely. I'm sorry, I feel very strongly about this—the best thing NASA does, ever did, or can do to stimulate an interest in science, math, engineering, biology, any scientific subjects, is to do the kinds of things, the kinds of bold, far-reaching missions of exploration that attract kids to study hard subjects because they want to be part of it.

I will relate, not for the first time, a personal story. I was 8 years old when *Sputnik* launched. And I was interested in space long before *Sputnik* launched. I was interested in it from the time I was 4 or 5 years old. So, I was in the odd position of being in the third grade and explaining to my teacher what *Sputnik* was and how it stayed up. I suspect that I was not typical.

[Laughter.]

Senator BILL NELSON. That's right.

Dr. GRIFFIN. But I went through school, all the way through college with a bunch of kids who got interested in science and engineering, aviation, all kinds of science and engineering, because of what happened with *Sputnik* and the reaction of the United States to *Sputnik.* In 1957 and 1958, we decided to build a great space program. And we did. We flew to the Moon, and we made plans to go farther. We never implemented those plans. And, yes, interest in studying difficult subjects waned as a result.

I believe, to the core of my being, that if NASA does bold, far-reaching missions that excite the imagination, that kids will want to study science and math to be part of it. And those benefits will echo throughout our society, and make us, once again, the most technologically competitive nation on Earth.

The CHAIRMAN. Well, let me close by saying this. As you know, we have a *Challenger* Learning Center in our state. But I sense that the support for those centers is dwindling, not only in our state, but throughout the country. What can we do to rekindle that support?

Dr. GRIFFIN. Again, sir, I have no better answer to rekindling the support for the *Challenger* Learning Centers and other space-related activities than to ask and require NASA and our space program to do the right things. And you've done that with the Authorization Act of 2005. With the Authorization Act of 2005, you have made the exploration of the solar system by the United States the

law of the land. And now it's my job to implement the first steps of that. I said in my earlier statement, I need your help, and you've provided it. We are on the right path. We are on the right path for space exploration in this country for the first time, in my opinion, in 30 years.

The CHAIRMAN. Well, I understand that, but I——

Dr. GRIFFIN. We just need to stay——

The CHAIRMAN.—I don't——

Dr. GRIFFIN.—the course.

The CHAIRMAN.—I don't sense the support from the private sector for those *Challenger* Learning Centers that we thought would follow the initiation of the construction and outfitting of those centers. And I would like to talk to you about that sometime.

I do believe——

Dr. GRIFFIN. I would be——

The CHAIRMAN.—that those centers are essential to interest grade school children and high school children, you know, to follow on in your path. But it's very difficult, right now, to maintain that support. I think it's because of the economy and the war and other things. But we certainly ought to improve it.

I congratulate you. I—and I totally support your vision of trying to have a true partnership with the private sector in the total support of the Space Station.

Thank you very much.

Senator HUTCHISON. Thank you, Mr. Chairman.

Dr. GRIFFIN. Thank you, Senator.

Senator HUTCHISON. Senator Allen?

STATEMENT OF HON. GEORGE ALLEN,
U.S. SENATOR FROM VIRGINIA

Senator ALLEN. Thank you, Madam Chairman. I'm really pleased you've called this hearing. And I've been listening to the testimony of Dr. Griffin—and thank you for being here today—and listening to the questions of my colleagues, focused on a variety of areas.

And it's nothing—you should never apologize for feeling strongly about an issue, especially one that's so important to the competitiveness of our country, and that is more young people, particularly women, Latinos, and African-Americans, being more interested and encouraged into science and technology and engineering.

One area where I do, as you well know, in our conversations from the beginning, when you were nominated by President Bush, where I feel that we're falling behind our competitors, is in aeronautics. I look at the proposed budget, and there is a decrease, not only in this year, but in out years. And I feel that, to the extent—if you want to look at the engineers in aeronautics, those engineers are generally older. How are you going to incent or interest young people in hypersonic flight and other aspects of aeronautics if the commitment of this country appears to be reducing in this area?

The Administration has focused on the space exploration aspects of it, and directed, obviously, a great deal of resources there. And there are arguments one way or the other as to how much that investment should be. I do not necessarily—in fact, I think it's a good idea, your vision for exploration. I think that's—there's nothing wrong with it whatsoever. But I've stated, on many occasions, that

the cutting-edge breakthroughs, whether it's—in particular, say, the new vehicle systems program—this constant cutting of this area and this research is bound to have an adverse impact on aeronautics in this country. And aeronautics is important for our economy, but it's also important for our national security. And I understand about budget priorities. And, obviously, last year, working with you, Madam Chairman, you were very helpful, as were others—but, in particular, you were a key ally in some of the mitigation of damages proposed, insofar as aeronautics funding. We're going to have to go through this entire battle again this year. And I know you recognize that. That's why I'd liked Senator Nelson's question, "If you had another billion dollars," you know, where I think at least a good portion of that should go.

Let me ask you this. Part of what we were—we adopted last year was the development of a national aeronautics research policy, so that it's not this annual pitched battle, where people who have spent their life in aeronautics research wonder if they're going to have a job, Are they going to be laid off? And there are also the commensurate number of folks in the private sector. And so, this, I think, was a positive step, the requirement of the development of a national aeronautics research policy.

Could you share with us what is the policy that's going to be laid out and what options are being considered as you share with us the status of the development of this national aeronautics research policy?

Dr. GRIFFIN. Yes, Senator.

First of all, the policy is due in December, and we'll have it by then. We're in the middle of working on it, as we speak. And we are working on it with our partners in OSTP, Defense, and FAA. It will be the first aeronautics policy for this Nation in a generation, as I know that you know, so we're taking it quite seriously.

From NASA's perspective, we take the position that our proper role is in fundamental aeronautics research, the unknowns that accompany flight at the frontiers of knowledge. And it's our goal to push back that frontier in hypersonics, in subsonic flight, for research that's applicable to DOD. We want to look across the board, but we want to look at aeronautics research, fundamental aeronautical science, rather than, as has been the case in some recent years, focusing on development of demonstrator projects, which, in my judgment, have not been well connected with what went before, and didn't leave a legacy for something to come after. They were demonstrations of point designs rather than carefully thought out experiments to resolve areas of understanding in aeronautics. So, that's what we are doing.

I have been fortunate to capture, from DARPA, as a matter of fact, one of the best people that it's ever been my pleasure with whom to work, a supporter, who is our AA for aeronautics. She and I would be happy to come up and discuss what we're doing, with you and your staff. But that's where we're going.

We think restoring health to NASA aeronautics is as much about what we do as the exact specific dollar figure that we put on the work. Aeronautics has been decreasing, within NASA and within the Nation at large, for quite a long time. It did not originate with this Administration. And we believe that part of the reason for that

is that we haven't been focusing on the right things. And that's what I'm trying to do.

Senator ALLEN. Well, Dr. Griffin, you're correct, the previous Administration, the Clinton Administration, cut aeronautics research and development approximately in half, and the present Administration's—with the proposals, if they actually went through, would cut it in half again.

What—we're in competition. Our European friends, obviously, have a determination, strategic plan, to dominate aeronautics by the year 2010—excuse me—2020. And they seem to be on the way. We've had—this past year was a good year, but, for the first time in history, a year ago, the United States was not number one in aircraft sales.

Where do you see United States research and development in aeronautics, compared to our global competitors? Do you think that we are winning, holding our own, or falling behind in the research and development in aeronautics?

Dr. GRIFFIN. I don't think the measure of success in research and development in aeronautics is necessarily reflected in the balance of trade and sales of airplanes. I believe that——

Senator ALLEN. It is an indicator.

Dr. GRIFFIN. It might be an indicator, as much, of marketing success—and it may be an indicator of industrial policies that are followed, but I personally—I can only tell you what I believe—I believe that the United States, in terms of the quality of its technical talent in the aeronautical sciences, is second to no one. We need to bring a better, and a different, focus to our work, and that's what I'm trying to do. But I believe NASA aeronautics researchers are the best in the world, and that what we do is still in the absolute forefront of the state-of-the-art.

We do work that enables commercial development a generation hence to be better. There is nothing that we, at NASA, can do, or, in my opinion, should do, to influence next year's balance of airliner sales, or even 5 years from now. That's not an issue that we, at NASA, can address.

Senator ALLEN. Well, for the entire history of flight since the Wright brothers, until that year, the United States was always number one in having the most advanced, most attractive aircraft for sales throughout the world. And while you may say it's a matter—measure of marketing, the United States has always been pretty good at marketing, as well. I don't think—I think that it's quality and value as part of it. And I think what—it's a very competitive international market. And the others have caught up, and, in some cases, passed us.

