COMMERCE, JUSTICE, SCIENCE, AND RELATED AGENCIES APPROPRIATIONS FOR FISCAL YEAR 2006

THURSDAY, MAY 12, 2005

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

The subcommittee met at 2 p.m., in room SD–192, Dirksen Senate Office Building, Hon. Richard C. Shelby (chairman) presiding.

Present: Senators Shelby, Hutchison, Cochran, and Mikulski.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

STATEMENT OF MICHAEL D. GRIFFIN, ADMINISTRATOR

OPENING STATEMENT OF SENATOR RICHARD C. SHELBY

Senator SHELBY. The subcommittee will come to order.

This hearing of the Senate Commerce, Justice, Science and Related Agencies Subcommittee is the first meeting of the restructured committee. I want to welcome the new NASA Administrator, Dr. Michael Griffin, who is joining us to discuss the President's fiscal year 2006 budget request for the National Aeronautics and Space Administration (NASA).

Dr. Griffin, in assuming your new post as the NASA Administrator, I can only imagine how busy the past few weeks have been for you. Now that you have had some time to reacquaint yourself with NASA's activities, we look forward to discussing your thoughts about how NASA is doing and hearing your insights as to what they could be doing better.

I also anticipate that we will have an ongoing and open dialogue about NASA's progress with return to flight and achieving the President's Vision for Space Exploration. I am very interested in discussing how we can preserve their expertise within the activities and institutions that will be necessary to take this ambitious journey.

More than 1 year ago, the President presented a Vision for Space Exploration that calls for a return to the Moon and eventually a manned mission to another planet. I am excited myself by the opportunities that lie ahead with the exploration vision at NASA.

However, there are fiscal realities that, like it or not, may affect the vision. That is what we deal with on this subcommittee, and I believe it is one of the difficulties that you will face as the NASA Administrator: having to balance NASA's limited resources with its programs and requirements.

I believe that we all appreciate the inherent risk involved with many of the activities NASA undertakes. We also appreciate that with risk comes the potential for failure. Inevitably, failures increase the overall cost of the activity, and one of the problems that I anticipate along the path to the Moon is the potential for failures that could pose a significant challenge to the forward momentum of the program and vision. Of course, we all hope there will not be any failures, but I believe we have to build in the possibility.

We have already experienced such a challenge with NASA's return-to-flight requirements. Specifically, we have seen a strain on science missions and aeronautics as NASA has redirected funds to pay for return-to-flight cost overruns. These fund shifts have caused programs and facility projects to be deferred, created uncertainty regarding the fate of the Hubble telescope and resulted in aeronautic spending being flat.

Dr. Griffin, I believe you have the knowledge, the background, and the ability to guide NASA. But I also believe that you must begin your journey on a firm foundation. Getting back to the Moon will take more than just plans for a rocket. It will also take a sound financial structure and capable management in order to balance all of the important activities that NASA undertakes to make this exploration vision a reality.

I believe there are several looming issues that must be addressed to maintain the forward momentum of NASA's exploration goals. The first, as I alluded to before, is the Shuttle fleet and how that impacts any future crew exploration vehicle—CEV. NASA has been working diligently to complete the necessary changes to the Shuttle that will provide additional safety for our astronauts and the vehicle itself. However, the Shuttle is targeted to be decommissioned by 2010. The next U.S. manned space vehicle, the crew exploration vehicle, is not currently scheduled for a manned flight until 2014. I am concerned by such a gap in U.S. manned space flight and, more importantly, I am concerned that the time schedule for the current 25 or more Shuttle flights prior to the 2010 retirement is quite optimistic. Any deviation in these schedules as they relate to funding could cause this gap to widen even further than is currently anticipated.

I understand that you have your own ideas, Dr. Griffin, as to how the gap between the Shuttle retirement and the CEV could be closed. I am interested in hearing how you believe this is a possibility during a tight funding environment.

The second challenge, the completion of the International Space Station, is directly linked to the first. The construction of the station is dependent on the Shuttle for critical supplies and parts that cannot be delivered by any other vehicle. Our international partners have done an admirable job filling in while the Shuttle is undergoing repair, but there is an expectation that the Shuttle will return as it is essential to complete the Space Station.

The United States has a commitment to our international partners to complete the station. I believe we must maintain that commitment, and I am interested in hearing your thoughts about NASA's plans for completing the International Space Station and, further, how that will impact our ability to work cooperatively with other countries in the future on the vision we have.

Finally, I believe NASA faces a significant challenge in building the technical workforce necessary to carry us into the future. NASA is one of the most publicly recognized agencies within the Federal Government. We all know something about NASA, whether it is the stunning pictures of the universe from the Hubble space telescope photos from Mars, or even the astronauts living on the Space Station. Such high visibility and name recognition can be powerful tools in inspiring and recruiting future scientists and engineers. But I believe the success of NASA programs in science and exploration that students see today is the inspiration necessary to attract the young people of this Nation to these careers in the future.

I know you realize that the missions of tomorrow will not be possible if there are no scientists and engineers being developed today. This is a serious issue that must be addressed in order to ensure that future exploration in space can occur.

I want to thank you again for being here today. It is my hope that this will be the beginning, Dr. Griffin, of a productive relationship between NASA and this newly constituted subcommittee.

Senator Mikulski.

STATEMENT OF SENATOR BARBARA A. MIKULSKI

Senator MIKULSKI. Thank you very much, Mr. Chairman. And today is really the first hearing of the new Commerce, Justice, Science Subcommittee, and I want to say how much I look forward to working with you, Chairman Shelby. Though we are new together in our assignment on this subcommittee, Senator Shelby and I have a very long and collegial history together. We served on the same committee in the House of Representatives, on Energy and Commerce. We were on the Appropriations Committee since our arrival in the Senate, and we have worked closely with Senator Shelby when he has had other committee responsibilities. And I must say, Senator Shelby, I have always found you to be a good friend and a very collegial colleague, and I look forward to that relationship.

Also, in your remarks and the priorities that you have laid out in your opening statement, I want to assure all those are also my priorities and that we can work on a bipartisan basis in the interest of the United States of America and look forward with you since we both have a parallel will to finding the wallet.

I am excited about this new subcommittee, though I was initially disappointed at the dissolution of the VA/HUD Subcommittee. But what we see here, I think you and I have a new opportunity for a true science subcommittee. I recall that our colleague and former astronaut John Glenn said that we should have done this a long time ago, that too much of our science was stovepiped into too many different subcommittees. But here now on this subcommittee we have something quite unique. We are bringing together NASA, the National Oceanic and Atmospheric Administration (NOAA), the National Science Foundation, the National Institutes of Standards, the Patent Office, and the President's Science Advisor. So we would hope that this would be the beginning of kind of a leveraged science policy.

I am excited about this because I believe that science is the key to innovation, and innovation is the key to our future. If we are

going to have a safer country, a stronger economy, we need to be smarter, and that involves really leveraging our research and technology development and a world-class workforce. Our economy and our national security will depend upon it.

I also think that we, because of this subcommittee, both through NASA and the National Oceanic and Atmospheric Administration, could present an incredible opportunity in terms of far-reaching research and far-reaching exploration of the stars, but in a way that we would focus efforts on Earth science that would save lives, save livelihoods, and advance our technological competitive edge.

So today I am looking forward to hearing from Dr. Griffin, our new head at the helm of NASA. I personally want to thank President Bush for appointing an actual rocket scientist to head NASA. But I would also like to take this opportunity to thank someone in the audience, Mr. Chairman—Mr. Fred Gregory, who served as the Acting Director of NASA and provided a very steady hand. And, sir, we would like to thank you and salute you for the job you did during that time, but also in your career at NASA. And I think it points out the wonderful civil service we have at NASA, these wonderful men and women who give their lives to scientific exploration, who work in the Government sphere to advance our national priorities. So we want to say thank you to you personally and to you representing really what an outstanding civil service we have. So thanks again.

We are looking forward, though, to hearing from Mr. Griffin. As the chairman said, we have got to talk about the Shuttle. We have got to make sure the Shuttle flies when it should fly so that it can go to space and return our astronauts safely. At the same time, I too am concerned about the fact that we could be without a crew exploration vehicle for 4 years. We know that the Shuttle is aging technology. We know that it will get us through a difficult time now. But I believe that we owe it to the country, we owe it to our astronauts, that we really look at what is a wide, prudent way to accelerate this crew transportation system.

The United States of America should always have its own access to space. The Space Station, too, we need to be able to finish that, keep our commitment to our international partners, and keep it as a premier research facility.

And, of course, then there is Hubble. Everyone knows my position on Hubble, and I believe it has been the greatest telescope invention since Galileo himself stood on that rooftop in Florence. And as Dr. Griffin knows, I have stood on those rooftops in Baltimore with the Space Telescope Institute and our beloved Hubble.

But Hubble has resulted in enormous scientific breakthroughs. We look forward to the next generation, but we think if we can repair Hubble, give it new batteries and new optics, it will take us far into the future at many different levels.

But, of course, then we look at the NASA budget. I am concerned about the Shuttle cost and our ability to pay for it, the Space Station and our ability to maintain it, that aging infrastructure that Senator Shelby has talked about, and our new vision, the President's vision to go into space. But along the way, I really hope that we do not neglect the other dimension of the NASA responsibility, and that is aeronautics.

Twenty years ago, the United States had over 90 percent of the market share for commercial airlines. Today we have 50 percent of that market, and the National Institute of Aeronautics told us we must really continue to focus on our aeronautics for our national security and our economic security. And, Mr. Chairman, I look forward to working with you, as always, on a balanced program: a reliable space transportation system, always supporting the daring and the outcome of human exploration, but also a special emphasis on science both in terms of understanding our own planet, others out there, and also new breakthroughs in aeronautics that will help our country be safer and stronger.

So, Mr. Chairman, I look forward to working with you, listening to Mr. Griffin, and again, Mr. Gregory, thank you very much.

Senator SHELBY. Senator Hutchison.

STATEMENT OF SENATOR KAY BAILEY HUTCHISON

Senator HUTCHISON. Thank you, Mr. Chairman. And welcome again, Mr. Administrator. I certainly look forward to having you at my subcommittee next week as well to talk about Space Shuttle and beyond.

The proposed budget for NASA is certainly one that reflects difficult choices, but given the overall reductions in discretionary spending, I think it is generous and fair. Undoubtedly, many areas of traditional NASA activity feel the pressure from our new priority: preparing humans for missions back to the Moon and on to Mars. This is a new direction. It is a bold direction and one that I totally support. NASA should be bold, and having the long-term vision is essential for NASA.

Where I have questions and concerns about NASA, they revolve around longer-term impacts to our current investments in human space flight capabilities. As you know, Mr. Administrator, I am concerned about the possibility of a gap between the planned retirement of the Shuttle and the availability of the replacement crew return vehicle. I think a 5-year gap is unacceptable. I think it is not only a risk to the important scientific research that we are doing, but it is a security risk to our country. And I am pleased that you have shared the same concerns, and I know both the chairman and the ranking member here have also expressed those concerns.

I also am concerned about the investment that our Nation and our international partners have made in the International Space Station and wanting to assure that with the budget priorities that we have, we keep the commitments to the International Space Station and finishing the job of building it out.

In addition, of course, I believe that the science is going to be the most important thing that we do with humans in space, and, therefore, we need to have the Space Station totally ready with its build-out and with the scientific emphasis that is so important for the missions to succeed.

So I am looking forward to working with you. I think what you have done in delaying the return to flight is exactly the right thing. Your concern for safety and your jumping right in and going to the bottom, not just the top, to determine that we were ready to go was exactly right. And as my friend and colleague Senator Mikulski

said, we want it to go badly but we want it to go at the right time more. So thank you very much for being here, and I look forward to being able to hear you and then ask questions.

Thank you, Mr. Chairman.

Senator SHELBY. Dr. Griffin, your written statement will be made part of the record in its entirety. Proceed as you wish.

SUMMARY STATEMENT OF ADMINISTRATOR MICHAEL D. GRIFFIN

Mr. GRIFFIN. Thank you, Senators. It is also my pleasure to be here. I thank you for the invitation to appear before your subcommittee and begin the process of communication with you, which I pledge will be thorough and ongoing throughout my tenure.

In the spirit of Senator Mikulski's remarks, I would like also to take a moment and thank Colonel Gregory for his service between Administrator O'Keefe's departure and my arrival. Fred is a personal friend of more than 15 years' standing, a person who has risked his life on behalf of this country in Vietnam, in military test flying, in weather flying, weather research flying, and on the Space Shuttle. His services in linking the tenures of Administrator O'Keefe and myself have been invaluable, and he continues to be invaluable today, and I want to take this opportunity to thank him publicly. So thank you, Fred.

Chairman Shelby, ranking member Mikulski, Senator Hutchison, members of the subcommittee, thank you for this opportunity to discuss the President's fiscal year 2006 budget request for NASA and our strategic direction in carrying out the Nation's civil aeronautics research, space and Earth science, and space exploration activities.

A month ago today, I appeared before the Senate Commerce, Science, and Transportation Committee as the President's nominee to be the NASA Administrator. I want to thank the Senate for your prompt consent to my nomination. It has been a busy month, and the Agency is well underway toward implementing the Vision for Space Exploration.

I have said before and will say again that, as a Nation, we can clearly afford vigorous, well-executed programs in both robotic and human space exploration, Earth science, and aeronautics research. In presenting the vision last year, the President put forth a commitment that our Nation will undertake a journey of space exploration over the next several decades. I am personally committed to carrying out that vision.

Every journey begins with a single step. The first step in that journey is to return—not rush—the Space Shuttle to flight. The next launch window for the first Space Shuttle mission following the *Columbia* tragedy begins in mid-July. Space Shuttle *Discovery* mission STS–114 will be commanded by Eileen Collins. I might add "Colonel" Eileen Collins. Our top priority in my tenure will be to make each successive flight safer for the crew than we believed the last one to have been.

The second step in the vision is to complete the construction of the International Space Station and to retire the Space Shuttle by 2010. After two successful return-to-flight Shuttle test flights, the Agency will complete its assessment of the relative risks of a Space

Shuttle mission to service the Hubble space telescope to increase its capabilities and to extend its operational life.

The next step in the Vision for Space Exploration is to develop the crew exploration vehicle that will be capable of ferrying the next generation of astronauts to the Space Station, the Moon, and Mars. As you may know, I recently kicked off an exploration systems architecture study team to examine ways to accelerate the development of the crew exploration vehicle in order to minimize any gaps in the United States' capability for human space flight. As I think all of you know, I completely share your concern about any gap between the retirement of the Shuttle and initiation of flights of the follow-on vehicle. I hope to share with you by mid-July NASA's plan for how we can accelerate development of the CEV, as well as that of the rocket needed to launch it. I also hope to share with you NASA's plan for the space architecture that will allow us to return to the Moon and eventually head onwards to Mars.

NASA's fiscal year 2006 budget also funds a variety of satellite missions and scientific research in Earth science as well as other planets in our solar system. It funds development of even more advanced space telescopes to follow the Hubble, such as the James Webb space telescope.

NASA's fiscal year 2006 budget for aeronautics research is focused on achieving results, such as reducing noise emissions, improving aircraft safety and security, and improving the capacity and efficiency of the National Airspace System. NASA is working closely with the FAA, the Defense Department, the Department of Homeland Security, and others to achieve those results.

While today's hearing concerns the upcoming fiscal year, I also want to update the subcommittee concerning the difficult choices that must be made in executing NASA's fiscal year 2005 budget and my guiding philosophy in dealing with those challenges.

First, I want to thank this subcommittee and the Congress for providing NASA with the additional flexibility to address our challenges in this year's appropriation bill. It is my pledge to keep you fully informed as to how this Agency spends its allocated resources in accordance with the flexibility you have given us.

In our fiscal year 2005 operating plan, which has been provided to this subcommittee, NASA is fully funding a $762 million cost increase for Space Shuttle Return to Flight consistent with the recommendations of the Columbia Accident Investigation Board, over $400 million in congressionally directed items, $291 million for Hubble servicing options, and over $500 million in programmatic cost increases for various programs, including the Mars Reconnaissance Orbiter, set to launch in August, and the New Horizons mission to Pluto set for launch in early January—and numerous others, I might add, not just those two.

To find offsets needed to fund these items, we have made some difficult choices. NASA cannot afford everything that is on its plate today. We must set clear priorities to remain within the budget NASA has been allocated.

In order to preserve the option of servicing the Hubble space telescope and to provide for a safe deorbit, NASA must defer work on even more advanced astronomy missions planned after the Webb

telescope. These projects, which are phenomenal technical achievements, will be done, but at a slower pace because we cannot afford to do everything at once.

We will also look at deferring some Mars missions in their formative stages, currently in their formative stages, and restructuring Project Prometheus space nuclear power efforts. We must focus on nuclear technology efforts on our highest priorities for near-term needs, and we will examine alternative nuclear systems, including surface nuclear power, nuclear thermal propulsion, and nuclear electric propulsion systems to support human and robotic missions.

Turning to NASA's fiscal year 2006 budget request, I think it is useful to emphasize that the proposal is balanced, allowing us to address national priorities in aeronautics and Earth science, while maintaining our focus on the vision for space exploration introduced in NASA's fiscal year 2005 budget.

Budget highlights include a $5.5 billion request for the Science Mission Directorate. This will support 55 missions in orbit, 26 in development—including the Lunar Reconnaissance Orbiter which will map the Moon's surface in great detail—and 34 projects in the design phase. NASA has a robust science agenda.

Our $3.2 billion request for the Exploration Systems Mission Directorate includes $753 million, a down payment toward the crew exploration vehicle, so that we will have the capability to launch humans into space as soon as possible after the Shuttle's retirement.

One of the ways we may accelerate development of the CEV is by down-selecting to a single contractor in early 2006 as opposed to the previously planned 2008. Likewise, we may also need to defer work in certain exploration-related technologies that are not needed in the early years of implementing the vision for exploration.

The funding request of $6.8 billion for the Space Operations Mission Directorate includes $4.5 billion for the Space Shuttle and $1.9 billion for the International Space Station. NASA is currently examining alternative configurations for the Space Station that meet the needs of the United States and our international partners. We hope to provide the subcommittee our results from this study of the station configuration this summer.

NASA's request for the Aeronautics Research Mission Directorate is $852 million. NASA's technical expertise and its facilities for aeronautics research must continue to become more focused and results-oriented. NASA must set realistic priorities for its aeronautics program within its limited resources. As we move forward, a broader national dialogue on aeronautics R&D goals may be appropriate as we enter the second century of aviation. These discussions must include a range of stakeholders and customers, including the Congress, Department of Defense, commercial civil aviation, and, of course, NASA.

NASA's education initiatives need to establish clear goals, metrics, and monitoring techniques in the coming months to ensure that the funds the Congress provides will achieve the greatest benefit.

I also intend to review how NASA can best harness the unique capabilities of the workforce at its field centers to achieve our Na-

tion's objectives in aeronautics research, space science, and exploration.

To conclude, let me stress my firm belief that as a Nation, we can clearly afford vigorous and well-executed programs in both robotic and human space exploration, Earth science, and aeronautics research.

PREPARED STATEMENT

I plan to work closely with your subcommittee to help achieve these ends.