Do you see the private sector making up for the reductions in some of this research and development that have been occasioned—you can take the last 8 years—do you see the private sector picking up any of the research and development funding?

Dr. GRIFFIN. Well, we try very hard not to do research and development——

Senator ALLEN. Right.

Dr. GRIFFIN.—that the private sector would do, or indicates that they would do, which generally means not doing evolutionary development work that would be just a small increment—a perform-

ance increment beyond where we are, you know, a more efficient turbine blade or something like that, that would increase efficiency a percent or so. That's a very valuable thing to do. It makes money for the developer of the turbine blade and his jet engine, but, broadly speaking, is, I think, not a NASA responsibility.

I think a NASA responsibility is to develop the kinds of newer, better, state-of-the-art computational fluid dynamics research tools and codes that enable everybody working in aeronautics to do better flow-field analysis, including, but not limited to, those people who want more efficient turbine blades. That example, which I just made up, but is, I think, a good one, is a difference between the kinds of things I think we ought to be doing at NASA and what commercial industry should do.

I've been in industry. Industry does not have the resources, and does not have the time horizons in its planning, to worry about developing, in this example, to improve the state-of-the-art in computational fluid dynamics codes. Government has had, and still has, the history of that kind of groundbreaking research. Once that is done, it benefits the entire aeronautical sciences community, and that's where we strive to have leverage.

Senator ALLEN. Understood. What NASA aeronautics needs to do, as you do, and others, is more of the high-risk——

Dr. GRIFFIN. Exactly.

Senator ALLEN.—futuristic—that's why the—you mentioned the hypersonic aircraft, as well as, I mentioned the vehicle systems programs. And so, that's where we're—we need to concentrate. I also think it'll make a great deal of sense. I'm glad to hear that you have—working with DARPA and the Department of Defense, because, ultimately—I love DARPA. They, even, are more innovative, probably the most innovative of all the Federal agencies. It's just a great group.

Dr. GRIFFIN. I love them, too.

Senator ALLEN. But to the extent you're working with them, also with the Department of Defense, it's important.

And I look forward to working with you, Madam Chairman, and you Dr. Griffin, understanding that there are constraints, priorities need to be met. But I just don't want this key competence for our country's security and competitiveness to atrophy with inadequate funding and not—to the extent you get the private sector or other Federal agencies in on it, I think that makes some sense—a great deal of sense in some cases. And I look forward to working with you.

And thank you, again, Madam Chairman and Dr. Griffin, for both of you alls leadership.

Dr. GRIFFIN. Thank you, Senator.

Senator HUTCHISON. Thank you, Senator Allen.

I would just suggest that it could be in your meetings with the Department of Defense where you are going to see how you can cooperate so that you're not duplicating effort. There may be things that the Department of Defense is doing through the Lockheed or the—for instance, on the Joint Strike Fighter—maybe there are some things that could be picked up by private industry that even stretches the NASA dollars further, just as a—an idea to add to the mix.

I want to pursue one other area, and then, if there is anyone else who has a second round——

In your testimony, you talked about the downsizing, basically, of the engineers and technicians as you transition to the CEV and the Launch Vehicles. It appears that you are trying to use the technology that is the base of knowledge of many of your engineers for the CEV and the Launch Vehicle. My question is, How are you going to make the transition? I know you're going to try to use as many of the people you have and put them over into the CEV and the Launch Vehicle research, but how are you going to manage that transition? And do you think that you can take the same people, with their base of knowledge, and effectively use them in these new areas?

Dr. GRIFFIN. Yes, Senator, I have no doubt at all that the people who today work Shuttle and Space Station operations can transition over and work CEV operations and CLV, distinguishing between the vehicle and the launch system. So, I have no doubt that that will work just fine.

Their skills are entirely appropriate—the difficulty is, of course, that the people who are working on the Shuttle today are needed for the Shuttle today, or we wouldn't be employing them. We must be very careful about diverting their attention from the Shuttle.

Also, we are in a design stage on CEV and CLV; whereas, of course, Shuttle and Station are totally into operations. They're not doing any design. We don't want them to do any design. We want them to finish building what has been designed.

So, we need to inform our design engineers through the experience of operations, so that good designs will result, by having some folks who are today in Shuttle and Station operations participate in the design of the successor systems, so that we get good information transfer.

Similarly, we need to take some of our younger folks, who either are not, or have not, worked Shuttle and Station, and see to it that, before all of the older workforce transitions out completely, that we have an opportunity to educate some of our younger workforce in both industry and NASA in the realities of existing flying programs. And the flying programs that we have today are Shuttle and Station.

We need a melding of all that we are doing, both the ongoing operational programs and the new design-phase programs, so that each properly informs the other, and we get the best value out of it.

Senator HUTCHISON. What is your timetable in determining how you reconfigure these assets that you have?

Dr. GRIFFIN. We are working on it, as we speak. We report on it regularly within the agency. In the end, of course, we have to have our plans in place by Shuttle retirement. We have to know who will transition over to the new systems and who will have to go somewhere else and do something else. We don't have that yet. We just don't have that yet.

Senator HUTCHISON. I suppose, when you start getting your returns on your proposals—or your requests for proposals on the CEV and the CLV, you'll begin to have better——

Dr. GRIFFIN. That will certainly help, because those proposals will come with estimates of the workforce necessary to launch and sustain them, and all of those things. Then, of course, we have the issues, as you well know—really, we have exactly the same issues as the Air Force Titan Program faced a year or two ago, when they were working up to flying the last Titan. They still needed the workforce that they needed to fly the second to last Titan or the third to last Titan. So, how do you keep the people onboard who are going to launch the last one? How do you provide incentives to them to stay with you for as long as you need them?

Senator HUTCHISON. Well, I think you're on the right track. You show them where the future is.

Dr. GRIFFIN. We show them where the future is for those who transition over, and we must, in some fashion, provide incentives to those who won't be able to go with us and will have to do something else.

Senator HUTCHISON. But I think your original concept of using basic Shuttle knowledge as you go into the CEV was a very visionary one, because that does keep more of your people.

Dr. GRIFFIN. Thank you. It seemed to me to be the best approach for retaining and capturing and utilizing the knowledge that we've spent tens of billions of dollars and two generations building. I didn't want to let it go.

Senator HUTCHISON. Well, I'd like to be kept up as you begin to see the handwriting on the wall for that kind of transition.

Dr. GRIFFIN. And you know that I will do that.

Senator HUTCHISON. Yes. Thank you very much.

Senator Nelson?

Senator BILL NELSON. Thank you, Madam Chairman.

Dr. Griffin, you notice that our questions and our comments are certainly most felicitous in nature. And we are here not only as encouragers, but we're also here as cheerleaders for a program that we happen to love and that we think is very, very important to the future of this country.

Now, I want to get back to the law. The law of this country now is the NASA Authorization Act. And in that law it says it is the policy of the U.S. Government that there is no gap between the shutting down of the Space Shuttle and the beginning of the CEV. And then it goes, because we negotiated with this with you, to give you wiggle room with certain reports to the Congress.

So, I want to go back to the fact that we stated, earlier, that this budget request that you are making, which, in essence, is OMB on your top line, or your bottom line, whichever way you look at it, is $1.1 billion less than the amount that is authorized. So, if the Congress's decision, since we are the funders, is that we appropriate the same amount that NASA is authorized for in the 2007 fiscal year, then it gives you new opportunities to do some things, maybe some in aeronautics, as you said, but you've got this report that's going on that won't be ready until December, where maybe you can work something out with the FAA and DOD. But clearly another billion-plus would give you an opportunity of speeding up the development of the CEV. Is that correct?

Dr. GRIFFIN. Well, yes, sir, of course. Yes, sir.

Senator BILL NELSON. Speeding it up by 4 years?

Dr. GRIFFIN. Sir, I don't believe that we can have a CEV by 2010, no matter what we do. We are technology-limited to the 2011–2012 timeframe. We're funding-limited for later dates than that. I mean, I've been in this business 35 years, short of a national priority crash program, which I think no one is suggesting, I do not believe that it would be operationally possible to have a working CEV/CLV combination sooner than 2011 or 2012. I'm in the awkward position that you know that I also believe that we should not have a significant gap in human spaceflight; and yet, our Nation has many priorities, and I defend the President's budget. And so, within the context of that budget, I am doing everything I can to get the CEV for us—not for you, for us—as early as it can be done.

Senator BILL NELSON. Clearly, an additional billion dollars from your request would give you some additional working room with regard to science.

Dr. GRIFFIN. Well, again, in the President's budget we believe that we have struck a good balance between the demands and the needs of science programs and the human spaceflight programs and aeronautics. There are science programs that we are having to defer that we would like to do sooner. There are some smaller programs that we will just outright cut. In the administration, we believe that we have captured the essence of the NASA science program without damage and that, as the CEV is being delayed a bit, so, too, it is fair to ask that some of the science programs be delayed a bit in order that everybody bears some of the consequences for hard choices, but no one bears them all.

Senator BILL NELSON. Where do you see us going with China, competitor or colleague?

Dr. GRIFFIN. This is my opinion, I think the details of this should be requested of the State Department rather than me.

Senator BILL NELSON. No, I'm talking about the space program.

Dr. GRIFFIN. In the space program, I would offer the following. China is, as we are, a great nation. They are not in consonance with us on many things that we would like them to be more closely aligned, and some of those issues were discussed at last week's summit. The Chinese have offered an opportunity for me to visit with them and discuss the beginnings of cooperation between us and them in space. I think the United States always benefits from discussions. I do not see how it can hurt us. I am pleased to accept that invitation. The President has advised me that he wishes me to accept that invitation. I look forward to it.

The United States needs good competitors, and it needs good partners. And sometimes they can both be the same. So, I can't, at this point, hazard a guess as to what our relationship in the long-term would be. I will say, 20 years ago who would have imagined that one of our best partners on the Space Station today is Russia? So, I think it is in our interest to behave always as if cooperation is a possible thing. And I believe that that's what we're doing.

Senator BILL NELSON. Although we saw the beginnings of that in *Apollo/Soyuz* in 1976, even though we were two superpowers in a Cold War, they were the seeds of what were sown——

Dr. GRIFFIN. That's correct.

Senator BILL NELSON.—at that point. So, you've got to start sowing those seeds. So, I would encourage you to have those discussions.

Dr. GRIFFIN. And I believe the President would share your view, which is why he has requested me to make this trip.

Senator BILL NELSON. Down the line, China may understand, even though they want the prestige of their own space program, that cooperating with the United States, and the rest of the world, indeed, on the Space Station might clearly be to their advantage. So, I will be interested to hear how those talks proceed.

Let me ask you just one final question. For our Committee, would you bring us up to date on the mandate that you have laid down in NASA with regard to openness of scientific opinion?

Dr. GRIFFIN. Of course, sir. I did recently release a policy, which I believe I—do we have a copy of that we could submit for the record? Yes, we have brought a copy. We'd be happy to submit that for the record.

[The information referred to follows:]

NASA POLICY ON THE RELEASE OF INFORMATION TO NEWS AND INFORMATION MEDIA

Scope

This directive sets forth policy governing the release of public information, which is defined as information in any form provided to news and information media, especially information that has the potential to generate significant media, or public interest or inquiry. Examples include, but are not limited to, press releases, media advisories, news features, and web postings. Not included under this definition are scientific and technical reports, web postings designed for technical or scientific interchange, and technical information presented at professional meetings or in professional journals.

Applicability

(a) This policy applies to NASA Headquarters, NASA Centers, and Component Facilities.

(b) In the event of any conflict between this policy and any other NASA policy, directive, or regulation, this policy shall govern and supersede any previous issuance or directive.

Principles

(a) NASA, a scientific and technical agency, is committed to a culture of openness with the media and public that values the free exchange of ideas, data, and information as part of scientific and technical inquiry. Scientific and technical information from or about Agency programs and projects will be accurate and unfiltered.

(b) Consistent with NASA statutory responsibility, NASA will "provide for the widest practicable and appropriate dissemination of information concerning its activities and the results thereof." Release of public information concerning NASA activities and the results of NASA activities will be made promptly, factually, and completely.

(c) To ensure timely release of information, NASA will endeavor to ensure cooperation and coordination among the Agency's scientific, engineering, and public affairs communities.

(d) In keeping with the desire for a culture of openness, NASA employees may, consistent with this policy, speak to the press and the public about their work.

(e) This policy does not authorize or require disclosure of information that is exempt from disclosure under the Freedom of Information Act (5 U.S.C. § 552) or otherwise restricted by statute, regulation, Executive Order, or other executive branch policy or NASA policy (e.g., OMB Circulars, NASA Policy Directives). Examples of information not releasable under this policy include, without limitation, information that is, or is marked as, classified information, procurement sensitive information, information subject to the Privacy Act, other sensitive but unclassified information, and information subject to privilege, such as predecisional information or attorney-client communications.

Responsibilities

(a) The Assistant Administrator for Public Affairs is responsible for developing and administering an integrated Agency-wide communications program, establishing Agency public affairs policies and priorities, and coordinating and reviewing the performance of all Agency public affairs activities. The Assistant Administrator will develop criteria to identify which news releases and other types of public information will be issued nationwide by NASA Headquarters. Decisions to release public information nationwide by NASA Headquarters will be made by the Assistant Administrator for Public Affairs or his/her designee.

(b) NASA's Mission Directorate Associate Administrators and Mission Support Office heads have ultimate responsibility for the technical, scientific, and programmatic accuracy of all information that is related to their respective programs and released by NASA.

(c) Under the direction of the Assistant Administrator for Public Affairs, public affairs officers assigned to Mission Directorates are responsible for the timely and efficient coordination of public information covering their respective programs. This coordination includes review by appropriate Mission Directorate officials. It also includes editing by public affairs staff to ensure that public information products are well written and appropriate for the intended audience. However, such editing shall not change scientific or technical data, or the meaning of programmatic content.

(d) Center Public Affairs Directors are responsible for implementing their portion of the Agency's communications program, adhering to Agency policies, procedures, and priorities, and coordinating their activities with Headquarters (and others where appropriate). They are responsible for the quality of public information prepared by Center public affairs officers. They also are responsible for the day-to-day production of public information covering their respective Center activities, which includes obtaining the necessary Center concurrences and coordinating, as necessary, with the appropriate Headquarters public affairs officers.

(e) Center Directors have ultimate responsibility for the accuracy of public information that does not require the concurrence of Headquarters. (See "Public information coordination and concurrence," section (d).)

(f) All NASA employees are required to coordinate, in a timely manner, with the appropriate public affairs officers prior to releasing information that has the potential to generate significant media, or public interest or inquiry.

(g) All NASA public affairs officers are required to notify the appropriate Headquarters public affairs officers in a timely manner about activities or events that have the potential to generate significant media or public interest or inquiry.

(h) All NASA public affairs employees are expected to adhere to the following code of conduct:

(1) Be honest and accurate in all communications.

(2) Honor publication embargoes.

(3) Respond promptly to media requests and respect media deadlines.

(4) Act promptly to correct mistakes or erroneous information, either internally or externally.

(5) Promote the free flow of scientific and technical information.

(6) Protect non-public information.

(i) All NASA employees are responsible for adhering to plans (including schedules) for activities established by public affairs offices and senior management for the coordinated release of public information.

(j) All NASA-funded missions will have a public affairs plan, approved by the Assistant Administrator for Public Affairs, which will be managed by Headquarters and/or a designated NASA Center.

(k) Public affairs activities for NASA-funded missions will not be managed by non-NASA institutions, unless authorized by the Assistant Administrator for Public Affairs.

(l) The requirements of this directive do not apply to the Office of Inspector General regarding its activities.

Public Information Coordination and Concurrence

(a) *General.* All NASA employees involved in preparing and issuing NASA public information are responsible for proper coordination among Headquarters, Center, and Mission Directorate offices to include review and clearance by appropriate officials prior to issuance. Such coordination will be accomplished through procedures developed and published by the NASA Assistant Administrator for Public Affairs.

(b) *Coordination.* To ensure timely release of public information, Headquarters and Center public affairs officers are required to coordinate to obtain review and

clearance by appropriate officials, keep each other informed of changes, delays, or cancellation of releases, and provide advance notification of the actual release.

(c) All public information shall be coordinated through the appropriate Headquarters offices, including review by the appropriate Mission Directorate Associate Administrator and mission support office head, or their designees, to ensure scientific, technical, and programmatic accuracy, and review by the Assistant Administrator of Public Affairs or his/her designee to ensure that public information products are well written and appropriate for the intended audience.