Thank you once again for the opportunity to appear before you this morning.

[The statement follows:]

PREPARED STATEMENT OF MICHAEL D. GRIFFIN

Mr. Chairman and Members of the Subcommittee, thank you for this opportunity to appear today to discuss NASA's plans for the future as represented in the President's fiscal year 2006 budget request for NASA.

On January 14, 2004, President George W. Bush announced the Vision for Space Exploration. The President's directive gave NASA clear objectives as well as a new and historic focus. The fundamental goal of this directive for the Nation's space exploration program is ". . . to advance U.S. scientific, security, and economic interests through a robust space exploration program." In issuing this directive, the President committed the Nation to a journey of exploring the solar system and beyond, returning humans to the Moon, and sending robots and ultimately humans to Mars and other destinations. He challenged us to establish new and innovative programs to enhance our understanding of the planets, to ask new questions, and to answer questions as old as humankind. NASA embraced this directive and began a long-term transformation to enable us to achieve this goal.

In June 2004, the President's Commission on Implementation of the United States Space Exploration Policy, led by E.C. "Pete" Aldridge, Jr. (the Aldridge Commission), reported its findings and recommendations to the President. The Aldridge Commission emphasized the crucial role that technological innovation, national and international partnerships, and organizational transformation must play if we are to implement the President's vision for an affordable and sustainable space exploration program. NASA is committed to making the necessary transformation to achieve the Vision for Space Exploration.

On December 21, 2004, the President signed a new national policy directive that establishes guidelines and implementation actions for United States space transportation programs and activities to ensure the Nation's continued ability to access and use space for national and homeland security, and civil, scientific, and commercial purposes. NASA will play a significant role in implementing this directive, fostering and enabling the development of space transportation capabilities for human space exploration beyond low-Earth orbit with the Crew Exploration Vehicle (CEV), consistent with the goals of the Vision for Space Exploration.

The President demonstrated his commitment to the Vision for Space Exploration by making it a priority in his fiscal year 2005 budget request, and Congress responded positively by providing funding for NASA at the level requested by the President. The President has reaffirmed his commitment to the Vision by again making it a priority in his fiscal year 2006 budget request in a very challenging budget environment. The $16.46 billion requested for NASA reflects an increase of 2.4 percent over fiscal year 2005.

While today's hearing concerns the President's fiscal year 2006 budget request for NASA, I must also use this opportunity to update the Committee regarding the difficult choices that need to be made in executing NASA's fiscal year 2005 budget, and my guiding philosophy in dealing with these challenges.

First, and most importantly, I want to thank this Committee and the Congress for providing NASA additional flexibility in the fiscal year 2005 appropriations bill to address the challenges facing the Agency. It is my pledge to keep you fully informed of how this Agency spends the funds you have provided us. A detailed fiscal year 2005 Operating Plan update was recently provided to all of the Committees in Congress which oversee NASA.

With this fiscal year 2005 Operating Plan update, NASA is fully funding—within our fiscal year 2005 budget—the $762 million increase for returning the Space Shut-

tle safely to flight, consistent with the recommendations from the Columbia Accident Investigation Board (CAIB), over $400 million in Congressionally-directed items, $291 million for Hubble servicing, and over $500 million in necessary programmatic cost increases, notably to cover cost growth in several space science missions, including the Mars Reconnaissance Orbiter, scheduled to be launched this August, and the New Horizons mission to Pluto set to launch in early January 2006.

Identifying offsets needed to fund these items has created some difficult choices for the Agency. Given a choice, I generally favor eliminating lower-priority programs rather than reducing all programs in the face of budget difficulties, because this allows for the more efficient execution of the programs which remain. Thus, we must set clear priorities to remain within the budget which has been allocated.

Allow me to be as clear as possible on what the impact of these costs means to other programs. The Agency has adopted a "go-as-you-can-pay" approach toward space exploration. Several NASA missions and activities will need to be deferred or accomplished in other ways in order to ensure adequate funding for the priorities of the President and the Congress in fiscal year 2005. NASA cannot do everything that we, and our many stakeholders, would like to accomplish. Several missions will have to be delayed, deferred, or cancelled in order to pay for the missions where the priorities were set by the President and Congress. We have tried to be sensitive to the priorities of the affected research communities, and have listened carefully to their input. For example, we seek to balance among planetary science, Earth science, solar physics, and astronomy within the overall science program by revisiting our Mars exploration program strategy and mission sequence. Deferring the Mars Science Lab to 2011 is an option in this reassessment.

In order to service the Hubble Space Telescope and provide for a safe deorbit, NASA will need to defer work on even more advanced space telescopes like the Space Interferometry Mission (SIM) and Terrestrial Planet Finder (TPF). The extent of this deferral and an appropriate follow-on strategy for the Origins program is currently under review. Space nuclear power and propulsion are absolutely essential for future space exploration. However, we must focus our nuclear technology efforts on our highest priorities for near-term needs. NASA will examine alternative nuclear systems—including surface nuclear power, nuclear thermal, and nuclear electric systems—to support human and robotic missions. As a result, we are able to restructure Prometheus Nuclear Systems and Technology, which, in the near-term, helps pay for fiscal year 2005 unrequested Congressional items and Agency priorities.

As we complete future planning activities later this summer, we will need to further examine resources to accelerate the CEV. Likewise, NASA's research and technology efforts to support human space exploration missions farther out into the future will need to be curtailed, to focus on near-term needs of developing the CEV to be available as soon as possible.

As someone who has managed many space and advanced technology programs, I believe that NASA's one-of-a-kind spacecraft missions must combine technical requirements and budget authority under clear lines of management authority and accountability. When I arrived at NASA a month ago, I found some programs (namely, the Hubble servicing mission, Robotic Lunar Exploration, and ISS crew/cargo) with overlapping responsibilities among Mission Directorates. We are simplifying the management chain-of-command and, in the May update to the fiscal year 2005 Operating Plan, are transferring management responsibilities to the appropriate line managers.

Likewise, when I arrived at NASA, the role of the CEV in supporting the International Space Station (ISS) was not clear. While the recently established Exploration Systems Architecture Study team will carefully define the CEV's requirements, I have specifically directed that the CEV will visit the ISS. As I testified during my confirmation hearing, I believe that the CEV development must be accelerated in order to minimize the gap between the Space Shuttle retirement and the first operational flight of the CEV. To that end, NASA's Exploration Systems Mission Directorate (ESMD) will be responsible for developing and acquiring crew and cargo capabilities to support the ISS, and funds have been transferred to that Directorate in the May update to NASA's fiscal year 2005 Operating Plan.

NASA PRIORITIES

Over the past year, NASA has made great strides in implementing the Vision for Space Exploration and meeting other national priorities:

—*Shuttle Return to Flight.*—We are making final preparations for the Space Shuttle return-to-flight planned for mid-July.

—*International Space Station*.—The ISS began its fifth year of continuous human presence on-orbit.

—*Exploring our Solar System and the Universe*.—The Mars rovers, Spirit and Opportunity, have exceeded all expectations and made unprecedented discoveries; the Cassini/Huygens mission is providing stunning views of Saturn and Titan; the Genesis mission, despite its hard landing, has returned primordial samples from space; new missions have been launched to Mercury and to comets; and amazing discoveries continue with Hubble, Chandra, and Spitzer.

—*Laying the Groundwork for the Future*.—We awarded initial contracts in preparation for a major milestone in 2008 with the mapping of the Moon in unprecedented detail by the Lunar Reconnaissance Orbiter (LRO).

—*Engaging the Public*.—We engaged the public and enhanced national excitement for space exploration thanks to the President's announcement of the Vision for Space Exploration. Indeed, in a Gallup poll, seven out of ten Americans supported the objectives of this Vision.

—*Aeronautics*.—We are continuing to execute a portfolio of focused, results-oriented technology demonstrations of next-generation aircraft along with aviation safety, security, and airspace systems. NASA, with its industry partners, recently demonstrated the feasibility of significantly reducing the sonic boom from supersonic aircraft, and, last November, NASA's hypersonic X–43A demonstrated that an air-breathing engine can fly at nearly 10 times the speed of sound.

—*Earth Science*.—We have completed deployment of the Earth Observing System and are supporting investments in the Global Change Science and Technology Program and the next generation Earth observing satellites for numerous applications, including improved weather forecasts, earthquake prediction, resource management, and other hazard warnings.

—*Education*.—We are continuing to educate the public and inspire the next generation of explorers.

AFFORDABILITY AND SUSTAINABILITY

In his February 2nd State of the Union Address, the President underscored the need to restrain spending in order to sustain our economic prosperity. As part of this restraint, it is important that total discretionary and non-security spending be held to levels proposed in the fiscal year 2006 Budget. The budget savings and reforms in the Budget are important components of achieving the President's goal of cutting the budget deficit in half by 2009, and we urge the Congress to support these reforms. The fiscal year 2006 Budget includes more than 150 reductions, reforms, and terminations in non-defense discretionary programs, of which 3 affect NASA programs. The Agency wants to work with the Congress to achieve these savings.

To achieve the Vision for Space Exploration, NASA is proceeding, as directed by the President, to plan and implement a sustainable and affordable, integrated robotic and human exploration program, structured with measurable milestones, and executed on the basis of available resources, accumulated experience, and technology readiness. Last year, we provided a long-range roadmap through 2020 to outline this program:

—The Space Shuttle will be retired by 2010. Prior to its retirement, it will be utilized primarily for the assembly of the ISS. Our top priority will be to make each flight safer than the last one.

—The crew transportation capability provided by the Shuttle will be replaced by the new CEV and its associated launch system. The CEV will be developed in the latter part of this decade and deployed operationally as soon as possible after Shuttle retirement. The CEV will conduct missions in Earth orbit, including missions to the ISS, but its primary mission will be to support exploration of the Moon and other destinations.

—A balanced program of robotic missions will continue to increase our understanding of our home planet and will continue the exploration of the solar system, traveling to the Moon and Mars in anticipation of later human visits, as well as to other destinations such as Mercury, Saturn, Pluto, asteroids, and comets. Observatories will be deployed to search for Earth-like planets and habitable environments around distant stars, and to explore the universe to understand its origin, structure, evolution, and destiny. Funding for these areas would significantly increase over the coming years, with Science investments growing from 33 percent to 38 percent of the Agency's total budget.

—Human explorers will return to the Moon, possibly as early as 2015—with the CEV as the first core element of a new exploration architecture. Major develop-

ment of the other elements in the exploration architecture will commence later this decade and will accelerate upon the retirement of the Space Shuttle. These exploration elements will include launch vehicles, in-space transfer systems, lunar landers, and surface habitation systems. Critical research and technology investment decisions will be guided by the development requirements of these elements.

These human and robotic explorers will enable our exploration and scientific plans. A recent report released on February 3, 2005, by the National Research Council, entitled Science in NASA's Vision for Space Exploration, states, "Exploration done properly is a form of science. Both robotic spacecraft and human spaceflight should be used to fulfill scientific roles in NASA's mission to explore." To that end, NASA has initiated an Exploration Systems Architecture Study, to be completed in mid-July, which will provide the analytical support for a number of key near-term decisions for NASA, the White House, and Congress. We will keep Congressional Committees informed as this study effort progresses.

This study effort has four products:

—Complete assessment of the top-level CEV requirements and plans to enable the CEV to provide crew transport to the ISS and to accelerate the development of the CEV and crew launch system to reduce the gap between Shuttle retirement and initial CEV flights to the ISS.

—Definition of top-level requirements and configurations for crew and cargo launch systems to support the Lunar and Mars exploration programs.

—Development of a reference Lunar exploration architecture concept to support sustained human and robotic Lunar exploration operations.

—Identification of key technologies required to enable and significantly enhance these reference exploration systems, and a re-prioritization of near-term and far-term technology investments.

NASA is also currently examining alternative configurations for the Space Station that meet the goals of the Vision and the needs of our international partners, while requiring as few Shuttle flights as possible to complete assembly.

NASA PRIORITIES IN THE FISCAL YEAR 2006 BUDGET REQUEST

The President's fiscal year 2006 budget request for NASA reaffirms the funding strategy outlined above. NASA's fiscal year 2006 request endeavors to provide a balanced portfolio of programs to meet the needs of our national priorities in aeronautics and civil space. It maintains focus on key priorities, milestones, and schedules for the Vision introduced in the fiscal year 2005 budget.

To support the Administration's goal of reducing the deficit, NASA's budget was reduced $0.5 billion in fiscal year 2006 below the level planned in the 2005 budget for fiscal year 2006. In addition, returning the Shuttle safely to flight will cost $0.4 billion more in fiscal year 2006 than previously estimated. To address these and other items, we proposed a budget that provided $0.4 billion (11 percent) less for Exploration Systems than previously planned for, $0.3 billion (5 percent) less in Science, $0.1 billion (11 percent) less in Aeronautics, and $0.2 billion (4 percent) more in Space Operations. These changes were not easy, but in the end, we made the decisions to protect the priorities outlined above.

SCIENCE

The fiscal year 2006 budget request of $5.5 billion for the Science Mission Directorate will support 55 missions in orbit, 26 in development, and 34 in design phase. By 2010, the Science budget will increase by 23 percent over current levels.

The fiscal year 2006 budget includes $858 million for Mars and Lunar robotic exploration. The Mars rovers, Spirit and Opportunity, have far exceeded all goals with their unprecedented discoveries and longevity. Last year, the rovers found definitive evidence of an ancient body of water on the Red Planet, and they continue to gather data more than a year after their successful landing. We recently awarded contracts for six instruments to be flown on the 2008 LRO that promises unprecedented mapping of the Moon's surface. The 2008 LRO will be the first step in revolutionizing our understanding of the Moon, in much the same way that our Mars missions have transformed our understanding of Mars. As mentioned earlier, to simplify the management chain-of-command among mission directorates, our fiscal year 2005 Operating Plan update transfers management responsibility for the Lunar Exploration program, including LRO, to the ESMD. This will help to maximize the exploration and science benefits of this important program.

The budget also includes $218 million to maintain competitive efforts for the Explorer Program, $56 million for the Beyond Einstein program to study the universe, $234 million for studying the Sun in the Living With a Star program, and $136 mil-

lion for competitive opportunities in the Earth System Science Pathfinder program. With our international partners, we also continue to add to the constellation of Earth-observing satellites that monitor our planet while extending our reach and presence further into the solar system. NASA launched Aura to look back at Earth and give us a better picture of our atmosphere and changing climate, and the entire Earth Observing System continues to return trillions of bytes of information about our dynamic Earth. In the future, NASA plans to develop a "sensor-web" to provide timely, on-demand data and analysis to users who can enable practical benefits for scientific research, national policymaking, economic growth, natural hazard mitigation, and the exploration of other planets in this solar system and beyond.

NASA will continue to expand its exploration reach with an armada of existing and new space observatories operating in many different wavelengths and looking at different parts of our exotic universe. The three "Great Observatories"—Hubble, Spitzer, and Chandra—will continue to bring wondrous images to our eyes and exciting new scientific discoveries. Missions such as Kepler will provide a new understanding and knowledge of the planets orbiting stars far from our solar system, perhaps identifying new targets for voyages of exploration by future generations of explorers.

This budget also includes $372 million to continue developing the James Webb Space Telescope for a 2011 launch and provides $93 million in development funds for the Hubble Space Telescope to extend its scientific productivity. This investment in the Hubble, together with the synergistic use of the other two Great Observatories, and combined with the greatly increased capability of ground-based assets and the emergent science of optical interferometry, will ensure many years of new scientific discoveries.

NASA's decision in January 2004 not to service the Hubble was a very difficult one, given the Hubble's record of spectacular successes. That decision was made at a time when significant uncertainty remained regarding the technical solutions and risks associated with return to flight. After the two successful Space Shuttle flights needed to achieve our return to flight objectives, NASA will have learned a great deal more regarding the risks and operations of the vehicle than was known when the previous decision was made. I am committed to reassessing this earlier decision after return to flight, based on the relative risks to the Space Shuttle as well as the costs and benefits to our Nation's astronomy program. As a result, we are continuing our efforts to preserve the option for a Shuttle servicing mission for Hubble. Consistent with this ongoing activity, NASA's fiscal year 2005 Operating Plan update has fully funded the $291 million identified in the Conference Report accompanying the fiscal year 2005 Consolidated Appropriations bill and has consolidated the funding and management responsibility within the Science Mission Directorate. NASA will use the balance of the fiscal year 2005 funds to maintain options for HST servicing and deorbit. NASA has also begun the analysis of how a de-orbit module for the Hubble Space Telescope could be added to the manifest of such a Space Shuttle servicing mission. I will make a decision regarding a Shuttle servicing mission for Hubble following the two successful Return to Flight missions. In the interim, the Agency will keep all stakeholders apprised as this work progresses. NASA remains committed to a world-class, affordable program of space-based astronomy.

PREPARING FOR EXPLORATION

The fiscal year 2006 budget request of $3.2 billion for the ESMD includes $753 million for continuing development of the CEV, the vehicle that will serve as the core element for future exploration beyond Earth orbit. The CEV promises safer travel for astronauts into space, continuing U.S. human access to space as soon as possible after retirement of the Shuttle.

Our earlier plans called for operational deployment of the CEV not later than 2014. However, given the role of the CEV as a replacement for the Shuttle in providing human access to space, we are now seeking programmatic alternatives to allow development of the CEV to be completed as soon as possible. Acceleration of the CEV program will be accomplished by down-selecting to a single contractor sooner than originally planned, and by deferring other elements of the Exploration Systems Research and Technology plan not required for the CEV or for the early phases of human return to the Moon.

The fiscal year 2006 budget request includes $919 million (a 27 percent increase) for Exploration Systems Research and Technology that will enable designs for sustainable exploration, including $34 million for a revamped technology transfer program and $34 million for the Centennial Challenges prize program. The Agency continues to seek the support of the Congress for authorization to enable larger prize

awards. This budget also includes $320 million for a restructured Prometheus Nuclear Systems and Technology Theme for space-qualified nuclear systems. The technology and capabilities being developed by the Prometheus Nuclear Systems and Technology Theme are critical for enabling the power and propulsion needs of the Vision for Space Exploration. As part of the Agency's effort to define an Exploration Systems Architecture, NASA will examine alternative nuclear systems, including surface nuclear power, nuclear thermal, and nuclear electric systems. NASA will restructure Project Prometheus for space-qualified nuclear systems to support human and robotic missions with clear priorities focused on near-term needs. We expect to make program decisions to focus our nuclear technology efforts on our highest priorities for near-term applications as part of the Exploration Architecture study, to be completed this summer. In addition, the fiscal year 2006 budget request provides $806 million for Human Systems Research and Technology, which has been restructured so its programs are now linked directly to exploration requirements for human missions to the Moon, Mars, and beyond.