(d) Centers may, however, without the full coordination of Headquarters, issue public information that is institutional in nature, of local interest, or has been deemed not to be a Headquarters release. (The Assistant Administrator for Public Affairs or his/her designee will determine which public information will be issued nationwide by NASA Headquarters.) These releases must be coordinated through the appropriate Center offices and approved by the Center Director and Center Public Affairs Director. The Center Public Affairs Director is required to provide proper notification to the NASA Office of Public Affairs, Headquarters, prior to release. (The Assistant Administrator for Public Affairs shall publish guidelines for the release of public information that may be issued by Centers without clearance from Headquarters' offices.)

(e) *Dispute Resolution.* Any dispute arising from a decision to proceed or not proceed with the issuance of a news release or other type of public information will be addressed and resolved by the Assistant Administrator for Public Affairs with the appropriate Mission Directorate Associate Administrator, mission support office head, Center Director, and others, such as Center Public Affairs Directors, as necessary. However, the appropriate Mission Directorate Associate Administrator shall be the arbiter of disputes about the accuracy or characterization of programmatic, technical, or scientific information. Additional appeals may be made to the Chief of Strategic Communications and to the Office of the Administrator. When requested by a Center Public Affairs Director, an explanation of the resolution will be provided in writing to all interested Agency parties.

Interviews

(a) Only spokespersons designated by the Assistant Administrator for Public Affairs, or his/her designee, are authorized to speak for the Agency in an official capacity regarding NASA policy, programmatic, and budget issues.

(b) In response to media interview requests, NASA will offer articulate and knowledgeable spokespersons who can best serve the needs of the media and the American public. However, journalists may have access to the NASA officials they seek to interview, provided those NASA officials agree to be interviewed.

(c) NASA employees may speak to the media and the public about their work. When doing so, employees shall notify their immediate supervisor and coordinate with their public affairs office in advance of interviews whenever possible, or immediately thereafter, and are encouraged, to the maximum extent practicable, to have a public affairs officer present during interviews. If public affairs officers are present, their role will be to attest to the content of the interview, support the interviewee, and provide post-interview follow-up with the media as necessary.

(d) NASA, as an Agency, does not take a position on any scientific conclusions. That is the role of the broad scientific community and the nature of the scientific process. NASA scientists may draw conclusions and may, consistent with this policy, communicate those conclusions to the media. However, NASA employees who present personal views outside their official area of expertise or responsibility must make clear that they are presenting their individual views—not the views of the Agency—and ask that they be sourced as such.

(e) Appropriated funds may only be used to support Agency missions and objectives consistent with legislative or Presidential direction. Government funds shall not be used for media interviews or other communication activities that go beyond the scope of Agency responsibilities and/or an employee's official area of expertise or responsibility.

(f) Media interviews will be "on-the-record" and attributable to the person making the remarks, unless authorized to do otherwise by the Assistant Administrator for Public Affairs or Center Public Affairs Director, or their designees. Any NASA employee providing material to the press will identify himself/herself as the source.

(g) Audio recordings may be made by NASA with consent of the interviewee.

(h) NASA employees are not required to speak to the media.

(i) Public information volunteered by a NASA official will not be considered exclusive to any one media source and will be made available to other sources, if requested.

Preventing Release of Classified Information to the Media

(a) Release of classified information in any form (e.g., documents, through interviews, audio/visual, etc.) to the news media is prohibited. The disclosure of classified information to unauthorized individuals may be cause for prosecution and/or disciplinary action against the NASA employee involved. Ignorance of NASA policy and procedures regarding classified information does not release a NASA employee from responsibility for preventing any unauthorized release. See NPR 1600.1, Chapter 5, Section 5.23 for internal NASA guidance on management of classified information. For further guidance that applies to all agencies, see Executive Order 12958, as amended, "Classified National Security Information" and its implementing directive at 32 CFR Parts 2001 and 2004.

(b) Any attempt by news media representatives to obtain classified information will be reported through the Headquarters Office of Public Affairs or Installation Public Affairs Office to the Installation Security Office and Office of Security and Program Protection.

(c) For classified operations and/or programs managed under the auspices of a DD Form 254, "*Contract Security Classification Specification,*" all inquiries concerning this activity will be responded to by the appropriate PAO official designated in Item 12 on the DD Form 254.

(d) For classified operations and/or information owned by other government agencies (e.g., DOD, DOE, etc.), all inquiries will be referred to the appropriate Agency public affairs officer as established in written agreements.

Preventing Unauthorized Release of Sensitive But Unclassified (SBU) Information/Material to the News Media

(a) All NASA SBU information requires accountability and approval for release. Release of SBU information to unauthorized personnel is prohibited. Unauthorized release of SBU information may result in prosecution and/or disciplinary action. Ignorance of NASA policy and procedures regarding SBU information does not release a NASA employee from responsibility for unauthorized release. See NPR 1600.1, Chapter 5, Section 5.24 for guidance on identification, marking, accountability and release of NASA SBU information.

(b) Examples of SBU information include: proprietary information of others provided to NASA under nondisclosure or confidentiality agreement; source selection and bid and proposal information; information subject to export control under the International Traffic in Arms Regulations (ITAR) or the Export Administration Regulations (EAR); information subject to the Privacy Act of 1974; predecisional materials such as national space policy not yet publicly released; pending reorganization plans or sensitive travel itineraries; and information that could constitute an indicator of U.S. Government intentions, capabilities, operations, or activities or otherwise threaten operations security.

(c) Upon request for access to information/material deemed SBU, coordination must be made with the information/material owner to determine if the information/material may be released. Other organizations that play a part in SBU information identification, accountability and release (e.g., General Counsel, External Relations, Procurement, etc.) must be consulted for assistance and/or concurrence prior to release.

(d) Requests for SBU information from other government agencies must be referred to the respective Agency public affairs officer.

Multimedia Materials

(a) NASA's multimedia material, from all sources, will be made available to the information media, the public, and to all Agency Centers and contractor installations utilizing contemporary delivery methods and emerging digital technology.

(b) Centers will provide the media, the public, and as necessary, NASA Headquarters with:

(1) Selected prints and original or duplicate files of news-oriented imagery and other digital multimedia material generated within their respective areas.

(2) Selected video material in the highest quality format practical, which, in the opinion of the installations, would be appropriate for use as news feed material or features in pre-produced programs and other presentations.

(3) Audio and/or video files of significant news developments and other events of historic or public interest.

(4) Interactive multimedia features that can be incorporated into the Agency's Internet portal for use by internal and external audiences, including the media and the general public.

News Releases Concerning International Activities

(a) Releases of information involving NASA activities, views, programs, or projects involving another country or an international organization require prior coordination and approval by the Headquarters offices of External Relations and Public Affairs.

(b) NASA Centers and Headquarters offices will report all visits proposed by representatives of foreign news media to the public affairs officer for the Office of External Relations for appropriate handling consistent with all NASA policies and procedures.

Dr. GRIFFIN. But the broad outlines of the policy are really—frankly, we found that the earlier policy was a bit confused. It had been on the books for quite some length of time. It was not even clear to my deputy, who happens to be an attorney. And it wasn't clear to her, then I felt I had no hope. So, we've clarified it.

The core points of the policy are that NASA employees are, of course, free to communicate their scientific and technical and engineering results as they see fit. As in the recent case of record in *The New York Times,* they may discuss policy issues, but they must label their discussion of policy issues as their own opinion, and not the agency's opinion, because executive agencies do not engage in policy debates. I do not do that, and they may not, as well. We will not tolerate any altering of scientific communications for someone's notion of political correctness. That will not be done. Scientists or engineers who are requested to be interviewed by news media may accept the request, or they may decline; they're not forced to do an interview that they do not wish to do, but they may do one, if they choose. Because relationships with the news media are an art form of a particular nature, we recommend that they do such interviews with representatives of NASA Public Affairs. But we do not require it.

I think those are the broad outlines of the policy. It's one of the absolute maximum in openness, with that as my clearly expressed intent. There is an adjudication mechanism for disputes. I think you will appreciate that not every scientist who wishes to issue a press release concerning his work necessarily need be accommodated by the agency, but there is an adjudication mechanism.

Senator BILL NELSON. Is it possible for an old-fashioned July 4th celebration with the launch of the Space Shuttle?

Dr. GRIFFIN. That could occur, sir. The opening of the window is July 1, and we're trying for the opening of the window. So, let's hope that we're in flight to celebrate on July 4th with a clean, successful Shuttle flight.

Senator BILL NELSON. Godspeed.

Dr. GRIFFIN. Thank you, sir.

Senator HUTCHISON. I'll be there.

Dr. GRIFFIN. I would hope that both of you could be there. I will be there.