AERONAUTICS RESEARCH

NASA's fiscal year 2006 request for the Aeronautics Research Mission Directorate is $852 million, a significant portion of the government's overall investment in aeronautics research. To make the most of this investment, NASA's technical expertise and facilities for aeronautics research are becoming more focused and results-oriented. NASA's current aeronautics research is focused on enhancing the public good. NASA is also working to maintain a strong basic aeronautics research program and to establish a series of far-reaching objectives, each of which, if enabled, could significantly transform civil aeronautics. The results from the basic research, technology development, and demonstrations achieved by NASA's Aeronautics efforts will be transitioned for use by both Government and industry. The President's fiscal year 2006 request increased the vital research of the Aeronautics program in Aviation Safety and Security and in Airspace Systems. These two priority programs are fully funded to ensure timely results critical to meeting national goals. NASA works closely and constructively with other Executive Branch agencies to enhance our Nation's aeronautics capability. In this vein, NASA, along with the Departments of Defense, Homeland Security, Commerce, and Transportation, is a principal member of the interagency Joint Planning and Development Office (JPDO), which was chartered by the Century of Aviation Revitalization Act to oversee research and technology efforts for the Next Generation Air Transportation System. NASA is working closely with industry consortia and other Government agencies to develop advanced aircraft demonstrations, such as those that would expand the capabilities of high-altitude, long-endurance, unmanned aerial vehicles, which could have numerous commercial, scientific, and homeland security applications.

At this time, NASA is also working with other U.S. Government departments and agencies and industry to assess its facilities for aeronautics research. NASA will need to consider the possibility of closing some underutilized aeronautics facilities, while modernizing some others to become state-of-the-art facilities.

As we move forward, a broader national dialog on aeronautics R&D goals may be appropriate as we enter the second century of aviation. These discussions should include a range of stakeholders and customers, including the Congress. This process could lead to a national consensus for aeronautics R&D goals.

EDUCATION

NASA's fiscal year 2006 budget request includes $167 million for the Office of Education to support programs that will keep the United States strong in science, technology, engineering, and math education. NASA will establish clear goals, metrics, and monitoring capabilities for its education initiatives in the coming months to ensure that these funds will achieve the greatest benefit.

MEETING OUR OBLIGATIONS

The fiscal year 2006 budget request of $6.8 billion for the Space Operations Mission Directorate (SOMD) reflects the first step in the Vision for Space Exploration: returning the Space Shuttle safely to flight and resuming flight operations. Going forward, all SOMD expenditures will be consistent with the retirement of the Space Shuttle by 2010, while maintaining operational safety of flight throughout the program. The fiscal year 2006 budget includes $4.5 billion for the Space Shuttle program. The budget also provides $1.9 billion for the ISS. NASA currently is examining configurations for the Space Station that meet the goals of the Vision for Space Exploration and needs of our international partners, while requiring as few Shuttle flights as possible to complete assembly.

A key element in the future of the ISS program is the purchase of alternate cargo transportation services to supplement the Space Shuttle, and the development of new crew transportation capabilities to replace Shuttle when it retires. Because the ESMD has the mission to develop and acquire such crew and cargo capabilities for the ISS and beyond, I have transferred management responsibility for the activities and budget of ISS Cargo/Crew Services to ESMD from SOMD, as stated in the May update to NASA's fiscal year 2005 Operating Plan. The budget request before the Congress provides $160 million for these services in 2006.

We are making final preparations to return the Space Shuttle safely to flight in 2005. We have made more than 100 major maintenance modifications and upgrades to Discovery and its supporting systems, including new cabling and wiring that will support leading edge sensors, a digital camera, and a boom extension for the Shuttle's robotic arm that will enable us to inspect nearly all the outside areas of the orbiter's Thermal Protection System during missions. Technicians have installed the Forward Reaction Control System and the Reinforced Carbon-Carbon Nose Cap, and 88 sensors are being installed on each wing, of which 66 will measure acceleration and impact data, and 22 will take temperature data during Discovery's journey. Discovery and its propulsion elements are now at the launch pad undergoing the final tests and checks required prior to launch, currently scheduled to occur not earlier than July 13, 2005.

As the United States implements the Vision for Space Exploration, the Administration recognizes the value of effective cooperation with Russia to further our mutual space exploration goals. At the same time, we must appropriately reflect U.S. nonproliferation policy and objectives in our relationship with Russia. The Administration is thus seeking a balanced approach that continues to maintain strongly our nonproliferation goals while advancing potential U.S. cooperation with Russia on the Vision for Space Exploration. Such a balanced approach must include the Iran Nonproliferation Act of 2000 (INA), which currently constrains cooperation with Russia on the ISS, and threatens to have an adverse impact on cooperation with Russia in our future space exploration efforts related to human space flight. To that end, the Administration will soon engage the Congress, and we look forward to working with Congress to ensure that the Vision for Space Exploration is successful, while remaining fully consistent with broader U.S. national security and nonproliferation goals.

This year, we began our fifth year of continuous astronaut presence on the ISS. Astronauts continue their international cooperation onboard the Station through a variety of joint research activities.

TRANSFORMING NASA

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 Space Station. In its final report, the CAIB was very forthright in its judgment that these goals are too limited to justify the expense, difficulty, and danger inherent in human 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 proposed by the President is that program, and NASA has embraced this new direction. 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 these 21st Century goals. 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 by continuing to assess our leadership practices.

—*Embracing Competition*.—NASA is embracing competition as a way to elicit the best from NASA's Centers, industry, and academia. The Agency is using competitive processes to encourage more cost-effective, innovative solutions to the scientific and technical challenges presented by the Vision. Over the past year, competitive selections in exploration have demonstrated increased collaboration between NASA's Centers and industry and academia. The engine of competition is the primary force behind the American economy, the greatest the world has ever known, and we plan to make greater use of this engine than has been the case at NASA in the past. NASA plans to pursue appropriate partnerships with

the entrepreneurial and commercial space sector to the maximum practical extent.

—*The Role of the Centers*.—While competitive processes are crucial to maintaining NASA at the "cutting edge" of science and technology, we must acknowledge that the NASA Centers and other Federal research and development laboratories exist, and have existed for decades, precisely because industrial competition does not serve to accomplish all of our national goals. In order to accomplish the national goals set forth by the President and Congress, NASA must set realistic priorities within limited resources. NASA Centers will have an important role in definition of the architecture and requirements for exploration beyond low-Earth orbit, and for the systems engineering and integration functions used in building the systems of that architecture. We will continue to assess the skill-mix that we require, the number of people we require, their location, and how we are organizing ourselves to fulfill our obligations to the President and Congress. To begin to create some of the workforce flexibility necessary for the future, NASA has offered voluntary separation incentives (buyouts) to employees in positions identified with excess competencies. To the extent that NASA's workforce needs revitalization, NASA will propose legislative initiatives to the Congress as part of the Agency's draft fiscal year 2006 Authorization Bill. Congress's enactment of the NASA Workforce Flexibility Act of 2004 is helping the Agency toward that end, and additional authorities will provide even more aid in managing the Agency's workforce.

—*Improved Decision-Making*.—NASA recently transformed its organizational reporting in order to provide more integrated decision-making. NASA field Center Directors now report directly to the Administrator, and I am drafting a position description for a new Associate Administrator who will manage the internal activities of the Agency. The Office of Education reports directly to the Director of Strategic Communications, who is also in charge of Public Affairs, External Relations, and Legislative Affairs, in order to provide a more integrated picture of what NASA is doing and can do for its stakeholders and public. NASA's new Office of Program Analysis & Evaluation has been created in order to provide analyses and assessments for strategic planning and budgeting decisions, independent cost estimates, evaluation of projects at major milestones, and feedback from the Centers on their capabilities and work climate. This is to ensure that the acquisition strategies, if done as planned, are executable, have exit and entrance criteria, contain clear approval milestones, and involve independent reviews.

—*Improving Financial Management*.—For the past two years, NASA has received a disclaimer of audit opinion on its annual financial statements due largely to two issues—financial system conversion, and accounting for property, plant and equipment, and materials and supplies. In fiscal year 2003, NASA converted the 10 separate NASA Center accounting systems and the associated 120 subsidiary systems, along with over 12 years of historical financial data, into a single integrated Agency-wide core accounting system. Problems associated with this conversion have been greater than expected and are taking longer than expected to correct. I regard improvement of NASA's financial management as one of my priorities.

—*Capital Asset Management*.—The management of NASA's capital assets, valued at $37.6 billion (83 percent of NASA's assets on the balance sheet), lacks the necessary internal controls and systems to support the proper valuation for management analysis as well as for audit purposes. Therefore, NASA is developing a comprehensive plan that will reform the manner in which we are accounting for and managing our assets.

THE NATION'S FUTURE IN EXPLORATION AND DISCOVERY

The aftermath of the tragic loss of the Space Shuttle Columbia on February 1, 2003, brought us to a watershed moment in the American civil space program. Choices had to be made. The President has put forth a choice, a strategic vision for the space program. That vision has been enunciated with exceptional clarity, and has been subjected to considerable public debate for over a year. While differences of opinion exist, the President's proposal has attained broad strategic acceptance. As a Nation, we can clearly afford well-executed vigorous programs in robotic and human space exploration, Earth science, and aeronautics research.

For America to continue to be preeminent among nations, it is necessary for us to be the preeminent spacefaring nation. It is equally true that great nations need allies and partners in this journey. That is what the Vision for Space Exploration is about.

As President George W. Bush said, "We choose to explore space because doing so improves our lives and lifts our national spirit. So let us continue the journey."

[Budget authority, dollars in millions]

By Appropriation Account, By Mission Directorate, By Theme	Full Cost							
	Initial Operating Plan Fiscal Year 2005	April Operating Plan Fiscal Year 2005	May Operating Plan Fiscal Year 2005	Fiscal Year 2006	Fiscal Year 2007	Fiscal Year 2008	Fiscal Year 2009	Fiscal Year 2010
Science, Aeronautics, and Exploration	$9,334.7	$9,335.0	$9,051.0	$9,661.0	$10,549.8	$11,214.6	$12,209.6	$12,796.1
Science [1]	5,527.2	5,527.0	5,554.0	5,476.3	5,960.3	6,503.4	6,853.0	6,797.6
Solar System Exploration	1,858.1	1,858.0	1,787.0	1,900.5	2,347.7	2,831.8	2,998.9	3,066.1
The Universe	1,513.2	1,513.0	1,475.0	1,512.2	1,531.5	1,539.4	1,495.0	1,406.7
Earth-Sun System	2,155.8	2,156.0	2,291.0	2,063.6	2,081.2	2,132.2	2,359.0	2,324.8
Exploration Systems [2]	2,684.5	2,684.5	2,356.0	3,165.4	3,707.0	3,825.9	4,473.7	5,125.5
Constellation Systems	526.0	526.0	422.0	1,120.1	1,579.5	1,523.7	1,990.9	2,452.2
Exploration Systems Research and Technology	722.8	722.8	766.0	919.2	907.3	989.2	1,050.3	1,078.5
Prometheus Nuclear Systems and Technology	431.7	431.7	270.3	319.6	423.5	500.6	614.0	779.0
Human Systems Research and Technology	1,003.9	1,003.9	897.7	806.5	796.7	812.4	818.5	815.8
Aeronautics Research: Aeronautics Technology	906.2	906.0	962.0	852.3	727.6	730.7	727.5	717.6
Education Programs: Education Programs	216.7	217.0	179.0	166.9	154.9	154.7	155.4	155.4
Exploration Capabilities	6,704.4	6,830.0	7,114.0	6,763.0	6,378.6	6,056.7	5,367.1	5,193.8
Space Operations	6,704.4	6,830.0	7,114.0	6,763.0	6,378.6	6,056.7	5,367.1	5,193.8
International Space Station	1,676.3	1,676.0	1,676.0	1,856.7	1,835.3	1,790.9	2,152.3	2,375.5
Space Shuttle	4,543.0	4,669.0	4,964.0	4,530.6	4,172.4	3,865.7	2,815.1	2,419.2
Space and Flight Support	485.1	485.0	474.0	375.6	370.9	400.0	399.7	399.1
Inspector General	31.3	31.0	31.0	32.4	33.5	34.6	35.2	37.3
TOTAL	16,070.4	16,196.0	16,196.0	16,456.3	16,962.0	17,305.9	17,611.9	18,027.1
Year to year increase	.....	.....	.....	2.4	3.1	2.0	1.8	2.4
Emergency Hurricane Supplemental	126.0	.....	.....	.....	.....	.....	.....	.....

[1] Science Mission Directorate reflects the combination of the former Space Science and Earth Science Enterprises.
[2] Beginning in fiscal year 2006, Exploration Systems moves from Exploration Capabilities to Science, Aeronautics and Exploration. Exploration Systems Mission Directorate reflects the combination of the former Biological & Physical Research and Exploration Systems Enterprises.

Totals may not add due to rounding.

SPACE SHUTTLE RETIREMENT

Senator SHELBY. Thank you, Dr. Griffin.

The proposed budget for NASA has the Space Shuttle scheduled for retirement in 2010. We have been talking about that. And the next man-rated vehicle, the crew exploration vehicle, CEV, is expected to be ready by 2014. The critical funding for the CEV, I understand, is dependent on the retirement of the Shuttle. It has been widely reported, Dr. Griffin, that you are an advocate of closing this 4-year gap—I mentioned it in my opening statement—in the U.S. launched manned space flight.

Whenever I hear about the acceleration of such programs, concerns arise, being an appropriator, about cost increases and development setbacks. So how much do you anticipate accelerating the CEV will increase the near-term costs of this vehicle? And where will these funds come from?

Mr. GRIFFIN. Sir, the widely circulated reports of my dissatisfaction with the gap in manned space flight have the virtue of being true.

Senator SHELBY. I am glad. Thank you.

Mr. GRIFFIN. I am dissatisfied with those, and we will be working to close that gap.

I will say at the outset that I cannot say, at this moment, what the near-term cost increases will be because that study effort is ongoing as we speak. When I have some knowledge of that, it will be communicated to this subcommittee and to the Congress. But let me outline the broad plan for things we might do to accomplish that.

First of all, I might add also, I believe it is true, when one stretches a project out beyond its appropriate and natural lifetime, that also causes cost increases.

Senator SHELBY. It does.

Mr. GRIFFIN. The 10-year period that we have been planning on as our first plan to design and develop and procure the new crew exploration vehicle is a lengthy period of time relative to our prior history in manned spacecraft development, and I believe reflects lack of the best possible planning as much as it does any fiscal realities.

That said, what could we do to make a difference? The first thing, as I have indicated, that we could do is we, NASA, have announced in our early planning documents to carry two contractors through 2008 before making a final down-select. I believe that the design of the crew exploration vehicle should be sufficiently straightforward, should be sufficiently within our experience base, that it may not be necessary to carry two contractors that long, that it may be more appropriate to down-select earlier, as I said, in fiscal year 2006. That saves an amount of money on the order of $1 billion or more, which can be used in the near term to fully fund one vehicle.

Second, some of our early planning has focused on the possibility of hardware demonstrations in mid-term development for the crew exploration vehicle. Those may or may not be necessary. We will be examining that, as we will be examining the rest of these issues,

but certainly such early demonstrations will require money that might best be spent bringing the vehicle to completion.

Third, as I have indicated, we have a substantial technology development line in exploration systems. I have been in charge, on behalf of the Defense Department in prior experience, of even more substantial technology development budgets, and I would say that, regarding my personal preferences, nothing would give me more pleasure than to sow the seeds widely in our NASA technology development. It has been a long time since we have been able to afford to do that. I would like to do it. But we must put development of new technology in second place behind the development of existing capability on the part of the United States to ferry astronauts and limited amounts of cargo to and from the Space Station and to get started down the path back to lunar return.

COST CONTROL AND TECHNICAL VIABILITY

Senator SHELBY. Doctor, along those same lines, financial responsibility, we have a great challenge, all of us here. What steps is NASA taking to ensure that the contracts it enters into are independently assessed for cost control and technical viability?

Mr. GRIFFIN. Sir, you raise a very important area. As I know that everyone knows, whether directly or not, you are referring to the fact that our audit posture is not a favorable one. We received at the end of 2004 a red audit. We expect to receive another one, I am told. We, NASA, need to frankly get busy on our financial accounting and make sure it passes all the tests.

We also need, in terms of the conduct of our programs, to make sure that, when we sign contracts, they have clearly specified goals, funding profiles are clearly made available, and, in general, we know what we are doing.

I am in the process of establishing a new Office of Program, Analysis, and Evaluation (PA&E), which will carry a set of forward-looking and backward-looking responsibilities, to wit: for backward-looking responsibilities, we will be assessing programs as they carry forward and determining whether they are meeting their cost schedule and performance goals, and making recommendations as to what to do if they fail with those.

We will also be looking at our track record for the development of hardware in terms of cost and schedule, and we will be factoring those estimates from the past into our predictions for the future.

Looking forward, the new PA&E office will carry the responsibility for strategic budgeting, making sure that we have appropriately accounted for all the exigencies which we can determine. And the new office will carry a directorate for advanced planning, helping to remove some of the responsibility for the advanced planning function from those mission directorates, which must carry it out. I have referred to this as eliminating the "fox in the henhouse" problem. I want my mission directorates focused on executing the direction they are given, rather than determining what that direction should be.

I hope and believe that this new office will assume a major responsibility for helping to get our programs on track.

Senator SHELBY. Senator Mikulski.

HUBBLE SPACE TELESCOPE

Senator MIKULSKI. Thank you, Mr. Chairman.

Picking up, I would like to go right to the Hubble space telescope. You know the history. Administrator O'Keefe was going to cancel the Hubble. He did agree to seeking a second opinion, and the National Academy of Science recommended that we do it, and they recommended two possibilities: a robotic mission to repair Hubble robotically—not repair but give it its batteries and its new optics; and then the other was a Shuttle mission for which there is some question about the safety of the astronauts.

Now, where are you on the Hubble? And where do you see us going? And in support of Hubble, what will it take from this subcommittee to support you to do that?

Mr. GRIFFIN. Senator, as I believe this subcommittee and, indeed, most of the world paying attention to Hubble knows, I have committed to re-examine the decision to do a Shuttle Servicing Mission 4, SM–4, in support of Hubble refurbishment and upgrades once we have accomplished our return-to-flight objectives.

To recap the reasons behind that statement, I would say that Administrator O'Keefe's decision made in the aftermath of the loss of *Columbia*, and before we had our return-to-flight planning fully fleshed out, was the reasonable one for the time, but when we return the Shuttle to flight, it will be essentially a new vehicle, and in some specific ways it will require careful examination to assess its ability to support SM–4, and that is what we will do. It is appropriate, I think, then to reconsider that earlier decision in light of the fact that we will be flying, you know, a very much improved vehicle and to assess the relative risks of a Hubble mission.

The National Academy did suggest that the human servicing mission was the proper path to go down, and in addition, there was an independent committee established to assess the feasibility of a robotic servicing mission. Before I was nominated to head NASA, I was the head of that independent commission. I think it is safe to say, although my tenure on that committee was interrupted by President Bush's nomination of me to serve as Administrator, I spent enough time with that committee to know definitely that each and every person on that committee, all of them very capable engineers and scientists, believed that the robotic mission was infeasible to accomplish within the time available before Hubble would degrade irreversibly and within any reasonable amount of money that could be appropriated to accomplish it.

I believe that is the best technical judgment that we will get concerning the feasibility of robotic servicing of the Hubble within the available time, and I think we should simply get off that page.

Senator MIKULSKI. Without getting on to the page, first of all, number one, we thank you for taking this so seriously and giving it such a high level of professional attention. In your testimony, both on page 3 and 6 about the Hubble, as I understand it, you say servicing of the Hubble will depend on the performance of the return to space on the Shuttle safely and the return of the astronauts and that it would take two missions to do that, to assess whether, according to the testimony on page 3 and 6, whether the station was up to a Hubble mission.

My question then: What would be the timeline where you would see those two missions being accomplished? And in the meantime, what should Goddard do? Does it just stand down and we could lose everybody and everything? Or do you see things moving forward in a simultaneous way? And what would be the price tag on that if that is your administrative recommendation?

Mr. GRIFFIN. Yes, Senator. I will return to this in a moment, but it is correct that we need the two Shuttle return-to-flight missions in order to fully assess certain technical issues that I will get to in a moment.

If we were to wait for the conclusion of those two missions to begin work at Goddard on SM–4, we would, if I could use a colloquial expression, get ourselves behind the eight ball on doing that servicing. And so I——

Senator MIKULSKI. It would be too late.

Mr. GRIFFIN. It would be too late.

Senator MIKULSKI. So when do you——

Mr. GRIFFIN. So I have directed Goddard to begin work on Shuttle Servicing Mission 4 under the assumption that we will be successful with return to flight and in our technical assessment of Shuttle capabilities. The first return-to-flight mission should occur in July, the second one in September, and, by that time, we will have accomplished the detailed test objectives we need to accomplish in order to know that it will be safe and effective to allow astronauts to service Hubble from the Shuttle.

EARTH AND SPACE SCIENCES

Senator MIKULSKI. Well, we, of course, wish Godspeed to our astronauts, and I know Senator Hutchison will be raising some important Shuttle questions, I presume. Number one, that is heartening. Number two, we look forward to talking about what we need to put in the appropriations to keep the simultaneity of these two endeavors going.

But if I could add just another thing—because we need to address the Shuttle; we are Shuttle obsessed, as you can imagine. Earth science and space science, do you see new—as you know, there was another National Academy study that said we were losing ground on the study of Earth science, that projects were either descoped, delayed, detoured, derailed, et cetera. And now with NOAA being in this subcommittee, do you see the potential to continue or to focus on a true Earth science set of projects that truly serve this Nation and even friends around the world in terms of understanding our planet both in terms of any number of aspects that have a great impact, from atmospherics to ocean currents to ocean winds and a variety of other things that truly impact the global environment and also how to make those projections that save lives and save livelihoods, kind of a NOAA, NASA, and perhaps NSF partnership?

Mr. GRIFFIN. Yes, Senator, I absolutely look forward to enhancing the NOAA, NASA, and NSF partnership in Earth science. Several comments on your points.

First of all, we at NASA have heard the response of the community to the changes we made or proposed and carried out in our science program in fiscal year 2005. We had allocated, and planned

to allocate, in fiscal year 2006 a substantial increment to funding Mars exploration, robotic Mars exploration in the out-years. We have withdrawn from that and are rebalancing our portfolio to again provide emphasis on Earth science as an important part of our portfolio. So we have heard the response of the science community, and we in turn are being responsive. And you will see that as we go forward in our op plan for 2005 and in 2006.

Senator MIKULSKI. Well, my time is up, and if we have a second round, we will return to some other important issues.

Senator SHELBY. We will have a second round.

Mr. GRIFFIN. Okay.

Senator SHELBY. Senator Hutchison.

BUDGET PRIORITIES

Senator HUTCHISON. Thank you, Mr. Chairman.

Dr. Griffin, we have heard that some Members of the House have urged moving funds from the International Space Station budget for 2006 into the aeronautics line to offset the proposed reductions in that area. That was the President's budget, and clearly having the International Space Station and the return to flight are the highest priorities. I wanted to ask you if you can tell the subcommittee what impact any reduction such as that in the International Space Station funding would have. And will you oppose that?

Mr. GRIFFIN. Senator Hutchison, I am the President's appointee and I support the President's budget. The administration's allocation of relative priorities between human space flight, science, and aeronautics is clear, and I do not propose any changes to those priorities.

Within those lines, we may choose to emphasize or de-emphasize certain things, but I simply cannot support moving money from completing the assembly of the International Space Station to any other activity.

Senator HUTCHISON. Thank you.

The Space Shuttles were originally intended to be capable of flying 100 missions. The *Columbia* had flown the most at 27. When you were talking about the expense of making the Shuttles go longer, I am sure that maintaining them does get more expensive as they grow older. But is that still something that would be more feasible since they were supposed to have been able to have longer terms anyway as a way to lengthen—or shorten the gap between the crew return vehicle coming on if, in fact, you are not able to bring that in at an earlier stage?

Mr. GRIFFIN. Senator, I cannot support that position. Again, I am the President's appointee, and the administration is committed to Shuttle retirement in 2010. The expense of maintaining the Shuttle fleet year after year is so great that, in order to move effectively ahead on the crew exploration vehicle systems, we must retire the Shuttle. We must retire it in an orderly fashion. We must fly every flight safely. But we must get it behind us.

The Shuttle is inherently flawed. It does not have an escape system for its crew, and we all know that since human perfection is unattainable, sooner or later there will be another Shuttle accident. I want to retire it before that flight can occur.

I want to work with you and this subcommittee to understand how we can accelerate the development of the crew exploration vehicle so that there is the minimal possible gap in transitioning from one system to another.

On a personal note, in my late 20s and early 30s, I was working in the space program, as I have most of my life, when we underwent a 6-year gap between the completion of the last Apollo, the Apollo-Soyuz flight, and the first Shuttle flight. That gap damaged our program. It damaged our unmanned program as well. It was damaging to the United States. I don't want to do it again, and I know you share that view. But the way to prevent that is not to continue to rely upon the Shuttle, which is an outdated system, but to move as expeditiously as we may toward the new system. And that is what I am here to support.

Senator HUTCHISON. I accept that, and I think you have made the case very well. Let me ask you this: If you are going to put more emphasis on the crew return vehicle, there have been other suggestions that you would take money out of the basic research budget and the International Space Station. Is that something that would be viable in your mind? And what impact would it have on the long-term national science asset that we have there if you take money from the research projects in the Space Station for the crew return vehicle?

Mr. GRIFFIN. Senator, the impact would be of delay, not of deletion. Yes, if I need the money to close the gap in human space flight between the end of the Shuttle program and the beginning of its replacement, my recommendation would be to take money from the research to be done on Space Station or other exploration systems research and technology development, simply because, as I said in my opening statement, we cannot do everything on our plate and we have to have priorities and first things first.

Now, the research of which you speak is very valuable, and it must be done. But if it is delayed a very few years in order to allow us to complete, in effect, a suitable transition between systems, then I believe that that delay would be worth it, and that would be where I would look for the money.

Senator HUTCHISON. Let me just ask my final question then. If you did something like that, you do not mean that you would stop all of the research on the Space Station at any point, do you? Or would it be just some projects that could be put off?

Mr. GRIFFIN. The phrase I have used is that when cutting budgets, you need to use a meat axe rather than a scalpel—or a scalpel rather than a meat axe, pardon me.

Senator HUTCHISON. Thank you.

Mr. GRIFFIN. Yes. It needs to be done carefully. We would obviously not go in and stop, on a wholesale basis, everything which is ongoing. Stopping projects in their middle is usually not an effective way to save money. I would look generally toward delaying projects which have not yet started.

The Space Station, once built, will be an excellent platform for a number of different kinds of engineering, physical science, and biological research. And we will do that. It will be flying for many, many years. But if, in order to produce the next vehicle, which will allow us to ferry astronauts back and forth to the Space Station,

I need to delay some of that research, then that is what I will have to do.

Senator HUTCHISON. "Some" is the operable word.

Mr. GRIFFIN. Yes.

Senator HUTCHISON. Thank you.

Mr. GRIFFIN. Thank you, Senator.

Senator SHELBY. Senator Cochran.

Senator COCHRAN. Mr. Chairman, thank you.

Let me first congratulate you, Mr. Chairman, on assuming the responsibility of chairing this subcommittee with an enlarged scope of jurisdiction.

Senator SHELBY. Thank you.

Senator COCHRAN. We look forward to working closely with you to help ensure that we meet our goals and identify our priorities in a thoughtful way. And I think starting the process with a new Administrator of NASA is an exciting opportunity for all of us. I want to congratulate you, Dr. Griffin, for your selection as Administrator of this important agency and say that we appreciate the fact that you are a person of experience, a great deal of education in these technical and scientific areas. I was just looking at the number of Master's degrees that you have been awarded at various universities, and it is really quite impressive, and I hope you do not mind my referring to you as "Dr. Griffin," because you did get a Ph.D. also, and that was in the University of Maryland system, which I know Dr. Mikulski may identify with, with some pleasure. This is a big job, and I know you are well suited and totally well qualified for it. And even though you have indicated that you support the budget request because you are the President's nominee and you are in this position to carry out these policies, we do notice that the research funding has been reduced because, I guess, of the increase in exploration initiative costs, over $675 million for the Moon and Mars exploration initiative. So this decreases other activities.

Have you looked at ways that you can balance that competition inside the agency so that there is not any serious harm done to interests for traditional activities that have been carried out by NASA?

Mr. GRIFFIN. Senator Cochran, the science budget in the large at NASA has not been cut to serve the needs of exploration, Moon and Mars. The science budget request for 2006 is $5.5 billion. We expect it to grow with inflation in the out-years. We have not, and, unless under the most extreme budget pressure, I would not, cut science in order to fund manned space flight. I believe that NASA has several substantially differing activities: human space flight, science, and aeronautics.

The President's priorities among those differing activities are expressed in his fiscal year 2006 budget, as are the proportions among those numbers, and I would intend to respect those proportions. If we need to solve problems in human space flight, we will do it within the human space flight suite of activities.

So I must respectfully suggest we have not cut the science budget in order to do exploration. In fact, I would say that the exploration budget has been reduced and exploration activities have

been delayed in order to accommodate Shuttle return-to-flight costs.

INTERNATIONAL COOPERATION IN THE SPACE PROGRAM

Senator COCHRAN. In looking at the global situation in terms of our relationships with other countries and cooperation in the space program—Russia has been actively involved in the manned program for a good many years—are there other nations that are interested or active in becoming partners in space exploration?

Mr. GRIFFIN. Senator, I have not had the opportunity to assess that yet. I will be, in fact, attending the Paris Air Show next month, and there will be, as you know, other international events at which my attendance will be expected, and I will be there. And then there will be formally arranged meetings, government-to-government meetings as well. And in the course of the next few months, I hope to get a feel for which nations wish to join us in this venture. I hope there are some.

I think one of the best things to come out of the Space Station program is the international partnership that has been developed, and the administration takes very seriously this Nation's commitments to those partners. So I look forward to it. I have not had an opportunity to assess it yet.

Senator COCHRAN. Well, we look forward to working more closely with you as we go through this budget process, and we intend to closely consult with you along the way to be sure that we cooperate in supporting the administration's initiatives in these areas. We appreciate your leadership.

[The statement follows:]

PREPARED STATEMENT OF SENATOR THAD COCHRAN

Mr. Chairman, I am pleased to join you in welcoming Dr. Griffin to the hearing today. NASA's history is without comparison. Continued human exploration will broaden our understanding of the universe, and coupled with its dedicated pursuit of scientific research, NASA will help secure our nation's position at the cutting edge of technology well into the future.

Dr. Griffin, I note that you are a man of action. While you have been in your job for less than a month, you have already made important decisions for the future of NASA, to include awarding the Shared Services Center contract and accelerating the development and launch of the shuttle replacement into orbit.

Stennis Space Center in Mississippi has been known for its engine testing work, and I am proud to acknowledge the recent selection of Stennis as the location for the NASA Shared Services Center. We welcome the center to Mississippi and look forward to the contribution that the men and women of Mississippi will make to help NASA be more efficient in conducting its administrative activities.

I look forward to working with you in the future and to hearing your testimony today.

NUCLEAR POWER SYSTEM

Mr. GRIFFIN. Thank you, Senator, and I will offer you my full cooperation as Administrator.

Senator SHELBY. Dr. Griffin, Project Prometheus has been a priority for NASA over the past 2 years. This nuclear program has the potential of providing great benefit to future NASA missions and the exploration vision. However, the Jupiter Icy Moons Orbiter mission has been determined to be too technically difficult, and the same operating plan you have mentioned in your written testimony

also includes a reduction of $161 million to the Prometheus program to reflect the mission deferment.

With the deferment of the Jupiter Icy Moons mission, NASA is looking at alternative missions to demonstrate a nuclear power system in space. Was the Jupiter Icy Moons Orbiter mission too ambitious? If so, what are the possibilities that NASA intends to explore? And how will this affect the funding level from Prometheus in the 2006 budget?

Mr. GRIFFIN. Senator, there were several questions there, and if I miss one, you can remind me. Let me address the issue——

Senator SHELBY. I bet you won't miss one.

Mr. GRIFFIN. I don't want to bet too much, but we will try.

The Jupiter Icy Moons Orbiter mission was, in my opinion, too ambitious to be attempted. Let me give a couple of specifics.

The vehicle would have required at least two heavy-lift launches to put into orbit where it would have been assembled prior to its departure from Earth to go to Jupiter. That would have been an extremely expensive undertaking, one which we have not performed before.

The nuclear electric propulsion system being developed for it does not presently exist, would not exist for some time, and if successfully developed, would have required approximately twice the world's annual production of xenon to be fueled to carry out the mission. It was not a mission, in my judgment, that was well formed.

The original purpose of the Jupiter Icy Moons Orbiter was to execute a scientific mission to Europa, a moon of Jupiter which is extremely interesting on a scientific basis. It remains a very high priority, and you may look forward in the next year or so, maybe even sooner, to a proposal for a Europa mission as part of our science line. But we would, again, not favor linking that to a nuclear propulsion system.

With that mission taken off the table as being something just too big for our plate at this time, the question then arises as to what shape and form we want the space nuclear program to be. I will say categorically we cannot effectively explore space without nuclear power and in the longer run nuclear propulsion. But having taken JIMO off the plate, Jupiter Icy Moons Orbiter, the proper ordering of priorities now changes.

The first thing we will need is surface nuclear power for our astronauts when they return to the Moon in a decade or so. The next thing we will need will be nuclear thermal propulsion——

Senator SHELBY. How difficult will that be?

Mr. GRIFFIN. Sorry, sir?

Senator SHELBY. How difficult will that be?

Mr. GRIFFIN. We need to execute some development programs that we have not done in a while, but many nuclear reactors have been flown in space—one by the United States, many by the former Soviet Union. We have that technology. We merely have to integrate it again.

Nuclear thermal propulsion will be the next step. A nuclear upper stage is the most effective way to take humans to Mars. The United States had prototype versions of such engines back in the late 1960s and early 1970s. In 1972, when President Nixon decided

that the Nation would not be going to Mars under his tenure as President, the NERVA, nuclear engine for rocket vehicle applications, program was terminated. We have not had a need for such a program in the last three decades. As we journey forward to Mars, we will need it.

Finally, the last priority would be the nuclear electric propulsion which was linked to JIMO, and that will be useful for cargo missions to Mars, but well after we start sending humans there.

MAINTAINING SKILLED WORKFORCE WITHIN SPACE SHUTTLE AND STATION ACTIVITIES

Senator SHELBY. Doctor, in another area, to what extent will it be possible or even desirable to maintain employment of skilled workers currently involved in Space Shuttle and station activities as NASA transitions to a post-Shuttle era and reduces its station-related programs?

Mr. GRIFFIN. Senator, it will be absolutely crucial. As I pointed out earlier in response to Senator Hutchison's question, I, as a professional, lived through the gap in manned space flight from 1975 to 1981, and I do not propose to repeat it. One of the things that happened during that period was the loss of skilled and experienced personnel in space flight of all varieties, both manned and unmanned, to other pursuits. When those people have gone to other occupations, our experience is we do not get them back. So we must effect an orderly transition from the shuttle to the new system.

I owe this Congress a plan for doing that, and I have said on several occasions in several ways that the first step is minimizing that gap.

FIELD CENTERS ROLE IN THE PROMETHEUS PROGRAM

Senator SHELBY. What is your view, doctor, of the role of the field centers in the Prometheus program? In other words, do you believe that the program is doing a good job of utilizing the full range of research and development capabilities that exists within the field centers, and if not, what action do you plan to take to employ the technical talent base within NASA?

Mr. GRIFFIN. Senator, the question was applied by you to Prometheus, but it goes beyond that. I have not had an opportunity to look at the Prometheus program directly. As I said, we will be restructuring it, not because it is not a valuable program, it is incredibly valuable, but I want to change the definition of what is produced first.

Senator SHELBY. Sure.

Mr. GRIFFIN. Now, with regard to your broader question of what are the value of the field centers, I have also in public utterances been most specific on this point. The President's Vision for Space Exploration is a multi-generation program. It will require decades. The people who will be taking us to Mars are in elementary and middle school today. Contractors and businesses come and go. They succeed and they fail. The Government ownership of the intellectual property that sustains our space exploration journey will be with us always, as long as there is a Government.

The core capability, the core intellectual property that will sustain this journey, must reside within NASA as an organization, and in particular within the NASA field centers. I am committed to maintaining and to restoring capability where we need to do it. I am committed to changing the skill mixes of the centers as we transition from a Shuttle operations culture to the development culture required for the new vehicle systems we must bring about. But in the process of adjusting the details of how the field centers accomplish their missions and what they do, I am committed to retaining strong field center capability.

HEAVY LIFT LAUNCH VEHICLE

Senator SHELBY. Doctor, what is the status of planning for a heavy lift launch vehicle to send large quantities of mass to low Earth orbit or directly to the Moon?

Mr. GRIFFIN. Senator, that is a very interesting question. I can plan the development of a heavy lift launch vehicle from a clean sheet of paper, which would likely be too expensive for this subcommittee or the full committee to provide me the money, or I can utilize the heavy lift launch vehicle that I presently own as the NASA Administrator, which is the Space Shuttle. We talk about retiring the Space Shuttle. What is really meant is that we need to retire the Space Shuttle Orbiter. The Space Shuttle is a system of systems. It consists of a number of very, very valuable, very expensive to develop components, the Shuttle external tank, the Shuttle solid rocket boosters, Shuttle main engines and other lesser things, as well as the assembly and launch pad infrastructure at the Cape.

Every time that stack lifts off, it carries 120 or 20 metric tons into orbit. If I remove the orbiter and put on a cargo module, I have a heavy lifter. To me, I have indicated on several occasions, that seems the shortest path to a heavy lifter. If money were free and being provided in unlimited quantities, I would enjoy the challenge of developing a new vehicle, but we all know it is not, so I believe that that is the appropriate way forward.

LAUNCH VEHICLES

Senator SHELBY. Where are we regarding the expendable launch vehicle versus a Shuttle derived launch vehicle?

Mr. GRIFFIN. Do you mean the evolved expendable launch vehicle?

Senator SHELBY. Yes, evolved.

Mr. GRIFFIN. The evolved expendable launch vehicle families, offered by Lockheed Martin and Boeing, are the Nation's transportation fleet for payloads of 20 metric tons or less, and I certainly would propose no NASA development of such vehicles because we do not need more.