Senator BILL NELSON. We will.

Senator HUTCHISON. We will. Thank you very much. We appreciate very much your coming. I'm very pleased with the progress you're making, and look forward to many more months of that kind of progress.

Thank you.

Dr. GRIFFIN. Well, Senator Hutchison and Senator Nelson you are, of course, key members of my oversight committee, but you are

also among the strongest allies that I have in this body, and I appreciate your support.

Thank you.

Senator HUTCHISON. Thank you very much.

Our meeting is adjourned.

[Whereupon, at 3:50 p.m., the hearing was adjourned.]

A P P E N D I X

RESPONSE TO WRITTEN QUESTIONS SUBMITTED BY HON. KAY BAILEY HUTCHISON TO HON. DR. MICHAEL D. GRIFFIN

Budget

Question 1. As you know, there are concerns about both the distribution of funds within the current NASA budget request for Fiscal Year 2007, and the fact that the total is dramatically less than the amount authorized. Regarding the outyear funding levels for Fiscal Year 2008 and beyond, are there areas of the budget that you believe should be given particular attention in those outyears?

Answer. The five-year budget plan included in the President's Fiscal Year 2007 budget request for NASA provides the level of funding necessary to meet the priorities of both the President and the Congress. Outyear funding levels are essential to all areas of NASA, and we carefully sought to balance our budget request not just in Fiscal Year 2007 but in the outyears as well. We must maintain that necessary balance by maintaining the proposed funding levels for all of NASA's mission directorates.

Question 2. Are you concerned that the many difficult choices you have had to make within the current funding levels and in the proposed Fiscal Year 2007 funding profile will erode important elements of the scientific and political constituency that is so important to sustain the public commitment to space exploration? If so, what is your message to those constituencies that are expressing their unhappiness with the budget choices?

Answer. With limited resources, NASA made some difficult decisions. Leadership means setting priorities of time, energy, and resources, and NASA has tried to make these decisions with the best available facts and analysis. The plain fact is that NASA simply cannot afford to do everything that our many constituencies would like the Agency to do. We must set priorities, and we must adjust our spending to match those priorities.

NASA needed to reallocate budgeted funds from the Science and Exploration budget projections for Fiscal Year 2007–2011 in order to ensure that enough funds were available to properly support the Space Shuttle and the ISS, while avoiding delays in development of the Crew Exploration Vehicle (CEV) that could increase risk and overall costs and lead to even more delays in pursuing the Nation's vision. Such delays in the CEV are strategically more damaging to our Nation's space program than delays to affected science missions. Furthermore, NASA cannot afford the costs of starting some new science missions at this time. It is important to know that NASA is simply delaying missions, not abandoning them.

NASA will work closely with our stakeholders in Congress and the scientific community to make sure they understand our rationale. Some of our stakeholders will not agree with our position, but it is important for everyone to understand the rationale.

Crew Exploration Vehicle (CEV)

Question 3. The Subcommittee is aware of trade studies and other assessments going on which might alter the requirements and specifications for the Crew Exploration Vehicle, as well as the Crew Launch Vehicle. Can you describe the status of those studies, and their possible impact on the procurement process for the CEV?

Answer. NASA continues to refine our initial system architecture based on the Exploration Systems Architecture Study (ESAS) to provide the highest probability for cost and performance effectiveness. The ESAS was the first in a series of design cycles. We have completed additional design cycles focusing on further trade assessments. At the conclusion of each design cycle, multiple studies are evaluated and result in modifications to our current design. The overall results of these design iterations have been incorporated into the Constellation system requirements and subsequently down into CEV Request for Proposals (RFP) released last January.

NASA has received and is now evaluating these proposals for a selection in September of this year. The two contractors selected under Phase I of this procurement are continuing to refine their design concepts. Contract actions on long-lead hardware for Crew Launch Vehicle (CLV) components, such as the first stage and the upperstage engine (J–2X), are in progress. In addition, we still plan to release an RFP for an upperstage production partner early in CY 2007. We also will continue to iterate on, and refine, the CEV/CLV design; and the final requirements will be baselined at System Requirements Review (SRR), later this summer. The refinement of the design concepts, cost, and schedule estimates will continue through the formulation phase of the projects, and will be baselined in the same timeframe as the Preliminary Design Review (PDR) in the Fall of 2008.

Question 4. Last year, and in subsequent statements, you have indicated that the key ingredient for accelerating development of the CEV, within the architecture you have adopted, is funding. Is that still your view, or are you seeing more technical challenges arise as you move closer to identifying actual design requirements?

Answer. Constellation Systems has identified several challenges, both technical and programmatic, to the successful implementation of the Vision and currently is working mitigation strategies. As the architecture and program proceed through formulation, we expect these mitigation strategies to be developed more fully.

Within the CEV and CLV programs, the primary technical challenge to supporting potential CEV launch dates earlier than 2014, according to our Risk Management Plan, is developing and integrating of the upper-stage engine. The J–2X engine development is well underway, but there are technical challenges in the design, fabrication, and test of the modifications of this engine. These challenges can be overcome with a disciplined and aggressive engine development effort that focuses on rigorous testing. While development of the J–2X is a challenge, the derivative J–2S engine has a long heritage at NASA. The J–2S was scheduled to fly on later Apollo missions before the Moon program was canceled, and the more recent X–33 had been successfully testing an engine based on the J–2S powerpack (turbo machine, gas generator, etc).

Our primary funding challenge is ensuring that we receive the President's Budget request for Constellation. Any reductions in funding could cause substantial schedule delays. Retaining our year-to-year carryover intact in order to ameliorate the non-optimal phasing will be key to our strategy to maximize the probability of program success. We believe that we can reach the milestone of launching the CEV by 2014. We face a schedule challenge in attempting to launch the CEV before 2014.

It is difficult to say which is the greater challenge—technical performance or cost. Each one has a direct correlation with the other. All things considered, the cost profile remains the greater issue for the program. Currently, we are including funding for long lead and critical path items to protect options for a launch before 2014.

Question 5. What is your best estimate today, based on available resources now and those you can expect over the next 5 years, for initial operations of the CEV?

Answer. The requirements that drive the architecture will be baselined at a System Requirements Review, later this summer. Part of the analysis of these requirements will include an assessment as to whether these changes in design will affect the schedule. Until then, we continue to support the first flight of CEV as early as possible, but no later than 2014.

Commercial Orbital Transportation Services (COTS) Demonstration Program

Question 6. The NASA Authorization Act endorses and encourages the private sector involvement in space station crew and cargo support. Among steps being taken to enable that involvement is the Commercial Orbital Transportation Services (COTS) demonstration program. Can you provide the Subcommittee with the status of this program, the basis used for selection of competitors, and the planned level of funding through 2010 for this program?

Answer. NASA appreciates the substantial capabilities that exist in the commercial space sector and the extent to which such capabilities augment NASA's own unique competencies. On January 18, 2006, NASA released the Space Act Announcement for Phase I of the Commercial Crew/Cargo Project. The announcement solicited proposals from industry for Earth-to-orbit spaceflight demonstrations of the following capabilities:

- Capability A: External cargo delivery and disposal,
- Capability B: Internal cargo delivery and disposal,
- Capability C: Internal cargo delivery, and
- Capability D: Crew transportation.

Participants were encouraged to propose a system solution targeting any of the capabilities individually or propose a system that satisfies multiple capabilities. NASA will evaluate the participants' proposal as it relates to their business plan, technical approach, and financial proposal as part of a tradeoff analysis. The purpose of this tradeoff analysis is to select a portfolio of approaches that best meets the objectives of the COTS program. Many companies have expressed interest in the Commercial Crew/Cargo Project, and we are diligently reviewing the proposals in accordance with NASA's evaluation criteria.

In late August, NASA hopes to enter into funded Space Act Agreements with one or more U.S. companies to develop and demonstrate the vehicles, systems, and operations to support transportation for a human space facility like the International Space Station (ISS). The budget for this program totals $520 million through 2010.

The COTS program, along with the Exploration Systems Mission Directorate (ESMD) Centennial Challenges Program, are ways that NASA is encouraging innovation in the private sector to help develop future space capabilities. Such programs, providing capabilities and technologies, will support U.S. competitiveness in the vital arena of space transportation.

Space Shuttle

Question 7. As more time passes between the first and the second Return-to-Flight test flights, there is increasing concern about the ability to meet the flight rate needed to complete the International Space Station before the planned retirement of the Space Shuttle. What is your confidence level that it can be done?