In terms of payload capability above about 20 metric tons, the field is open, and again, from NASA's perspective to meet my heavy lift needs, I would probably stick with what I have. Again, we need to make these judgments on a cost basis and I am in the process of assessing those costs, but it looks likely to me that sticking with what I have is the way to go.

Senator SHELBY. Senator Mikulski.

STATION ASSEMBLY-SHUTTLE FLIGHTS

Senator MIKULSKI. Thank you, Mr. Chairman.

I want to pick up a line of questioning both from Senator Shelby and Senator Hutchison, and it goes to the Shuttle and the completion of the station. How many flights will it take to complete the station, how many Shuttle flights, and how long do you anticipate that this is going to take?

Mr. GRIFFIN. Senator, the current plan on the table at NASA is a 28 flight sequence, of which 18 flights are assembly flights, 5 flights are logistics flights, and 5 are utilization flights. I have indicated, in response to the Senator's question, that some of the research to be accomplished on the utilization flights could be deferred until we have a new system. With some time to plan, 2 or 3 years in the future, out to 2008 or so, some of the logistics flights cargo could be offloaded onto expendable vehicles, the Arian Transfer Vehicle, the Japanese HTV or new commercial systems which we would develop.

That leaves a core of 18 Shuttle assembly flights. Again, with time to plan, even some of that hardware could be put up by alternate means, but right now we are looking at a core of about 18 assembly flights.

Senator MIKULSKI. Well, let me jump in here because first of all, again, we are very concerned about the Shuttle, the safety of our astronauts, but also those 15,000 people, both contractors and civil servants who are employed.

Now, it is 2005. We are talking about retiring the Shuttle in 2010. So that gives us essentially 4½ years to do 15 flights. Do you think it can be done? Well, actually, that is not the question. I am really concerned that with the magnitude that it will take to complete the station, and we know it must be completed for both scientific reasons, and honoring our commitment to international partners. We do not want to jeopardize that relationship because we are going to need it, we both need and want international partners for other things that we hope to do in space. But my point is then, if you have, let us just say 18 in 4½ years, that seems like a robust schedule, given the fact that by the time we do the next two flights, presuming everything goes the way we hope, that will be—we are then into 2006. So that gives you 2006, 2007, 2008, et cetera. How do you see all of this unfolding?

Mr. GRIFFIN. Directly answering your question, it is an extremely robust schedule. We are not sure we can accomplish it. We are looking at alternative assembly sequences for the Shuttle that we would use in case we are not able to get all 18 assembly flights accomplished with the Shuttle. I will provide a set of options for this Congress by midsummer.

Senator MIKULSKI. I think what we are looking at then is the impact on the workforce, and also presuming then that they are working nonstop to do this, we would be concerned about then its impact on safety, just even general fatigue, of both people and the Shuttle itself. We have three orbiters and one has to go, one has to be ready to go, and one is taking a breather. That is kind of a liberal arts graduate's description of this.

But then, of course, what would be the cost to do this? Will it accelerate, et cetera? I think you might not be able to do this today. We know you support the President's budget, but we would like to also know the consequences of this because we are then talking about five or six flights a year, and we have not even ever met that—have we ever met that type schedule?

Mr. GRIFFIN. I believe we have, but it was very difficult, and it was in a different environment. With the care that we are taking today we are not planning on a six flight per year schedule. We would need roughly four flights a year to fly 20 flights in the fiscal years 2006, 2007, 2008, 2009 and 2010.

Senator MIKULSKI. And with one flight hopefully going to Hubble.

Mr. GRIFFIN. And one going to Hubble.

Senator MIKULSKI. Which would be an additional flight.

Mr. GRIFFIN. Senator, your question is extremely on point. There is no question, as I said before, it is an extremely aggressive schedule and we must have fall-back options if we are not able to meet it, because we do not want the program to be schedule driven. We do not want safety to be compromised. We will provide, by midsummer, a set of options that we can offer to avail ourselves of if we are not able to carry out the aggressive flight rate required to get all 18 assembly flights completed by the time we are ready to retire.

Senator MIKULSKI. I think this subcommittee is looking forward very much to working with you and with our authorizer, Senator Hutchison, on this endeavor.

I had the good fortune to visit Texas with Senator Hutchison to see the kinds of research that we are talking about in the Shuttle, and also at Marshall, physical science, life science, that could be stunning, and that for an international partnership to have a completed Shuttle where we are really working together on breakthrough ideas, I think would go a long way to science, a long way to international cooperation. I think the world would feel better about the United States and its preeminence in space, particularly in the civilian side. So we want to be able to do that.

I know that my time is up, and my next area would be of course aeronautics.

Senator SHELBY. Senator Hutchison.

INTERNATIONAL SPACE STATION COMPLETION

Senator HUTCHISON. I just want to follow along with what Senator Mikulski was saying because it seems to me that you have got two major priorities here. You were very firm about wanting to retire the Shuttle on time, but also equally firm, as is the President, on finishing the Space Station for all of the reasons that Senator Mikulski said. If we cannot finish the Space Station with what you have available—let me rephrase. Are you prepared to say that finishing the Space Station is the top priority?

Mr. GRIFFIN. Well, the administration has said that we will finish the Space Station. For the next 2 to 3 years, unequivocally, we are dependent upon the Shuttle to go to the Space Station and begin the process of completing that assembly. If we look further out, there are alternative means we could engage to get that hard-

ware up there, and we of course would look at that because we need options. In the longer term, if time comes to retire the Shuttle and we are not finished, then I have said for the record on several occasions, both before and after becoming Administrator, that the United States should complete the station, but we may again encounter some delays in accomplishing that until we have the new system on board.

I do want to complete it. I think it is worth a lot for the United States to keep its word, to maintain our obligations to the partnership and to go forward together, and we will try to do that.

All we are discussing here are ways and means of accomplishing it, not whether or not the President is committed to completing the station, because with his speech of 1 year ago and his budget in 2006, he clearly is committed to that completion.

Senator HUTCHISON. As all of us have said, we are going to work with you. We know that you have to have time to put alternatives together, but just one more time to reemphasize, in addition to keeping our word to the international community, which is very, very important, it just seems if we are not committed to the science that one of the key reasons that we have NASA is diminished, and I do not want to ever have any indication that the actual science that will be done at the Space Station is in any way a lesser priority.

Mr. GRIFFIN. Yes, Senator. I do not think it is a lesser priority either, but again, if the funding to do science is getting in the way of the funding to complete the station, I would be presented with a Hobson's choice. I will work with you and with the subcommittee to minimize the dislocations, but if completion is the first priority, I must do what I must do.

Senator HUTCHISON. I understand, and we will work with you in every way. I just hope we do not end up being the hospital that is clean because there are not any patients.

I mean we really have to——

Mr. GRIFFIN. Yes, Senator, I understand.

Senator HUTCHISON [continuing]. Remember the mission.

Thank you.

Mr. GRIFFIN. I understand.

Senator SHELBY. Thank you, Senator.

Dr. Griffin, as we move forward how many Shuttle flights do you think will be needed to complete construction of the International Space Station?

Mr. GRIFFIN. Well, again, the final answer on that may depend on the outcome of some of the studies we have ongoing and which I have promised to you by midsummer, and I understand that commitment. The current baseline is 18 assembly flights, 5 logistics flights, 5 utilization flights.

INTERNATIONAL AGREEMENTS

Senator SHELBY. In regard to international partners, it no longer seems that NASA plans to provide everything that it promised or could in international agreements that govern the International Space Station program. What discussions are planned or underway with the other partners to rebalance what each partner is required

to do and what it gets in return? In other words, where are we going there?

Mr. GRIFFIN. Senator, as we stand today, we are committed to orbiting the partner hardware and providing the partner flights. Disasters can ensue, as we know. If there is any planned change to that, I would come forward to this subcommittee and discuss it first.

Senator SHELBY. Have any agreements been made in this regard at this time?

Mr. GRIFFIN. Not at this time.

FINANCIAL MANAGEMENT

Senator SHELBY. Okay. Financial management, we have to do this because we are in appropriation business here. NASA continues to face significant challenges in improving financial management. I know you have not been at NASA long, but in the past 2 years NASA's auditors were unable to issue an opinion on NASA's financial statements because NASA could not provide the auditors with sufficient evidence to support the statements. While NASA implemented a new integrated financial management system in 2003, NASA auditors found pervasive errors in 2004 financial statements generated from the new system. In October of this past year, the NASA Inspector General reported that one of the most serious management challenges facing NASA is, and I quote, "ensuring that the integrated financial management system improves NASA's ability to allocate costs to programs"—we have been talking about this—"efficiently provides reliable information to management and supports compliance with the Chief Financial Officer's Act."

Also in January of this year, 2005, the Government Accountability Office, in its High Risk Series Report stated, and I quote, "While it has taken recent actions to improve the contract management function, NASA continues to face considerable challenges in implementing financial management systems and processes that would allow it to manage its contracts effectively."

My question, Dr. Griffin is, does NASA have a written corrective action plan that addresses the scope of its problems and the resources at the time that will be needed to fix these problems pointed out by the Inspector General and GAO?

Mr. GRIFFIN. Senator, we do not at this point. I take the GAO's comments and our independent auditor's comments as seriously as I know how to say. We understand, as an Agency, that our financial accountability has been lacking. I will not hedge. We have lacked that. I have, as we speak, a team of people working on putting a plan together for how we will get from where we are to where you require and where we want us to be.

Senator SHELBY. You are committed to doing whatever is necessary?

Mr. GRIFFIN. I am absolutely committed to providing the resources necessary to get our financial management on track, and I will share with you the plan to do that when we have it.

Senator SHELBY. What obstacles have you encountered that would have an impact on your financial management efforts? Are you there yet?

Mr. GRIFFIN. We are really not. I have not been able to see obstacles so much as we simply have not stepped up to the plate on it. The major aspects of the situation are driven, as you know, by the fact that NASA has 10 field centers. They did not even historically all come from the same agencies. Some came from the Department of Defense (DOD), some were created out of a whole cloth, some came from NACA. They evolved their own financial management systems and they were never really linked up. Part of our integrated financial management plan, as the name implies, is to have, if you will, one NASA, one system, and be able to account for all the money in a common framework. Linking those 10 centers and headquarters together in a transparent and straightforward way has proven to be more of a challenge than anyone had thought. Clearly it has, because we flunked the last couple of years. I am absolutely dedicated to seeing to it that, as my tenure goes forward, we do not flunk, that we pass with flying colors.

Senator SHELBY. Thank you.

Senator Mikulski, you have any more questions?

RETAINING AND ATTRACTING SKILLED WORKFORCE

Senator MIKULSKI. Thank you.

First of all, I want to associate myself with Senator Shelby's questions about fiscal accountability, fiscal responsibility and implementing the reforms in the GAO report.

I also want to thank you in this testimony here for your candor about what you are facing. Actually, I think we are off to a good start even if some of the things are giving us heartburn, at least we feel that we are getting a candid conversation and look forward to more.

I am going to raise an issue about workforce. You talked about the astronauts that will be on the trip to Mars are now in elementary school, and we also know that NASA has an aging workforce in certain projects, so you need to retain, you need to recruit, and there needs to be a development of our future scientists and technologists.

Could you give us your view on two things, number one, the workforce at NASA and our ability to retain the qualified people that you need to complete the priorities that you outline and we support; and number two, what do you see NASA's role in really helping generate, cultivate, that next generation of scientists and technologists?

Mr. GRIFFIN. Well, Senator, this is a subject that, as I believe you know, I am quite passionate about.

Senator MIKULSKI. I know you are.

Mr. GRIFFIN. I sometimes say, who is it that you will find who loves education more than I do? That said, two things. First of all, we have $167 million in the NASA Education Program and more in the mission directorates as we sit here today. I believe that we need to focus that education program, establish goals and metrics for it, and make it effective, but it is a substantial amount of money.

In addition, I think it is time to recognize that NASA's biggest, most important, most lasting contribution to education for our future workforce is to do the kinds of things that excite young kids

enough to want to be part of the space program and to get an education to do it. They can get almost any kind of an education and we will have a place for them at NASA. We are a very broad Agency. We need a lot of different specialties, but an education is a requirement.

If we return to the Moon, if we set up a permanently manned lunar base there, if we go to Mars, if we visit the nearest asteroids, if we service the James Webb space telescope in future years, if we look beyond the Moon and Mars, young kids today and young kids of the future will want to be part of that program, as I did when I was a small boy, and they will do what is necessary with their education to get it.

It is in that sense that NASA best served the educational community in my humble opinion.

Senator MIKULSKI. On a personal note, you grew up in Maryland. You grew up in Aberdeen, close to a military base. It is the home of Cal Ripken.

Mr. GRIFFIN. Yes, Senator, I was born on a military base.

Senator MIKULSKI. That is exactly right, and you went to our public schools. What was it that got you interested in—what do you think—you have outlined those projects, but what got you interested?

Mr. GRIFFIN. This story is almost embarrassing to recount. I have not told it in public for some years, but it is true that—my mother was a teacher when I was a kid, and the first book that I was ever given was a book on astronomy and space. I have since commented that sometimes that based on what we know today, everything in that book was wrong.

Senator MIKULSKI. Gee, and I started with "The Three Bears."

Mr. GRIFFIN. Well, we went down different tracks. I still have that book actually, and I was 5. This was in 1954, and I was absolutely fascinated by it, and from that time forward I never considered for myself anything other than being a scientist or engineer or mathematician and involving myself in the space business. And I never did. So that was what motivated me.

I have no doubt—I hear often from—they are not kids any more—you know, men or women in their 30s whose early memories are the Apollo landings on the Moon, stimulated them into science, development of science and engineering. I hear from other young men and women who have technical educations that they were fascinated by Bob Ballard's discovery of the *Titanic*. Any sort of exploration into the unknown, any sort of discovery of the new and unknown excites our kids. And if you catch them at that age, they are with you forever.

We all went through puberty. If you let kids get to middle school and high school before having fastened onto that interest, they are going to be interested in girls and football, or guys and football, whatever it is, but it is less likely to be science and engineering because science and engineering are hard.

Senator MIKULSKI. They are hard. Well, first of all, I could not agree with you more that it is, number one, people interested in young people to expose it to them; number two, that it is wonderful projects that get people excited and young people knowing and hearing about them. And then also, I believe, that with that $167

million in NASA's education budget, that we really get perhaps more of a focus on where we would like to do it. Should it be in those areas like what we would call extra educational institutions like science centers and others? Today is not the day of doing that, but we want this year to be a success. But we want to be preeminent for the decade. We want to be preeminent for the century in science and exploration.

So we look forward to working with you, and we would hope that all the work you do, you can start a treaty negotiation with NOAA and we will look forward to hearing about that. And I and the Hubble will be keeping an eye on you.

Mr. GRIFFIN. Senator, I will make sure that you do not have to keep a sharp eye. I will make sure that you know what we are doing with Hubble and with NOAA.

Senator MIKULSKI. Thank you very much.

Senator SHELBY. Thank you, Senator Mikulski.

ADDITIONAL COMMITTEE QUESTIONS

Dr. Griffin, I want to thank you for appearing here today before our subcommittee. I am sure you will be back many times. We will all be carrying on a dialogue with you. You have a lot of work cut out for you. I think you are up to the challenge. You bring the experience. You are candid, which is something we like, it is refreshing. We look forward to working with you. We have some hurdles to jump over, and you will be our leader in that regard.

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

QUESTIONS SUBMITTED BY SENATOR RICHARD C. SHELBY

Question. The implementation plan for the Vision laid out in the fiscal year 2005 budget request was prepared based on underlying assumptions. How have these assumptions changed? What is the impact of any changed assumptions on NASA's funding needs?

Answer. As communicated in its September 2005 Operating Plan Update, NASA has concluded the Exploration Systems Architecture Study (ESAS) to implement the Vision for Space Exploration. Based on ESAS recommendations, NASA has laid out a detailed plan to support sustained human and robotic lunar exploration operations. This plan features accelerated development of the Crew Exploration Vehicle (CEV) and Crew Launch Vehicle (CLV) systems for missions to the International Space Station, Moon, and Mars, and identifies key technologies required to enable this exploration architecture.

ESAS results are broadly consistent with the assumptions on which the fiscal year 2005 budget request was based. However the specific architecture defined by the ESAS study allows NASA to accelerate CEV and CLV and to further focus and refine ESMD research and technology.

To stay within planned budget guidance for Exploration Systems while accelerating CEV and these launch systems, it is necessary to redirect existing funding for longer-term and lower-priority research and technology (R&T) elements within the Exploration Systems Mission Directorate (ESMD), while focusing on those R&T activities that support the acceleration of the CEV, launch systems, and high-priority, long-lead items.

In the fiscal year 2006 budget amendment, $292 million was identified as moving from R&T activities into Constellation for CEV and CLV acceleration. Following the results of the ESAS, as described above, an additional $493 million is identified from the R&T activities for acceleration of CEV and CLV, as detailed below. This yields a total shift from R&T to Constellation for acceleration in fiscal year 2006 of $785 million, relative to original plans for fiscal year 2006.

Constellation Systems.—NASA plans to accelerate the timeline for flight of the next human flight system by two years, from 2014 to a goal of not later than 2012.

The first flights will be to the International Space Station (ISS), but the primary goal of the CEV is to support exploration efforts, including enabling humans to return to the Moon for weeklong stays as early as 2018, but no later than 2020. Longer-duration human presence on the Moon is targeted for 2022. The changes in the R&T programs will provide funds required to accelerate the design, development, and fabrication of the elements and systems needed to support a return to the Moon on the above timeline.

Human System Research and Technology.—NASA is focusing HSRT funding on program elements that mature technologies needed to support ISS access and lunar sortie missions, while reducing program elements targeting longer-term or lower priority needs. As NASA concentrates the use of the Shuttle on ISS assembly, ISS utilization will be deferred.

Exploration Systems Research and Technology.—NASA is realigning projects to support the ESAS recommended architecture requirements. This realignment has resulted in a focused and phased, requirements driven, R&T program in which some projects are curtailed, some are adjusted, and some are added. Ongoing projects are streamlined to deliver Technology Readiness Level 6 capabilities when needed (system preliminary design review) so as to enable the CEV, launch systems, and lunar lander development schedules. Examples of technology projects focused on the near-term include ablative thermal protection and oxygen-methane propulsion for CEV. Additional work is phased in after the first few years for lunar lander propulsion systems and nontoxic power and reaction control for launch vehicles. Finally, funding for technologies, such as in-situ resource utilization (ISRU) and those applicable to lunar surface systems, are phased in only during the out years. Discontinued, descoped or delayed technology projects include nanomaterials, inflatable structures, large-scale solar power, intelligent robotic systems, Mars mission specific technologies, and electric propulsion.

Prometheus Research and Technology.—Program elements have been deferred as a result of the ESAS architecture study. Surface nuclear power systems to support potential long- duration stays on the Moon will not be required until after 2018. Nuclear propulsion will not be required until planning for Mars missions begins in earnest. The result will be a total reformulation in the nuclear program, yielding $76 million in fiscal year 2006 to accelerate development of CEV and CLV. NASA's funding of the DOE's Naval Reactors program, the JIMO mission, and several technology research programs related to electric propulsion will be curtailed.

Question. The fiscal year 2006 budget request contains less than half the percentage increase proposed by President Bush last year. [It was projected to increase by 4.7 percent above fiscal year 2005, but instead is 2.4 percent more when compared with what was appropriated in the fiscal year 2005 regular appropriations bill, or only 1.6 percent more if the $126 million provided by the emergency supplemental for hurricane relief are included.] How would the lower-than expected funding affect execution of the Vision?

Answer. NASA is pleased to have received a 2.4 percent increase in the President's fiscal year 2006 budget request. This is about half the increase that was planned in the fiscal year 2005 budget runout, with the reduction representing NASA's contribution toward overall deficit reduction efforts—a priority for the President.

In his State of the Union Address on February 2, 2005, the President underscored the need to restrain spending in order to sustain our economic prosperity. The fiscal year 2006 budget request includes more than 150 reductions, reforms, and terminations in non-defense discretionary programs, of which 3 affect NASA programs. Overall, NASA's budget is up, growing 2.4 percent in fiscal year 2006 and is projected to continue to climb thereafter at the approximate rate of inflation. This is a significant increase, when compared with other non-defense, non-homeland security funding, which is generally flat or declining.

In comparison with last year's fiscal year 2005 budget projected runout, the fiscal year 2006 budget is about $546 million less. This reduction, contributing to overall deficit reduction, is spread among NASA's Exploration, Science and Aeronautics Mission Directorates, while enabling increased funds for Shuttle Return to Flight requirements. None of the reductions in Science and Aeronautics Programs is directed to Exploration Systems.

With proposed fiscal year 2006 funding levels, NASA is capable of implementing the Vision for Space Exploration and other national priorities. It should be noted that, as a result of the President's fiscal year 2006 budget amendment and NASA's proposed adjustments in the fiscal year 2005 Operating Plan September update, NASA has identified realigned a total of $785 million within planned fiscal year 2006 Exploration Systems funds from Research and Technology efforts to Constellation for acceleration of CEV and CLV relative to original fiscal year 2006 plans.

Question. In your opinion, should NASA be a "single-mission" agency focused on implementing the President's Vision for Space Exploration, or a multi-mission agency as it has been in the past? If you intend to lead NASA as a multi-mission agency, to what extent is the budget you are requesting for fiscal year 2006–2010 sufficient to accomplish that objective?

Answer. NASA is and should remain a multi-mission agency. Over the past year, NASA has made great strides in meeting national priorities in its missions not directly connected to milestones in the President's Vision for Space Exploration:

—*Earth Science*.—We have completed deployment of the Earth Observing System and are supporting investments in the Global Change Science and Technology Program and the next generation Earth observing satellites for numerous applications, including improved weather forecasts, earthquake prediction, resource management, and other hazard warnings.

—*Aeronautics*.—We are re-establishing NASA's dedication to mastery of core competencies in subsonic, supersonic and hypersonic flight, along with aviation safety, and airspace systems. NASA, with its industry partners, recently demonstrated the feasibility of significantly reducing the sonic boom from supersonic aircraft, and, last November, NASA's hypersonic X–43A demonstrated that an air-breathing engine can fly at nearly 10 times the speed of sound.

—*Exploring our Solar System and the Universe*.—The Mars rovers, Spirit and Opportunity, have exceeded all expectations and made unprecedented discoveries that will help prepare for eventual human exploration; the Cassini/Huygens mission is providing stunning views of Saturn and Titan; the Genesis mission, despite its hard landing, has returned primordial samples from space; new missions have been launched to Mercury and to comets; and amazing discoveries continue with Hubble, Chandra, and Spitzer.

NASA's fiscal year 2006 budget request provides a balanced portfolio of programs to meet the needs of our national priorities in space and aeronautics.

—The fiscal year 2006 budget request of $5.5 billion for the Science Mission Directorate will support 55 missions in orbit, 26 in development and 34 in design phase. By 2010, the Science budget will increase by 23 percent over current levels. NASA will continue to expand its exploration reach with an armada of existing and new space observatories operating in many different wavelengths and looking at different parts of our exotic universe. The three "Great Observatories"—Hubble, Spitzer, and Chandra—will continue to bring wondrous images to our eyes and exciting new scientific discoveries. Missions such as Kepler will provide a new understanding and knowledge of the planets orbiting stars far from our solar system.

—NASA's fiscal year 2006 request for the Aeronautics Research Mission Directorate is $852 million, a significant portion of the government's overall investment in aeronautics research. To make the most of this investment, NASA's technical expertise and facilities for aeronautics research are becoming more focused and results-oriented. NASA's current aeronautics research is focused on enhancing the public good. NASA is also working to maintain a strong basic aeronautics research program to ensure continued mastery of core competencies in subsonic, supersonic, and hypersonic flight. The results from the basic research, technology development, and demonstrations achieved by NASA's Aeronautics efforts will be transitioned for use by both Government and industry.

—The President's fiscal year 2006 budget amendment, submitted July 15, 2005, continues to reinforce a balanced, multi-mission proposal, allowing NASA to address national priorities in Space Science, Earth Science, and Aeronautics, while maintaining focus on the Vision for Space Exploration outlined by the President in January 2005. The multiyear budget plan is sufficient to accomplish this balanced portfolio. It should be noted that the President's fiscal year 2006 budget amendment accomplished several objectives within the request level, including initial steps to accelerate development of the Crew Exploration Vehicle (CEV) and Crew Launch Vehicle (CLV), while preserving funding for Science and Aeronautics Programs. NASA's fiscal year 2005 Operating Plan September update identifies further reallocation within proposed fiscal year 2006 funding levels for Exploration Systems to support these objectives. It is important to note that NASA has not redirected funding from Science and Aeronautics activities to support exploration activities.

Question. How important is meeting the milestones set out in the President's speech—2008 for a demonstration flight of the Crew Exploration Vehicle, 2008 for the first Vision-related robotic lunar probe, and 2015–2020 for a human return to the Moon? Is there flexibility in the dates so that other NASA activities do not necessarily have to be sacrificed in order to meet them? If there is flexibility in meeting those dates, is there also flexibility in the 2010 date for retiring the shuttle?

Answer. The President's fiscal year 2006 budget request, as amended, provides resources to enable NASA to implement the milestones established in the Vision for Space Exploration. These key milestones include the Shuttle Return-to-Flight, 2008 Lunar Robotic Orbiter, and accelerated development of the Crew Exploration Vehicle (CEV) and Crew Launch Vehicle (CLV), to return Americans to the Moon before 2020. NASA is not prepared to be flexible with respect to the major milestones established for the agency by the President.

It is important to note that NASA has not redirected funding from Science and Aeronautics activities to support exploration activities, either in the fiscal year 2006 budget request as submitted in February 2005, or in the President's fiscal year 2006 budget amendment, submitted to Congress on July 15, 2005. NASA has no plans to reduce funding for other NASA activities to support exploration goals.

In accordance with the President's direction, NASA intends to fly out the Shuttle program in an orderly, safe, and disciplined fashion, with retirement not later than 2010.

Question. Please clarify what your plans are for personnel cutbacks over the next year and a half. How many full time equivalents (FTEs) does NASA employ today, and how many will have to leave the agency, voluntarily or involuntarily, by the beginning of fiscal year 2007? What is the breakdown of those personnel cuts by center and by discipline?

Answer. NASA's fiscal year 2005 actual FTE (Full Time Equivalents) including the NASA Inspector General's office, was 18,807. As of early October 2005, the current rate is 18,630.

NASA is implementing the Vision for Space Exploration. In doing so, we are implementing an orderly retirement of the Space Shuttle by 2010, defining the architecture for space exploration, and accelerating the development of the new exploration vehicles and associated launch and support systems. We are continuing to work on the International Space Station, fulfilling our commitments to our partner countries. We are establishing an aeronautics program focused on technological advanced in cutting-edge areas of research and development. In addition, we are retaining a robust science portfolio.

These activities require a balanced workforce skill mix and productive NASA Centers to complete the work over several years. We are in the process of developing plans to reshape our workforce and capital asset portfolio to ensure that we can meet our goals. In the short term, however, we have an imbalance of skills at the Centers because we have not yet fully matched up the new and revised work with the existing workforce.

We have already taken several actions to reduce the uncovered capacity at the Centers, including two early retirement/buyout programs which resulted in approximately 650 employees retiring or resigning from the Agency. In addition, job fairs were held at NASA Centers, which resulted in 119 jobs offers and 95 placements. While these actions have helped reduce the extent of the problem, a significant imbalance still exists. As of early October 2005, the following uncovered capacity existed.

Center	Uncovered Capacity
ARC	246
GRC	268
LaRC	181
MSFC	226
Total	921

In August 2005, the senior leadership at NASA initiated an aggressive plan to reduce the uncovered capacity for fiscal year 2006 and fiscal year 2007, with the ultimate goal of avoiding or minimizing the need for a Reduction in Force (RIF) in fiscal year 2007. Targets numbers were established for each NASA Center to either identify program work within their Center for their own uncovered personnel or identify work packages from existing or newly-assigned programs that other Centers can perform. The goal is to assign work equitably to maintain a reasonable balance among 10 healthy NASA Centers. A team of representatives from all NASA Centers and Mission Directorates are working together to identify the competencies available at the Centers and the work packages available for placement. Work packages will be transferred as soon as possible, with a goal of completing the action no later than June 2006. At that time, an assessment will be performed to determine the remaining uncovered capacity and the likelihood of NASA needing those com-

petencies in the near future. For those competencies that will not be needed, RIF proceedings will be initiated, with a targeted implementation date in fiscal year 2007.

By identifying required skills and working collaboratively to match those skills with funded work, NASA intends to retain the expertise we'll need to achieve the Vision for Space Exploration.

Question. What is NASA's total estimated cost to develop and implement IFMP?

Answer. Development and implementation of IFMP (now Integrated Enterprise Management Program) will be completed in fiscal year 2008. Investment through that time will be $662.6 million.

AERONAUTICS

Question. NASA's requested budget for aeronautics in fiscal year 2006 is $852 million, a reduction from $906 million this year. Further reductions are projected for fiscal year 2007. According to the program, this will mean the elimination of about 1,100 jobs at NASA centers. Since coming on board as NASA Administrator, have you reexamined these proposals? Do you anticipate modifying them at all?

How does NASA reconcile the National Institute of Aerospace's call for increased funding with NASA's funding stream which can only be interpreted as de-emphasizing aeronautics research and development? To what extent is NASA using the NIA report in its planning for future aeronautics research investment?

Answer. NASA is using the NIA report, along with the Congressionally directed Joint Program and Development Office report on the Next Generation Air Transportation System, the report of the Congressionally-chartered Commission on the Future of the U.S. Aerospace Industry, past reviews by the National Research Council, and the newly formed Decadal Survey of Civil Aeronautics, to contribute to identification of potential opportunities for additional research and establishment of priorities for aeronautics programs and projects. NASA agrees with the national needs and critical aviation technology sectors called out in the NIA report. We are beginning to address the technological needs listed in the NIA report by initiating a national dialogue within the Executive Branch and the Congress about the future of aeronautics research and the role of the Federal government in this research arena. In addition, H.R. 2862, the fiscal year 2006 Science, State, Justice, Commerce, and Related Agencies appropriations bill calls upon the President to develop a comprehensive, national aeronautics policy similar to the one we now have for space exploration. In a Statement of Administration Policy regarding H.R. 2862, the Administration endorsed the Committee's call for the development of a national aeronautics policy. While the NIA report makes several significant and useful recommendations, the doubling of the aeronautics budget will not be possible to achieve within projected funding levels for NASA. Rather, NASA must ensure that our current investments in aeronautics research and technology are prioritized and effective.

The Agency is addressing its workforce and institutional issues with two teams. The NASA Workforce Transition Review team is focusing on identification of additional work the Agency needs done in the near future that both contributes to the Agency's mission agenda and which could be directly assigned to NASA Centers. The Systems Engineering and Institutional Transitions Team (SEITT) is conducting a long-term study focused on the institutional requirements needed to ensure the Agency's goals are met with minimum cost, maximum reliability, and measurable high performance. NASA is attempting to identify additional activities from other Agency programs, such as Exploration Systems, to assign to Agency Research Centers, but it remains unclear whether this will totally resolve projected "uncovered capacity" within the Agency workforce by the end of fiscal year 2006.

As NASA Administrator, I am working to the best of my abilities to resolve these workforce issues, and I will continue to work with the Congress to resolve them.

SCIENCE

Question. Funding constraints are forcing difficult choices in NASA's Science programs. What process or processes, and criteria, do you use to prioritize among your space and earth science programs that are in planning or development? For example, the National Research Council prepares decadal strategies that prioritize within particular disciplines (planetary exploration, astrophysics, etc.), but what mechanism and criteria does NASA use to prioritize across disciplines? Similarly, how do you determine which existing probes—such as Voyager—should be turned off because they are past their design lifetimes, even though they continue to return useful data? What is the status of your decision-making on whether or not to turn off Voyager?

Answer. NASA works to maintain a balanced portfolio of investment over time among the several disciplines in the Earth and Space Sciences. We start from the baseline of existing programs and most recent strategic plans, and update them based on recent progress, Presidential initiatives, and science community advice. As you point out, the NRC decadal surveys are very useful in prioritizing within major disciplines. In any given period, choices among programs in different disciplines can be driven by recent scientific discovery, technology readiness, or partnership opportunities that can leverage NASA's investment. A chief factor is "science value"—the anticipated scientific return per dollar investment—though that is not always readily estimable. Over the longer term, portfolio balance is maintained as we listen to our stakeholders in the science community and the Executive and Legislative branches of government.

Regarding extension or termination of existing probes and satellites that have fulfilled their prime missions, NASA also relies heavily on science value as determined by independent scientific peer review. Those nearing or beyond their prime mission (the period of operation proposed when selected) are subjected to a Senior Review Process. In this process, mission science teams are required to submit a proposal describing what science they propose to accomplish via continued operation, and at what cost. An independent panel of external scientists reviews, evaluates, and scores the proposals on their merits. NASA uses this ranking in deciding which missions to operate and for how long, given the funds available.

There are currently 12 operating missions funded within the Earth-Sun System division of NASA's Science Mission Directorate that have fulfilled their primary mission and are in the extended mission phase, including Voyager 1 and 2. Additional funding is identified in the President's fiscal year 2006 budget amendment to maintain continued operation of the fleet of spacecraft conducting space and solar physics missions pending decisions on scientific priorities to be made once NASA receives input from both the Sun-Earth Connection and Earth System Science Senior Review Panels. These Panels, composed of external and independent senior researchers with relevant knowledge and experience, meet periodically to review proposals for innovative research, accomplished with existing space assets. NASA will permit the Sun-Earth Connection missions to operate while the Senior Review process provides for a new assessment of the future scientific value of these operating missions. At the conclusion of the Panels' deliberations, NASA will use their assessment and findings to develop Agency decisions regarding the continued operation of these missions.

Question. The National Research Council recently issued an interim report on NASA's Earth Science program, saying that it is "at risk," citing reduced funding levels for Earth Science projects following the announcement of the Vision for Space Exploration. What is your reaction to that report?

Answer. While funding for Earth science declined in the fiscal year 2005 budget request, the Earth science budget was largely protected from further reduction in the fiscal year 2006 request. The President's fiscal year 2006 budget amendment reallocates funding within the Science Mission Directorate to focus resources on near-term requirements while deferring investments in longer-term activities. Specifically, the Earth-Sun Theme is increased by $88.3 million to fully fund a standalone Glory mission, provide additional funding for extending the missions of currently operating satellites, and maintain the launch schedule for the Solar Dynamics Observatory. To the extent possible, we will address some concerns raised in their interim report in the fiscal year 2007 budget process. We look forward to receiving the NRC's decadal survey report for Earth science (expected around the end of next year), which will help guide NASA's future investments in Earth science and observation.

Question. The fiscal year 2006 budget request and its projections through 2010 assume a cut of about $1 billion to programs within the new Science Mission Directorate compared with the fiscal year 2005 budget projections. How much of that $1 billion cut was taken from programs previously under the former Office of Space Science versus those in the former Office of Earth Science?

Answer. Given past budget reductions to former Office of Earth Science programs, the Science Mission Directorate protected these programs from further reductions in the fiscal year 2006 budget request. As a result, the vast majority of reductions contained within the fiscal year 2006 budget request for the Science Mission Directorate came from planned growth in programs previously part of the Office of Space Science. Of the reductions in the Earth-Sun System Theme, only the Earth System Science Pathfinder (ESSP) program and Glory reductions affected programs from the former Earth Science Enterprise. It is important to note that the reduction to ESSP was used to offset a budget increase for the Hydros mission. The fiscal year 2006 budget request has since been amended to increase funding for the Earth-Sun System Theme by $88.3 million to fully fund a standalone Glory mission, provide

additional funding for extending the missions of currently operating satellites, and maintain the launch schedule for the Solar Dynamics Observatory. All reductions in the fiscal year 2006 budget amendment in the Solar System Exploration and Universe division budgets were taken from former Office of Space Science programs.

Question. What is the status of planning to send a probe to further study Jupiter's moon Europa? NASA proposed a Europa mission in fiscal year 2002, but replaced it a year later with the Jupiter Icy Moons Orbiter (JIMO). Now JIMO has been indefinitely deferred. Does the planetary science community still have a Europa mission at the top of its list for the next large-class planetary mission? If so, when do you expect to launch such a probe?

Answer. The 2003 National Research Council decadal survey report entitled, "New Frontiers in Solar System Exploration: An Integrated Exploration Strategy," identified a Europa mission as the top priority flagship-class mission (those missions costing $650 million or more). NASA recognizes the priority the scientific community places on the science returned from the Europa mission. Therefore, we are continuing to examine the technological challenges and our mission options for such a probe.

Question. You have stated that once the shuttle returns safely to flight, you will reexamine the option of a shuttle mission to service the Hubble space telescope. What has changed since your predecessor's decision that safety considerations preclude using the shuttle to service Hubble?

Answer. Based on analysis of the relative risks immediately following the loss of *Columbia*, NASA decided not to proceed with a Shuttle servicing mission. NASA's decision not to service the Hubble was a very difficult one, given the Hubble's record of spectacular successes. That decision was made at a time when significant uncertainty remained, regarding the technical solutions and risks associated with return to flight. After the two successful Space shuttle flights needed to achieve our return to flight objectives, NASA will have learned a great deal more regarding the risks and operations of the vehicle than was known when the previous decision was made. The Administrator has committed to reassess the earlier decision, after return to flight, based on the relative risks to the Space Shuttle as well as our efforts to preserve the option for a Shuttle servicing mission for Hubble in advance of that decision. He has further indicated that he will make a decision regarding a Shuttle servicing mission for Hubble following the second successful Return to Flight mission. In the interim, the Agency has funded the option for a Hubble servicing mission in the fiscal year 2005 Operating Plan at $291 million. In addition, $30 million has been included in the President's fiscal year 2006 budget amendment to continue to preserve the option for a Hubble servicing mission, pending the second return to flight mission of the Space Shuttle. NASA will keep the Committee informed of our efforts and conclusions in this regard.