Answer. NASA currently is planning to fly sixteen Shuttle missions to complete the International Space Station prior to 2010, with one additional Hubble Servicing flight. Under this manifest, the flight rate will be 2, 4,5, 5, 1 for the next 5 years, beginning with the STS–121 mission, planned to launch in July 2006. NASA engineers have worked diligently to address the foam liberation issues experienced on STS–114, including removing the Protuberance Air Load (PAL) ramp, and the Agency is confident that this flight rate is achievable in a safe and successful manner. The Program can accommodate some additional delays and still complete ISS assembly prior to the Shuttle retirement in 2010. Should any large-scale delay occur, NASA will confer with the International Partners on a joint course of action.

Question 8. What is the status of plans, if any, to retire the Orbiter *Atlantis,* rather than put it through its scheduled major modifications procedure? When is that process scheduled to begin, how long would it be expected to take, and what are your current plans regarding it?

Answer. Because *Atlantis* is in need of an Orbiter Major Modification (OMM) per Shuttle program requirements after its next five flights, and because that OMM would not be completed in sufficient time to be available for flight before September 30, 2010, NASA will remove *Atlantis* from the fleet in Fiscal Year 2008. At this time, no decision has been made as to the final disposition of *Atlantis* or any of the Space Shuttle orbiters. NASA's primary focus is ensuring that the Space Shuttle safely and successfully completes its mission—completing its role in assembly of the International Space Station (ISS) by the end of Fiscal Year 2010.

Question 9. The mothballing of *Atlantis* would, of course, mean the availability of only two Orbiters for completion of the Shuttle manifest remaining at that time. How confident are you that it will be possible to complete that manifest under those circumstances?

Answer. Currently, NASA is operating with the availability of two Orbiters—*Discovery* and *Atlantis,* while *Endeavor* is in the Orbiter Processing Facility for an OMM. The Agency is confident that manifest is achievable in a safe and successful manner with the use of two orbiters.

Question 10. Your very valid usual answer when asked when the Shuttle will fly again is that "we will fly when we are ready," meaning you do not want to be schedule-driven, but make launch decisions based on all steps necessary being completed. Why not apply the same reasoning to the question of when you will stop flying the space shuttle, and say, "When it has fulfilled its mission."

Answer. The Vision for Space Exploration directed the retirement of the Space Shuttle by the end of Fiscal Year 2010. NASA will complete assembly of the International Space Station by 2010, at which point the Space Shuttle will be retired. The Agency is confident that assembly can be completed in the planned number of missions. NASA has a carefully planned flight manifest that provides for completion of ISS assembly in the sixteen Shuttle missions that will occur prior to Shuttle retirement in 2010. Any delay in Shuttle retirement would delay the introduction of the CEV as resources that would have been directed to exploration would need to be directed back to supporting the Shuttle.

Question 11. The President's Vision directed the retirement of the Space Shuttle in 2010. But, he also said that the next step in the Vision is to complete the International Space Station. Does it make sense to say we will complete the Space Station, and then say we will stop flying the Shuttle in 2010, whether the space station is completed or not?

Answer. The Agency is confident that assembly can be completed in the planned number of missions. NASA has a carefully planned flight manifest that provides for completion of ISS assembly in the sixteen Shuttle missions that will occur prior to Shuttle retirement in 2010. The Shuttle budget also is sufficient to support two contingency logistics Shuttle flights to the ISS in Fiscal Year 2010. If commercial services are not available, these could be flown to pre-position spares if the flights are deemed to be cost-effective and can be safely flown without jeopardizing the Shuttle's 2010 retirement date.

International Space Station

Question 12. The current plan, as reflected in the budget request, is to fly sixteen missions to complete and outfit the International Space Station (ISS). That means that at least two logistics missions have been reduced, and perhaps more. Primarily, those missions were to have been used to fly Orbital Replacement Units (ORU's) to be attached to the Station as spares for major systems too large to be launched on expendable launch vehicles. Is that a correct statement? If so, can you describe what those ORU's are, what is their stage of development and related cost, and what options, if any, are being considered to eventually find a means of taking them to the Space Station?

Answer. ISS spares were designed to be carried aboard the Space Shuttle. Other ISS cargo delivery vehicles are available for providing some spares to ISS; however, the Shuttle is the most capable of the delivery vehicles. Capability to modify the Japanese cargo transfer vehicle and critical spare flight support equipment to accommodate the critical spares is under assessment. The two contingency Shuttle flights are currently carried as placeholders for the delivery of utilization payloads and pre-positioned spares in the event that commercial services that can accommodate the spares are not available at the time of Shuttle retirement and if the flights are deemed to be cost-effective and can be safely flown without jeopardizing the Shuttle's 2010 retirement date. The need for these contingency flights will be continually assessed based on hardware failures and the sparing needs of ISS.

The following represents some of the large spares that have completed development and are ready for launch: external heat rejection system pump module assemblies (PMA) (2 units), fluid hose rotary coupler (FHRC), and nitrogen tank assembly (NTA), the control moment gyroscope (CMG) for non-propulsive attitude control, the special purpose dexterous manipulator (SPDM/"Dextre") spare arm, Mobile Transporter/Trailing Umbilical System Reel Assembly (MT/TUS RA), and linear drive unit (LDU) to support robotic maintenance, a large Space to Ground antenna (SGANT), a high pressure oxygen gas tank, 9 electrical power components including 6 batteries.

Question 13. What is the current status of the launch plans for the modules of our international partners to be delivered to the ISS? Are our partners satisfied with the current plans to meet our obligations to them regarding the ISS?

Answer. The European Columbus Module is scheduled to be launched on the seventh Shuttle mission to the ISS after STS–121 (ULF1.1), and was recently delivered to the Space Station Processing Facility at Kennedy Space Center. The components of the Japanese Experiment Module (JEM) are currently planned to be launched on the eighth, ninth, and twelfth Shuttle missions. The Canadian built Special Purpose Dexterous Manipulator is planned to be launched on the eighth Shuttle mission. The Agency is in close contact with our international partners regarding overall assembly completion and the status of their modules, and they are satisfied with our current plans. The heads of the five partner space agencies met in March 2006 and endorsed this plan. We will continue this close cooperation through the life of the ISS.

Question 14. Besides launching their modules to the ISS, what are our other commitments to our international partners with regard to ISS? (Operations, Research, Crew Time, etc.)

Answer. Under the Memoranda of Understanding (MOUs) between NASA and each of the International Partners, each Partner will receive rights to operate experiments on the ISS and to provide astronauts to serve as Space Station crew. They receive or retain rights to space for their experiments, resources such as power and crew time to conduct their experiments, and rights to purchase a commensurate share of transportation and communications services to support their research. They also have obligations to bear the costs of developing, maintaining and (in the case

of Russia's Multi-purpose Laboratory Module and Research Module) launching the elements and systems they provide and share in the ongoing operations costs of the ISS. NASA has, in addition to its generic partner obligations, special roles reflecting its lead partner status such as overall responsibilities for systems engineering and integration, management and safety and mission assurance. NASA also has specific obligations to provide assembly launches to other partners as detailed in the individual MOUs. One example is the obligation to launch the European and Japanese laboratories.

Question 15. As you know, the Authorization bill we enacted into law requires that 15 percent of the total ISS research budget be allocated to research that is not directly related to the Vision for Exploration. The purpose for that is to keep, as much of the scientific expertise and experiment equipment available for a time when more research opportunities can be made available for those science disciplines, hopefully through the vehicle of the National Laboratory, which the bill also designated the ISS to be. Can you provide the Subcommittee with the status of NASA's response to that requirement?

Answer. The 15 percent research selection pool included all fundamental, non-exploration research in HSRT prior to the ESAS research and technology review. Selection pool topics included but were not limited to animal and plant research, basic fluid physics, combustion research, cellular biotechnology, and cellular research. The primary focus was to maximize ISS research to the greatest extent possible, taking into account resource limitations such as upmass/downmass and crew time. Free Flyer investigations will encourage multidiscipline research and promote international collaboration. Ground-based research will be selected to foster U.S. scientific expertise and research capability in microgravity research. All investigations have been or will be peer-reviewed.

The 15 percent non-exploration allocation includes funding for renewals and extensions of grants in compliance with Congressional direction: Ground research, ISS research, Free Flyer research, and Multiuser User System Support (MUSS). Ground-based research includes fundamental grants ending in FY06, and any ground research supporting ISS flight and Free Flyer experiments.