Question. Is the option of servicing Hubble robotically now completely off the table? What is the last date at which a decision could be made to service Hubble robotically? What have we learned from the work that was done on this option?

Answer. Based on analysis of the relative risks immediately following the loss of *Columbia*, NASA decided not to proceed with a Shuttle servicing mission (the previously planned Servicing Mission 4, or SM–4). That decision was made at a time when significant uncertainty remained regarding the technical solutions and risks with Return to Flight. In response to Congressional direction, NASA tasked the National Academy of Sciences (NAS) to examine all reasonable options for extending the lifetime of the HST. The NAS concluded that it was "highly unlikely that NASA will be able to extend the science life of [Hubble] through robotic servicing," and recommended that "[a] robotic mission approach should be pursued only to de-orbit Hubble." Consistent with the conclusions of the NAS study, NASA discontinued the robotic servicing effort this past spring.

In the future, however, robotic concepts for an eventual de-orbit mission for HST may be considered, and, in the meantime, much of the work done for the robotic servicing concept is being used in developing new capabilities needed for the Exploration Vision as well as other advanced robotics concepts. The Agency believes that an aggressive use of robotics in the Exploration Vision is required to execute many of the elements of that program.

Question. If NASA proceeds with a Hubble servicing mission, and it is successful, how much longer will Hubble operate? What will be the annual operating costs for extending Hubble's lifetime? What impact will these additional costs have on other NASA astronomy programs? At the end of Hubble's extended lifetime, should we anticipate calls for yet another extension?

Answer. The expected (design) life of the equipment planned for the potential SM–4 is 5 years. That said the design of the HST and its hardware is robust and redundant. The Agency has not done an extensive analysis of the potential lifetime of the

HST after servicing, but the prime mechanism for the end of science is loss of the fine pointing gyroscopes. With new batteries, gyros, and science instruments installed on SM–4, and the improved operational concepts developed as part of the ongoing life extension program, it is reasonable to expect that the system as a whole will be producing quality science for up to 7 years after servicing.

The cost of operations of the HST after servicing depends on several variables, including the amount of overlap with other programs using the Space Telescope Science Institute (STScI) and the outcome of negotiations with the contracted management organization. It is expected that it will cost less to operate the HST in the future if there are no subsequent servicing missions.

Existing operational missions should not be impacted by additional years of operations of the HST. At present, we have budgeted sufficient funds to operate the telescope until the end of our present budget cycle. The greatest impact to Space Science has been and continues to be the additional costs driven by the delay in SM–4 due to the Shuttle accident and NASA's goal to demonstrate two successful Shuttle Return to Flight missions before proceeding with a Hubble servicing mission.

After SM–4, any future required servicing, if desired, to further extend the life of HST, would be after the retirement of the Shuttle fleet.

EXPLORATION

Question. The fiscal year 2006 budget request indicates that NASA plans to spend through fiscal year 2010 over $10 billion on the Earth Orbit Capability (Spiral 1) program to develop, demonstrate and deploy the capability to safely transport a crew to and from earth orbit, by 2014, in preparation for future missions to the moon. The five-year forecast in your fiscal year 2006 request shows steep increases in anticipated funding needs for the Spiral 1 program in fiscal years 2009 and 2010. What is a reasonable timeframe in which we could expect you to share the total cost of the Spiral 1 program and future Spirals with the Congress?

Answer. Exploration Systems is no longer using the term "Spiral" to categorize its development process. The initial capability developed by the Constellation Program will be transportation of crew and supplies to the International Space Station in low-Earth orbit.

As part of its Exploration Systems Architecture Study, the Agency has completed preliminary cost estimates for the new Exploration architecture. NASA has briefed Committee staff on these estimates and the methodology followed to arrive at them.

Question. You said last year that the issue wasn't whether there was enough money allocated to the Vision, but "why we are expecting so little for the money which has been allocated?" How, specifically, will you get more "bang for the buck" as you execute the Vision?

Answer. In order to provide the maximum return for the taxpayer's investment, NASA must make priority decisions within the exploration program by focusing on those activities that are best able to produce significant results, and by ensuring that individual programs complement each other.

In September, NASA promulgated an integrated exploration architecture derived from the Vision for Space Exploration that specifies the capabilities necessary for future exploration activities. Based on that architecture, clear priorities have been established to focus NASA efforts on those development activities designed to provide the greatest return to the taxpayer. Teams have been established to assess how to best utilize our resources and workforce to ensure that we get the most "bang for the buck." Funds have already been redirected from projects that do not need immediate funding (such as Project Prometheus) towards those that do (e.g., the CEV). Additional cost savings and efficiencies will be realized through a careful, focused transition between Shuttle infrastructure and new exploration capabilities. These new capabilities will create new opportunities for exploration, discovery and understanding.

Question. NASA has announced that it will accelerate its plans for the Crew Exploration Vehicle. Given this maiden flight was not to have occurred until 2014, where do you anticipate the associated funding will come from and which NASA programs will be impacted as the result of advancing the development of the CEV? What steps would you take to ensure that accelerating the program would not lead to excessive cost growth and/or technical risk?

Answer. The capability to accelerate the development of the CEV will be driven by development schedules, test schedules, safety considerations, and funding. These were areas of interest for the Exploration Systems Architecture Study (ESAS).

To stay within planned budget guidance for Exploration Systems while accelerating CEV and these launch systems, it is necessary to redirect existing funding

for longer-term and lower-priority research and technology (R&T) elements within the Exploration Systems Mission Directorate (ESMD), while focusing on those R&T activities that support the acceleration of the CEV, launch systems, and high-priority, long-lead items.

In the fiscal year 2006 budget amendment, $292 million was identified as moving from R&T activities into Constellation for CEV and CLV acceleration.

Constellation Systems.—NASA plans to accelerate the timeline for flight of the next human flight system by two years, from 2014 to a goal of not later than 2012. The first flights will be to the International Space Station (ISS), but the primary goal of the CEV is to support exploration efforts, including enabling humans to return to the Moon for week-long stays as early as 2018, but no later than 2020. Longer-duration human presence on the Moon is targeted for 2022. The changes in the R&T programs will provide funds required to accelerate the design, development, and fabrication of the elements and systems needed to support a return to the Moon on the above timeline.

Human System Research and Technology.—NASA is focusing HSRT funding on program elements that mature technologies needed to support ISS access and lunar sortie missions, while reducing program elements targeting longer-term or lower priority needs. As NASA concentrates the use of the Shuttle on ISS assembly, ISS utilization will be deferred.

Exploration Systems Research and Technology.—NASA is realigning projects to support the ESAS recommended architecture requirements. This realignment has resulted in a focused and phased, requirements driven, R&T program in which some projects are curtailed, some are adjusted, and some are added. Ongoing projects are streamlined to deliver Technology Readiness Level 6 capabilities when needed (system preliminary design review) so as to enable the CEV, launch systems, and lunar lander development schedules. Examples of technology projects focused on the near-term include ablative thermal protection and oxygen-methane propulsion for CEV. Additional work is phased in after the first few years for lunar lander propulsion systems and non-toxic power and reaction control for launch vehicles. Finally, funding for technologies, such as in situ resource utilization (ISRU) and those applicable to lunar surface systems, are phased in only during the out years. Discontinued, descoped or delayed technology projects include nanomaterials, inflatable structures, large-scale solar power, intelligent robotic systems, Mars mission specific technologies, and electric propulsion. Transitional action is being taken in fiscal year 2005 to discontinue plans for 80 tasks and activities, previously planned at $206 million in fiscal year 2006, which do not directly support ESAS architecture or schedule requirements. These actions will yield $174 million in fiscal year 2006 that will be applied towards accelerated development of CEV and CLV.

Prometheus Research and Technology.—Program elements have been deferred as a result of the ESAS architecture study. Surface nuclear power systems to support potential long-duration stays on the Moon will not be required until after 2018. Nuclear propulsion will not be required until planning for Mars missions begins in earnest. The result will be a total reformulation in the nuclear program, yielding $76 million in fiscal year 2006 to accelerate development of CEV and CLV. NASA's funding of the DOE's Naval Reactors program, the JIMO mission, and several technology research programs related to electric propulsion will be curtailed.

Further, in order to reduce cost and technical risks, ESMD and Constellation Systems are currently investigating innovative approaches to software development, early incorporation of operational expertise into the program, a lean program and theme office, and a robust oversight role for the theme and program.

Question. Generally speaking, do you anticipate that the decision to merge the EELV programs will save money for the government, and specifically for NASA? If so, how will it save money, and how much?

Answer. The Department of Defense is in the best position to evaluate impacts to EELV due to changes in the program structure. Nonetheless, NASA is an important customer for EELV and we are very interested in potential efficiencies that could reduce our costs over the long run.

We have been following the initiative to consolidate elements of the individual EELV programs into common, integrated activities under the proposed "United Launch Alliance (ULA)." We understand that this initiative could drive economies of scale and allow us to reduce the individual "standing armies" that contribute to fixed costs for each of the EELV programs. This approach holds some potential for significant cost savings and we look forward to benefiting from them if and when they occur. However, we have not evaluated the ULA proposals in enough detail to quantify any potential cost savings.

Question. Considering the large amount of information that we have from the Apollo program, and the number of lunar probes being launched by other countries,

why does NASA plan to launch lunar probes of its own prior to a human return to the Moon? Please explain what these probes will be doing that is crucial to accomplishing the President's goal. What is the status of planning for these lunar probes?

Answer. NASA intends to launch lunar probes—including orbiters and lenders—in order to prepare for extended human presence on the Moon. As a synergistic benefit, NASA also expects to contribute to the advancement of scientific knowledge of the Moon, which in turn will advance our understanding of our own planet's evolution.

As noted in the question, other countries are also launching probes to the Moon. NASA expects to take full advantage of the knowledge gained from those probes. However, there are more questions NASA must answer to meet the lofty goals of the Vision for Space Exploration. NASA probes will focus on filling gaps in knowledge needed to ensure the safety of future human missions to the Moon. They will address specific questions related to human exploration of the Moon, and demonstrate key technologies required for future human missions. The programs are designed to avoid unnecessary redundancy and take full advantage of the results from other probes.

For example, NASA is planning a Lunar Reconnaissance Orbiter (LRO) launch in 2008, which will provide a much higher fidelity map of a larger portion of the lunar surface, especially the poles, than is offered by any other probe. Such a map is critical for selecting future sites for human landing. LRO instruments will also provide information to help NASA protect our astronauts from the Moon's radiation environment and to identify likely sources of water.

Shortly after the LRO mission, NASA plans to send a lander to the Moon. This lander will help demonstrate precision navigation techniques that will be important for positioning humans on the exact lunar landing site of choice. It will conduct a more detailed survey of a potential human landing site and confirm the existence and composition of resources that can support an extended human presence. Eventually, lenders may demonstrate capabilities needed for extended human presence, such as the ability to convert lunar water into hydrogen and oxygen for life support and propulsion.

In summary, NASA's lunar probes are intended to meet the needs of the Vision for Space Exploration. Other probes complement planned NASA lunar probes. We design our probes to provide additional knowledge critical to ensuring future successful human missions to the lunar surface.

SPACE OPERATIONS: THE INTERNATIONAL SPACE STATION (ISS) AND THE SPACE SHUTTLE

Question. What is your current cost estimate for returning the space shuttle to flight status—for fiscal year 2005 and fiscal year 2006, specifically, and the total cost (fiscal year 2003–2009)?

Answer. NASA's estimate for Space Shuttle Return to Flight (RTF) costs from fiscal year 2003 through the end of fiscal year 2006 is just over $1.4 billion. Overall, Return to Flight costs are stabilizing as technical solutions have reached maturity and implementation of solutions nears completion. The estimates provided in the latest Implementation Plan for Space Shuttle Return to Flight and Beyond, dated June 3, 2005 (attached), remain valid and have not substantially changed since November 2004. Management tools are in use to monitor progress and provide early warning of potential problems. However, the potential exists for additional content that may be required in the post-Return to Flight time frame depending on the ongoing work addressing issues seen during STS–114 and the results of the Shuttle's performance on the second Return to Flight mission, STS–121.

Current estimates for RTF costs are: Fiscal year 2003—$42 million; fiscal year 2004—$496 million; fiscal year 2005—$602 million; and fiscal year 2006—$288 million.

If there are any increases in Return to Flight costs, NASA is committed to accommodating them within its total budget request.

Actual costs to date are tracking very closely with the November 2004 estimate provided to Congress. The total estimated cost for returning the Shuttle to flight status through fiscal year 2009 is approximately $1.98 billion. The outwear costs are associated with added manpower for Systems Engineering. NASA's plan and our budget reflect the end of RTF after the second RTF mission and subsequent post-flight assessment actions. These milestones will take the Agency through most of fiscal year 2006. RTF, from a budget perspective, will end in fiscal year 2006, and will no longer be tracked as a separate effort, beginning in fiscal year 2007.

RETURN TO FLIGHT COST SUMMARY

Proposed Program solutions for all return to flight (RTF) actions are reviewed by the Space Shuttle Program Requirements Control Board (PRCB) before receiving final NASA implementation approval. The PRCB has responsibility to direct studies of identified problems, formulate alternative solutions, select the best solution, and develop overall cost estimates. The membership of the PRCB includes the Space Shuttle Program Manager, Deputy Manager, all Project and Element Managers, Safety and Mission Assurance personnel, and Management Integration and Planning Office. This process applies to solutions to the *Columbia* Accident Investigation Board (CAIB) recommendations as well as to the Space Shuttle Program (SSP) corrective actions.

In the process of down-selecting to two or three "best options," the projects and elements approve funding to conduct tests, perform analysis, develop prototype hardware and flight techniques, and/or obtain contractor technical expertise that is outside the scope of existing contracts.

The Space Flight Leadership Council (SFLC) is regularly briefed on the overall activities and progress associated with RTF and becomes directly involved when the SSP is ready to recommend a comprehensive solution to a CAIB recommendation or an SSP corrective action. The SFLC receives a technical discussion of the solution as well as an assessment of cost and schedule. With the concurrence of the SFLC, the SSP then receives the authority to proceed. The membership of the SFLC includes the Associate Administrator for the Office of Space Operations, Associate Deputy Administrator for Technical Programs, Deputy Associate Administrator for ISS [International Space Station] and SSP, Associate Administrator for Safety and Mission Assurance, Space Shuttle Program Manager, and the Office of Space Operations Center Directors (at Johnson Space Center, Kennedy Space Center, Marshall Space Flight Center, and Stennis Space Center).

All recommended solutions are further reviewed, for both technical merit and to determine whether the solution responds to the action, by the Return to Flight Task Group (also known as the Stafford-Covey Task Group).

Processes established by NASA to estimate and capture all costs related to RTF have steadily improved the accuracy of Agency budget forecasts. As the technical plan for RTF has matured, so the cost estimates have matured. NASA incurred costs in fiscal year 2003, valued at $42 million, to initiate RTF actions based on preliminary CAIB recommendations. Since November 2003, additional corrective actions have been initiated, in accordance with the process described above and based on the final CAIB Report recommendations and internal SSP actions.

During fiscal year 2004, RTF activities moved rapidly from planning to execution, with several key option "downselect" decisions being made by the end of the year. The July 2004 RTF cost estimate is considered the first credible Agency projection because it was based on a more mature technical plan. NASA estimated that RTF activities in fiscal year 2004 would cost about $465 million. By the end of the year, the actual costs totaled $496 million. The costs incurred included work carried over from fiscal year 2003 as well as late-year changes in fiscal year 2004 technical content.

The value of RTF activities for fiscal year 2005 is estimated at $602 million, of which $413 million have been approved through the PRCB. Of the remaining $189 million, $73 million represent the estimated value of work review by the control board, but with additional technical effort required before a directive is released, and $116 million is the value of activities that are still in technical definition. As NASA gains actual flight experience, the estimates for fiscal year 2005 and fiscal year 2006 will be adjusted and the changes will be reported to Congress as soon as they are fully assessed.

Fiscal year 2006 is planned to be a transition year for the Shuttle Program. RTF technical content that must be sustained for the Program's remaining service life, along with the workforce required to continue safe flight, will be absorbed into the Program's baseline. Therefore, at the end of fiscal year 2006, RTF costs will no longer be budgeted or reported separately.

Excluded from the cost estimates provided below are other RTF-related funding requirements resulting from a complete evaluation of *Columbia* accident impacts across the Program, such as replacement of hardware (e.g., cargo integration, Orbiter pressure tanks). Several solutions to improve NASA's culture and some of the Program's actions detailed in "Raising the Bar—Other Corrective Actions" are integrated into existing processes and do not always require additional funding.

TABLE 1.—RETURN TO FLIGHT BUDGET ESTIMATES/IMPLEMENTATION PLAN MAP FOR NEW ESTIMATES INCLUDING THREATS [1]

[Dollars in millions]

		Fiscal year—				Recommendation Numbers Map to Implementation Plan																				
						CAIB #																				SSP Rec-ommen-dation
		2003	2004	2005	2006	3.2–1	3.3–1	3.3–2	3.3–3	3.3–4	3.3–5	3.4–1	3.4–2	3.4–3	3.8–1	4.2–1	4.2–2	4.2–3	6.2–1	6.4–1	7.5–1	7.5–2	7.5–3	9.1–1	9.2–1	
([2])	Total Initiated SSP RTF Activities	42	496	602	288	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
RE/RP	Orbiter RCC Inspections and Orbiter RCC–2 Shipsets Spares	.....	39	41	5	.....	X	X	.....	.....	.....	.....	.....	.....	X	.....	.....	.....	.....	X	.....	.....	.....	.....	.....	.....
RE/RP	On-orbit TPS Inspection and EVA Tile Repair	20	71	167	49	.....	.....	.....	.....	.....	.....	.....	X	.....	.....	.....	.....	.....	.....	X	.....	.....	.....	.....	.....	X
	Orbiter Workforce	.....	.....	38	46	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	X	.....	.....	.....	X	.....	.....	X
RE/RP	Orbiter TPS Hardening	.....	29	1	.....	.....	.....	X	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
	Orbiter/GFE	.....	8	4	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
RE	Orbiter Contingency	.....	8	4	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
RE/RP	Orbiter Certification/Verification	.....	47	9	.....	.....	X	.....	X	X	.....	.....	.....	.....	.....	.....	X	.....	X	.....	.....	.....	.....	.....	X	X
RE/RP	External Tank Items (Camera, Bipod Ramp, etc.)	10	93	88	14	X	.....	.....	.....	.....	.....	.....	.....	X	.....	.....	.....	X	.....	.....	.....	.....	.....	.....	.....	.....
RE/RP	SRB Items (Bolt Catcher, ETA Ring Invest., Camera)	1	14	4	.....	.....	.....	.....	.....	X	.....	.....	.....	X	.....	X	.....	.....	.....	.....	.....	.....	.....	.....	.....	X
RE/RP	Ground Camera Ascent Imagery Upgrade	8	40	13	11	.....	.....	.....	.....	.....	.....	X	.....	.....	.....	.....	X	X	.....	X	.....	.....	.....	.....	.....	.....
	KSC Ground Operations Workforce	.....	15	38	42	.....	.....	.....	.....	.....	X	.....	.....	.....	.....	.....	X	X	.....	X	.....	.....	.....	.....	.....	X
RE/RP/AC	Other (System Intgr. JBOSC Sys. Full Cost, Additional FTEs, etc.)	4	132	178	121	.....	X	X	X	X	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	X	X	X	X	.....	X
RE/RP	Stafford-Covey Team	([3])	[4] 1	[5] 4	([6])	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	X
	Other RTF Related: NASA Engineering and Safety Center (NESC) [7]	.....	45	77	79	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	X	X	X	.....	.....