In the Free Flyer area, ESMD is continuing its collaboration with the Russians through completion of the FOTON M2 data review and future M3 mission. The FOTON M3 mission will include both life and physical science experiments. In addition, ESMD is strongly considering a domestic free flyer for life and physical science experiments, which may include commercial entities. This domestic free flyer activity is currently under formulation.

To advance non-exploration research on ISS, NASA selected several payloads to fly on the STS–121 flight: TROPI plant biology experiment, FIT fruit fly immunology experiment, MICROBE, and POEMS microbiology experiments. In addition, other physical science experiments have been identified, but have not yet been manifested. It is anticipated that these physical science payloads will be manifested once the future Shuttle flight schedule is known.

In addition, the MUSS will support the non-exploration payloads. Responsibilities of the MUSS include developing a manifest, integration of payloads and facility class racks, crew training, planning increment operations, testing payloads prior to flight, payload operations while on-orbit, and return of the payload to Earth.

Interagency Cooperation/Collaboration

Question 16. The Subcommittee has stressed the importance of seeking and establishing new and expanded partnerships and cooperative relationships between NASA and other Federal agencies, such as the National Science Foundation, the Department of Energy, the National Institutes of Health, and the Department of Defense. Can you tell us the status of those efforts? Where do you believe you are likely to have the greatest success in achieving those relationships?

Answer. NASA shares the view that collaboration with other Federal agencies can yield important benefits, and is committed to pursuing cooperation with other Federal agencies wherever it may be mutually beneficial. NASA already has well-established partnerships with a host of Federal agencies, including those highlighted, for a wide variety of activities including technology development, basic and applied research, and operational program support. NASA is continually seeking new opportunities to enhance its interagency relationships through a variety of mechanisms. In the case of the Department of Defense (DOD), the NASA Administrator meets on a regular basis with his DOD counterparts in the Space Partnership Council. This Council was established to explore and assess collaborative opportunities and activities to advance our Nation's civil and national security space objectives. Each of NASA's interagency partnerships helps the Agency to synergize scarce resources,

avoid costly duplication of effort, and achieve in many cases much more than we could independently for the benefit of science, exploration, and our Nation.

International Cooperation

Question 17. The Vision for Space Exploration underscores the importance of maintaining the U.S. commitment to our international partners in the ISS. It also clearly states, as does the NASA Authorization Act of 2005, that international cooperation should be an essential element of our future exploration activities. What steps are being taken now to pursue that cooperation? In what areas of future activity do you believe that is desirable, necessary, and possible?

Answer. As directed by the President, NASA is pursuing opportunities for international participation in the Vision for Space Exploration. In addition to numerous bilateral and multilateral discussions about areas of potential mutual interest for cooperation on the Vision, NASA hosted two international workshops, in November 2004 and March 2005, that included representatives from a number of international space agencies and focused on potential international participation in the Vision. In addition, in late April 2006, NASA hosted 13 international space agencies at a NASA-hosted Exploration Strategy Workshop in Washington. This four-day workshop was the first in a series of activities planned for 2006 focusing on defining a strategy for lunar exploration, including the role of the moon as a stepping stone to Mars and other destinations. A recent example of the tangible results from these discussions is the Memoranda of Understanding signed between NASA and the Indian Space Research Organization on May 9, 2006, for the flight of two NASA-provided instruments aboard India's planned lunar mission *Chandrayaan-1* and ongoing discussions with Russia and Japan regarding cooperation on upcoming lunar missions.

NASA has indicated to its international partners that it has limited interest in international involvement in NASA's ongoing development of a new U.S. capability for assured access to space. NASA has indicated, however, that it is very interested in potential discussions on cooperation in areas such as: habitats, rovers, power and logistics, science and in-situ resource utilization equipment, data sharing and communications, lunar robotic pre-cursor missions, and enhanced ISS re-supply. NASA has also indicated that it is prepared to discuss other areas of interest on a case-by-case basis.

Question 18. From your past work in defense-related activities, you are familiar with the notion of "linkage" in our relations with foreign governments. It seems obvious that many nations will, in part, base their decisions on future cooperation with the U.S. on their experience with regard to past and current commitments. Two current projects in which the U.S. has made international commitments are currently being reviewed and there appears to be some chance that the U.S. may back away from its commitments, which would leave a number of international participants in those projects in a difficult position. These are the SOFIA project, the Stratospheric Observatory for Infrared Astronomy, in which the German Aerospace Center is heavily involved, and the AMS, or Alpha Magnetic Spectrometer, in which 16 other nations are participating. Can you discuss these two projects and the degree to which international commitments should be a factor in decisions regarding their future?

Answer. SOFIA is a cooperative project conducted by NASA and the German Aerospace Center (DLR) to develop an airborne observatory. The AMS program is a Department of Energy-led collaborative initiative composed of a 16-nation international science team for development of the AMS experiment. NASA's role in this program, through DOE, was to provide integration and launch of the AMS experiment to ISS. For both of these projects, and for any effort involving international agreements, commitments to our partners are one of many factors that are considered when NASA makes programmatic decisions. The degree to which these commitments are weighed relative to other considerations, such as cost, schedule, technical, and safety factors, depends upon the specific project and the issues it faces. In the case of SOFIA, the NASA and DLR collaboration is formalized under a Memorandum of Understanding (MOU). NASA, with participation from DLR, recently completed a review of the SOFIA project due to continuing cost overruns and schedule delays. With DLR's participation, NASA has recently established a technically viable plan to proceed with the development of the SOFIA aircraft, subject to the identification of appropriate funding offsets. NASA's participation in the AMS program had been accomplished though an MOU between NASA and DOE that expired in September 2005. Under that MOU, DOE was responsible for all of the international aspects associated with the AMS program's implementation. Although NASA's MOU with DOE has expired, NASA has indicted to DOE that it will continue to explore potential alternatives to launch of the AMS program, subject to an

assessment by the National Academy of Sciences of relative priorities for astronomy and physics missions not yet confirmed for flight.

Question 19. You have been invited to visit China and meet with their space program officials, and have indicated your interest and willingness in doing that. Can you describe what your objectives would be in such a visit? Do you have a sense of where there might be potential for cooperation with China in the Vision for Exploration or in other areas of NASA activity?

Answer. The NASA Administrator has accepted an invitation from the China National Space Administration (CNSA) to visit China. The Administrator is looking forward to the trip to get acquainted with colleagues in China and to better understand Chinese civil space interests and capabilities. Specific areas of interest to NASA include Earth science and lunar exploration, particularly potential sharing of data from robotic missions.

American Competitiveness Initiative (ACI) and Science, Technology, Engineering and Mathematics Excellence (STEM)

Question 20. As you know, NASA has always been in the forefront of this Nation's advancement in technology. The President did not include NASA in the focused effort of the American Competitiveness Initiative, but Dr. Marburger has made it clear that does not reflect in any way a belief that NASA no longer plays an important role in enhancing our Nation's competitiveness. Can you describe ways in which you believe NASA will continue to make contributions to innovation and competitiveness now and in the future?

Answer. Since its inception, NASA has served as a pioneer to the expansion of technological and medical breakthroughs, scientific research, and commercial development of space. NASA expects to remain on the forefront of innovation and competitiveness enhancements as we develop and launch new, innovative missions to the Moon and beyond as part of the Nation's Vision for Space Exploration. This will be primarily accomplished by continuing to engage industry and academia through a myriad of research and educational opportunities.

Through its Innovative Partnerships Program, NASA licenses technologies to U.S. firms for commercial application and quality-of-life benefits. NASA's Innovative Partnerships Program also facilitates dual-use technology development partnering with U.S. industry for the purposes of producing technology for NASA mission use at less cost to NASA. In the process, U.S. partner entities benefit from the joint development of cutting-edge technology having strong likelihood of commercial application. NASA's Innovative Partnerships Program thereby further serves to strengthen U.S. industry's competitive position in international markets.

Also located within NASA's Innovative Partnerships Program are the Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR) program elements, which have the primary purpose of providing the U.S. high technology small business sector with an opportunity to provide innovative technology for NASA's missions. Accordingly, the Innovative Partnerships Program is serving to produce technology that improves U.S. industry's competitive position now and into the future.

Additionally, NASA is a key participant in the Federal High Performance Computing and Communications (HPCC) Program. As a key participant of the Federal Program, the primary purpose of NASA's HPCC Program is to extend U.S. technological leadership in high-performance computing and communications for the benefit of NASA stakeholders: the U.S. aeronautics, Earth and space sciences, and spaceborne research communities. As international competition intensifies and as scientists push back the frontiers of knowledge, leading-edge computational science is more important than ever.

The NASA Program is structured to contribute to broad Federal efforts while addressing agency-specific computational problems called *Grand Challenges.* NASA provides resources to develop tools to solve *Grand Challenges* in four HPCC project areas; the NASA Research and Education Network (NREN) supports the four projects. NASA will also continue the Agency's tradition of investing in the Nation's education programs and supporting the country's educators who play a key role in preparing, inspiring, exciting, encouraging, and nurturing the young minds of today who will manage and lead the Nation's laboratories and research centers of tomorrow.

In 2006 and beyond, NASA will continue to pursue three major education goals, which will continue to make contributions to innovation and competitiveness now and in the future:

- *Strengthen NASA and the Nation's future workforce*—NASA will identify and develop the critical skills and capabilities needed to achieve the Vision for Space

Exploration. 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*—To compete effectively for the minds, imaginations, and career ambitions of America's young people, NASA will focus on engaging and retaining students in STEM education programs to encourage their pursuit of educational disciplines 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.

NASA's Aeronautics Program has recently been restructured with the aim of providing long-term stability and focus on high-quality, innovative research that produces ideas, capabilities, and technologies that are critical enablers for the Nation's long-term technological leadership. Toward this end, the Aeronautics Program has been refocused away from evolutionary research and technology development and toward more revolutionary research that will answer fundamental aeronautics questions that will benefit the broad aeronautics community in academia, industry, and government. The technologies developed by NASA under this strategy will help to secure the U.S. leadership role in global aviation and greatly enhance U.S. competitiveness in the future.

NASA's ESMD also promotes innovation and competitiveness. A major step in spurring the development of a space economy is already underway through the establishment of NASA's Commercial Crew and Cargo program. The objectives of the Commercial Crew and Cargo program are as follows:

- Implement U.S. space exploration policy with an investment to stimulate commercial enterprises in space.
- Facilitate U.S. private industry demonstration of cargo and crew space transportation capabilities with the goal of achieving reliable, cost effective access to low-Earth orbit.
- Create a market environment in which commercial space transportation services are available to government and private sector customers.
- Procure commercial services for NASA cargo and crew transportation needs.

ESMD has established the "Centennial Challenges" program to conduct prize competitions that support the Vision for Space Exploration and ongoing NASA programs. Specifically, the Centennial Challenges program conducts prize competitions that stimulate innovation in basic and applied research, technology development, and prototype demonstration that have the potential for application to the performance of the space and aeronautical activities of NASA. These two ESMD programs, providing capabilities and technologies, will support U.S. competitiveness in the vital arena of space transportation.

Question 21. Can you provide a similar response in the area of enhancing science, technology, engineering, and mathematics excellence in schools and industry?

Answer. NASA shares the concerns of the Nation regarding the quality of math, science, and technology education policy and practices that have led to a reported decline of Americans that are scientifically and technologically trained to enter the NASA and the U.S. aerospace workforce.

As noted previously, NASA will continue the Agency's tradition of investing in the Nation's education programs and supporting the country's educators. To that end NASA education efforts are designed to: improve the understanding and appreciation of science, technology, engineering, and mathematics disciplines, to enhance scientific and technological literacy, mathematical competence, problem-solving skills, and desire to learn; provide educators with unique teaching tools, compelling teaching experiences, and world-class research experiences; inspire students through hands-on activities to pursue careers in science, mathematics, engineering, and technology; and, build a diverse pipeline of science and engineering talent to serve in the coming decades and continue America's pre-eminence in space and aeronautics research and development.

NASA has a number of innovative projects that use science, technology, engineering, and mathematics resources (content, people, and facilities) to inspire the next generation of explorers and innovators through the Vision for Space Exploration.

Among the current Education projects are NASA Educator Astronaut, NASA Explorer Schools, Aerospace Education Services Program, National Space Grant Scholarship & Fellowship, Experimental Program to Stimulate Competitive Research, Graduate Student Research Program, Undergraduate Student Research Program, and Curriculum Improvement Partnership Awards.

NASA's Educator Astronaut project has helped to revolutionize education by providing new content, advanced technological tools, and other educational services such as direct participation in space research and interaction with NASA scientists, engineers, and astronauts. To date, the project has trained the top tier of Educator Astronaut applicants, called the Network of Educator Astronaut Teachers (180), to perform as NASA Education advocates by engaging their schools and communities across the country in NASA education activities and informing them of NASA resources.

NASA's Explorer Schools (NES) project establishes a three-year partnership between NASA and school teams, consisting of teachers and education administrators from diverse communities across the country. Focusing on underserved populations, NES joins educators, students, and families in sustained involvement with NASA's research, discoveries, and missions. The project is designed for education communities at the 4–9 grade levels to help middle schools improve teaching and learning in science, technology, engineering, and math through significant structural techniques such as professional development, stipends, grants, and curricular supports based on NASA's resources. An integral part of the NES is availability of the NASA Digital Learning Network (DLN) that provides NASA people, technology, facilities, programs, and resources to deliver learning opportunities via videoconferences to teachers and students.

The Aerospace Education Services Program serves the elementary and secondary education community by providing classroom demonstrations, faculty workshops, parent training, in-service training for teachers, and identification of appropriate classroom resources. NASA uses former teachers who are well trained and well equipped in STEM content.

The Space Grant, a national network of colleges and universities, works to expand opportunities for Americans to understand and participate in NASA's aeronautics and space programs by supporting and enhancing science and engineering education, research, and public outreach programs.

The Experimental Program to Stimulate Competitive Research develops academic research enterprises that are long term, self-sustaining, and nationally competitive by supporting states with modest research infrastructure to become more competitive in attracting research funding. Funding is awarded to lead academic institutions in twenty different states to foster a STEM relationship with industries for research and development opportunities.

The Graduate Student Researchers Program cultivates research ties to the academic community to help meet the continuing needs of the Nation's aeronautics and space effort by increasing the number of highly trained scientists and engineers in aeronautics and space-related disciplines, and broadens the base of students pursuing advanced degrees in science, mathematics, and engineering. The program awards fellowships for graduate study leading to masters or doctoral degrees in the fields of science, mathematics, and engineering related to NASA research and development.

The Undergraduate Student Researchers Program attracts undergraduate students from the widest array of backgrounds, who are fully representative of America's racial, ethnic, and cultural diversity; and provides them with hands-on, challenging research experiences that stimulate continued student interest in the fields/disciplines aligned with NASA's research and development mission.

The Curriculum Improvement Partnership Award, a three-year undergraduate curriculum improvement program for minority-serving institutions (MSIs), including Historically Black Colleges and Universities, Hispanic Serving Institutions, Tribal Colleges and Universities, and other MSIs, emphasizes improvements that are directly related to the NASA mission by infusing innovative learning experiences in STEM into the curriculum.

Finally, NASA's Office of Education is continually and collaboratively engaged with other Federal agencies, including the Department of Education and the National Science Foundation. Collaboration and coordination takes place in a number of fora. For example, the Assistant Administrator for Education serves as NASA's representative on the Subcommittee on Education and Workforce Development, under the President's National Science and Technology Council (NSTC) Committee on Science. The NASA Deputy Administrator is a member of the Academic Competitiveness Council (ACC) included in the Reconciliation Act of 2006. Chaired by Secretary Spellings, the ACC brings together senior administrators from each of the

Federal agencies that sponsor math and science education programs, including NASA, to evaluate and coordinate these programs.

Question 22. Are there areas where NASA could do even more in each of these areas if more resources were made available for it to do so?

Answer. NASA will continue its strong commitment to promoting innovation, enhancing competitiveness, and inspiring the next generation of explorers and innovators, but must do so within the reality of balancing the many priorities within NASA and across the Federal domestic programs. Application of any additional resources must be considered within the context of our well-aligned programs that are designed to achieve the Vision for Space Exploration and on-going science and aeronautics research activities.

For example, within the education portfolio there is a delicate balance within the pipeline of opportunities for NASA to inspire, engage, educate, and employ our Nation's talented youth. The primary goal remains attracting and maintaining a workforce that is representative of the Nation's diversity and includes competencies that NASA needs to deliver and sustain levels of high performance that the Agency's challenging mission requires. As we implement the Vision we must continually assess the strategy for deploying our resources, be that for attracting students to the teaching profession; providing pre- and in-service teacher training; providing leading-edge research opportunities for faculty and students that compliment NASA's research; developing curricula that infuses innovative learning experiences into the curriculum; or, supporting informal learning across government, industries, and professional organizations.

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