RE = Reestimated Item; RP = Rephased; AC = Added Content.

[1] These estimates could change due to improved estimates, additional tasks, and added scope as we better understand the implementation of RTF recommendations.

[2] This update includes added scope of work and improved estimates. RTF costs are stabilizing as technical solutions reach maturity. The Congress will be kept informed as we refine these requirements and associated cost estimates.

[3] NASA assumed an estimate of $94 million in budget authority for fiscal year 2003 of which $52 million of fiscal year 2003 planned work and associated cost were carried into fiscal year 2004.

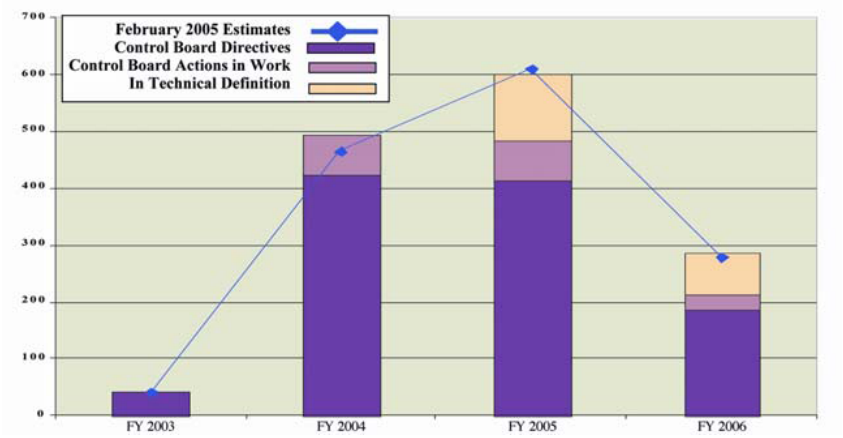
[4] The fiscal year 2004 RTF cost estimate of $496 million includes $423 million of activities that have been approved for implementation. The remaining $73 million of RTF activities are pending approval. As soon as these additional activities are definitized, they will be shared with Congress.

[5] The fiscal year 2005 RTF cost estimate of $602 million includes $413 million of activities that have been approved for implementation. Of the remaining $189 million potential, $73 million is in work and $116 million of activities are in technical definition. As soon as these additional activities are definitized, they will be shared with Congress.

[6] The fiscal year 2006 RTF cost estimate of $288 million includes $188 million of activities that have been approved for implementation. Of the remaining $100 million potential activities, $26 million is in work and $74 million of activities are in technical definition. As soon as these additional activities are definitized, they will be shared with Congress.

[7] The NASA Engineering and Safety Center (NESC) is funded through NASA's Corporate G&A. The NESC at NASA's Langley Research Center in Hampton, VA, provides comprehensive examination of all NASA programs and projects. The Center thus provides a central location to coordinate and conduct robust engineering and safety assessment across the entire Agency.

CHART 1.—FEBRUARY 2005 RTC/CAIB ESTIMATES



	Fiscal year—			
	2003	2004	2005	2006
Estimates Published in July 2004	42	465	643	331
Value of Control Board Directives Issues	42	423	413	188
Estimates for Control Board Actions Work	.....	73	73	26
Estimates for Activities Still in Technical Definition	.....	.....	116	74
Total Board Actions/Pending Board Actions	42	496	602	288

TABLE 2.—FEBRUARY 2005 RTF STATUS

	Fiscal year—			
	2003	2004	2005	2006
RTF Activities—Control Board Directive	42	423	413	188
RTF Activities—Been to Control Board/Awaiting	.....	73	73	26
RTF Activities—In Review Process	.....	.....	116	74
TOTAL RTF	42	496	602	288
RTF Activities—Control Board Directive:				
Orbiter RCC Inspections & Orbiter RCC–2 Shipsets Spares	.....	39	22	.....
On-Orbit TPS Inspection & EVA Tile Repair	20	71	151	20
Orbiter Workforce	.....	.....	33	41
Orbiter Hardening	.....	29	1	.....
Orbiter/GFE	.....	7	4	.....
Orbiter Contingency	.....	8	12	.....
Orbiter Certification/Verification	.....	47	.....	.....
External Tank Items (Camera, Bipod Ramp, etc.)	10	42	25	2
SRB Items (Bolt Catcher, Camera)	1	14	4	.....
Ground Camera Ascent Imagery Upgrade	8	40	13	11
KSC Ground Operations Workforce	.....	15	38	42
Other (System Intgr., JBOSC Sys., SSME Tech. Assess, Ground Ops Workforce)	4	110	107	71
Stafford-Covey Team	.....	1	4	.....
Total, RTF Activities—Control Board Directive	42	423	413	188
RTF Activities—Been to Control Board/Awaiting:				
Orbiter RCC Inspections & Orbiter RCC–2 Shipsets Spares	.....	.....	.....	.....

TABLE 2.—FEBRUARY 2005 RTF STATUS—Continued

	Fiscal year—			
	2003	2004	2005	2006
On-Orbit TPS Inspection & EVA Tile Repair			6	8
Orbiter Workforce			5	5
Orbiter Hardening				
Orbiter/GFE				
Orbiter Contingency			5	
Orbiter Certification/Verification				
External Tank Items (Camera, Bipod Ramp, etc.)		51	50	9
SRB Items (Bolt Catcher, Camera)				
Ground Camera Ascent Imagery Upgrade				
KSC Ground Operations Workforce				
Other (System Intgr., JBOSC Sys., SSME Tech. Assess, Ground Ops Workforce)		22	7	4
Total RTF Activities—Been to Control Board/Awaiting		73	73	26
RTF Activities—In Review Process:				
Orbiter RCC Inspections & Orbiter RCC–2 Shipsets Spares			19	5
On-Orbit TPS Inspection & EVA Tile Repair			10	21
Orbiter Workforce				
Orbiter Hardening				
Orbiter/GFE				
Orbiter Contingency				
Orbiter Certification/Verification			9	
External Tank Items (Camera, Bipod Ramp, etc.)			14	3
SRB Items (Bolt Catcher, Camera)				
Ground Camera Ascent Imagery Upgrade				
KSC Ground Operations Workforce				
Other (System Intgr., JBOSC Sys., SSME Tech. Assess, Ground Ops Workforce)			64	46
Total RTF Activities—In Review Process			116	74

Question. You have said that the United States will (1) terminate the space shuttle by 2010, and (2) fulfill our commitments to the partners in the International Space Station (ISS) program. How will that be accomplished, considering that the partners were relying on the availability of the shuttle during the operational phase of the ISS program?

Answer. NASA is currently studying the options, including the utilization of commercial or partner vehicles and acceleration of the Crew Exploration Vehicle, to meet our obligations to our International Partners and to meet our commitment to retire the Shuttle by 2010.

Question. Under what circumstances would you advocate waiver of the Iran Nonproliferation Act?

Answer. Section 6 of the Iran Nonproliferation Act of 2000 (Public Law 106–178) (INA) restricts U.S. Government payments, in cash or in kind, to certain Russian entities for work related to human space flight, including the International Space Station (ISS). Section 6 adversely impacts U.S. interests by limiting/eliminating U.S. human access to space and pursuit of the President's Vision for Space Exploration. Russia has said they will no longer provide critical ISS crew rescue and logistics services and have publicly stated their intention to interrupt Soyuz training for 2006 ISS U.S. astronauts unless they are compensated. The United States is dependent on Russia for Soyuz crew rescue with no other options until the new NASA Crew Exploration Vehicle is available. By April 2006, INA restrictions will prevent the United States from maintaining American crew members on the ISS expect during Space Shuttle visits.

On July 12, 2005, the Administration proposed to Congress an amendment to INA to advance U.S. Government interests by enabling NASA's work and cooperation with the Russian Federal Space Agency to proceed: (1) operationally on the ISS and meet U.S. commitments to International Partners; and (2) programmatically in implementing the Vision for Space Exploration in a manner that maintains the strong commitment of the U.S. Government to nonproliferation. The Administration's proposed amendment took into consideration Congressional concerns voiced to date by

proffering an amendment that retained all nonproliferation elements of INA (Sections 1–5) and made a minimal change to definition in Section 6 which, in effect, removed the prohibition on payments to Russian entities related to most ISS and human space flight activities.

The Senate passed S. 1713, the Iran Nonproliferation Amendments Act of 2005, by unanimous consent on September 19, 2005. As passed, the measure amends INA to a limited degree, allowing NASA to meet near-term ISS operational and programmatic needs, but maintaining the restrictions of the INA for any payments related to human space exploration, and for ISS-related payments, beyond January 1, 2012.

Question. If NASA is unable to get relief from the Act, how do you plan to provide crew rotation/rescue services?

Answer. Assured crew return is an important safety protection under current ISS operational plans. Should the Soyuz vehicle be unavailable at any time in the future, U.S. crews would only be maintained on the ISS while the Space Shuttle or a potential future vehicle capable of serving as a crew rescue vehicle (e.g., the CEV or a commercial crew transfer vehicle) is docked.

Question. What are the potential costs to NASA if you are given the authority to purchase crew rotation/rescue services from Russia?

Answer. Actual costs are subject to negotiations with Russia, but NASA anticipates that the total amount of purchases of crew and cargo services from Russia would fit within the total funds appropriated by Congress for fiscal year 2005 and requested for fiscal year 2006 for the ISS Cargo and Crew Services budget line. [Fiscal year 2005—$98 million; fiscal year 2006—$160 million; fiscal year 2007—$160 million; fiscal year 2008—$160 million; fiscal year 2009—$500 million; and fiscal year 2010—$890 million.] Costs for other services would fit within the total ISS budget.

Question. What decision has been made about whether to continue building the centrifuge? How much has Japan spent on it to date? If NASA decides the centrifuge no longer is needed for ISS, are there alternative uses for it? Will NASA have to reimburse Japan for its costs if the program is canceled? What other termination costs would be associated with a decision to cancel it?

Answer. Pursuant to the NASA-Government of Japan Memorandum of Understanding for the International Space Station (ISS) and an Agreement in Principle for JEM Launch Offset, Japan is developing the U.S. Centrifuge for NASA to partially offset NASA's costs for launching the Japanese Experiment Module, Kibo, to the ISS.

On September 27, 2005, NASA informed officials from the Japan Aerospace Exploration Agency (JAXA) and the Japanese Ministry of Education, Culture, Sports, Science and Technology (MEXT) that the United States had withdrawn its requirements for development and launch of the U.S. Centrifuge Accommodation Module based on a re-prioritization of research requirements with greater focus on research having a direct and near-term benefit to the exploration mission.

NASA has not incurred termination costs and we believe we do not have an obligation to directly reimburse Japan for its costs. Under the arrangements described above, however, NASA is committed to launch the Japanese Experiment Module to the International Space Station in exchange for Japan's provision of the Centrifuge, associated hardware and H–IIA launch services.

Discussions are currently underway between NASA and Japanese officials to discuss the implications of this NASA decision including areas of continuing commitment by both parties.

While the Japanese Government has not provided NASA with the detailed Japanese budget for development of the U.S. Centrifuge, the following information is known:

—In April 2004, the Japan Aerospace Exploration Agency (JAXA) informed NASA that they had contracted $425 million to date for the Centrifuge. JAXA's estimate for total Centrifuge development costs at that time was $692 million.

Question. When will the Administration submit its plan to Congress for coping with the issues posed by the Iran Nonproliferation Act in terms of assuring access to ISS by U.S. astronauts after 2006? What can you tell us today about the strategy the Administration plans to take?

Answer. Section 6 of the Iran Nonproliferation Act of 2000 (Public Law 106–178) (INA) restricts U.S. Government payments, in cash or in kind, to certain Russian entities for work related to human space flight, including the International Space Station (ISS). Section 6 adversely impacts U.S. interests by limiting/eliminating U.S. human access to space and pursuit of the President's Vision for Space Exploration. Russia has said they will no longer provide critical ISS crew rescue and logistics services and have publicly stated their intention to interrupt Soyuz training

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The Senate passed S. 1713, the Iran Nonproliferation Amendments Act of 2005, by unanimous consent on September 19, 2005. As passed, the measure amends INA to a limited degree, allowing NASA to meet near-term ISS operational and programmatic needs, but maintaining the restrictions of the INA for any payments related to human space exploration, and for ISS-related payments, beyond January 1, 2012.

Question. How many Shuttle flights are needed to complete construction of the ISS? What is your plan if that number of flights cannot be accomplished by the end of 2010, when the Shuttle program is supposed to be terminated?

Answer. The NASA Administrator commissioned an assessment known as the Shuttle/Station Configuration Options Team (S/SCOT) study to evaluate options for the assembly and utilization of the ISS, taking into account the plan to retire the Space Shuttle by 2010 and honor U.S. commitments to the Space Station International Partners. The assessment also considered that Space Shuttle flight rate planning must account for the limitations of the Shuttle that became apparent after the loss of *Columbia*, namely that NASA's ability to successfully conduct 28 Shuttle flights by 2010 was no longer technically feasible.

The results of the study now have been thoroughly reviewed by the Space Operations Mission Directorate and other NASA offices and the Administrator has approved a plan for discussion with the ISS International Partners. The International Partners were informed of NASA's proposed approach the week of September 26, 2005.

NASA is operating under four key parameters:

—Retiring the Shuttle by the end of fiscal year 2010;

—Developing an achievable and robust Shuttle flight manifest;

—Meeting our International Partner commitments; and

—Completing the Space Station with a sustainable configuration with acceptable vehicle and crew risk.

Each of these parameters brings with it a number of unique considerations and constraints, which were assessed using a series of potential approaches. NASA management together with technical experts from the ISS and Space Shuttle programs developed a plan to optimize the capability of each program.

Key Elements of NASA's Proposed Plan for Space Station

NASA's proposed plan, subject to the normal budget and appropriation process, as well as ongoing return-to-flight considerations, is to fly the Shuttle in a disciplined, measured fashion, targeting 19 Shuttle flights. The 19 flights include 18 flights to the ISS beginning with STS–121, plus a possible additional flight to service the Hubble Space Telescope. The flights to the ISS would provide the infrastructure for the International Partner modules first, followed immediately by the Partner laboratories. Maintenance and logistic flights for sustainability are at the end of the sequence. The order and flight strategy is as important a consideration as the specific number of flights.

The plan includes the launch of key NASA-provided infrastructure elements and other capabilities to enable a potential 6 person crew and meaningful utilization of the ISS. NASA has determined, however, that its exploration research objectives no longer require the Centrifuge Accommodation Module that is being developed for NASA by JAXA under a barter arrangement.

The approach would also accommodate almost all of the International Partner elements currently planned for launch to the ISS, with the notable exceptions of the U.S. Centrifuge and the Russian Solar Power Module. In both cases, NASA is pre-

pared to immediately engage in detailed bilateral discussions to establish a mutually beneficial arrangement to accommodate the proposed change.

The first 13 flights, scheduled to occur over the three years after the Shuttle returns to flight, would not vary significantly from the reference assembly sequence endorsed at the Multilateral Coordination Board and Heads of Agency meetings in Montreal last January.

Question. To what extent does imposing a date certain on ending the shuttle program create schedule pressure similar to that which existed prior to the *Columbia* accident (according to the *Columbia* Accident Investigation Board)?

Answer. The *Columbia* Accident Investigation Board recognized that schedules were a recognized, even unavoidable tool for managing large and complex systems such as the Space Shuttle and International Space Station programs. As such, the *Columbia* accident wasn't caused by schedule pressure per se, but rather by a safety system that had lost much of its independence and had grown too weak to act as an effective check on safety issues in the face of normal schedule factors.

The Vision for Space Exploration outlines an ambitious series of goals, including completing assembly of the International Space Station, retiring of the Space Shuttle Orbiter fleet, and developing the next-generation of crew and cargo vehicles that will support ISS utilization and missions to the Moon, Mars, and beyond. These goals are now supported by a strong, independent, and proactive safety organization, one that has played a key role in returning the Space Shuttle to flight as expeditiously and as safely as possible and that will continue to ensure safe mission execution throughout the rest of the Space Shuttle's operational lifetime.

Question. What are the current plans for the ISS once it has reached the end of its useful life? What is the current plan for de-orbiting, or decommissioning, the ISS?

Answer. There is no current specific plan for de-orbiting or decommissioning the ISS. The budget plans announced in 2004 indicated the completion of essential U.S. exploration research in 2016, and an end of the funding for ISS operations. Some hardware elements of the ISS reach their service life limitations in 2016. Prior to 2016, a determination will be made on the costs of extending the Station's service life and benefits of continuing U.S. ISS operations beyond 2016. Based on that determination, NASA will develop plans to address the potential future involvement of NASA, the U.S. government, International Partners, the private sector, and academic institutions in ISS operations and utilization.

QUESTIONS SUBMITTED BY SENATOR PETE V. DOMENICI

Question. Dr. Griffin, in the President's new National Space Transportation Policy, you are directed, in coordination with the Secretary of Defense, to recommend an option to meet future heavy lift requirements. This Committee, as well as that chaired by Senator Stevens, is keenly interested in the costs of the preferred option.

—Have your studies progressed far enough to identify the potential most cost effective solution?"

—Is the process of "coordination" with DOD working to your satisfaction?

—What are the implications of the recent news about the Air Force's intention to increase their space presence?

Answer. NASA has conducted a detailed assessment of our launch vehicle requirements, including heavylift requirements and crew launch requirements. We believe those studies have identified highly effective solutions that include cost-effectiveness, schedule, minimization of programmatic risk, mission reliability, and crew safety. Based on all of these factors, NASA and the Department of Defense (DOD) have agreed on a policy for use and development of national launch systems. The attached letter, signed on August 5, 2005, by the NASA Administrator and the DOD Executive Agent for Space, outlines that policy. Specifically, NASA has chosen Shuttle-derived options for its future crew and very heavy cargo lift requirements because of their proven safety and superior cost and schedule availability. Specifically, the Space Shuttle propulsion elements are reliable, human-rated, and best able to fit the available architecture within the available timeframe.

Throughout the process, we have been actively engaged with the DOD, including senior management and staff levels. We have been very encouraged by the constructive dialogue and support at all levels, and believe the process of coordination is working well.

We look forward to continuing our close working relationship with the Air Force. While the Air Force and NASA each has unique and independent roles and responsibilities, it is also true that we benefit from each others investments, experience, and talents.

Question. Dr. Griffin, in your response to questions from my colleagues in other sessions, you stated that it costs about $4.5 billion to own the Shuttle, whether it flies or not. Unlike the post-*Challenger* return to flight efforts, your current continuing extensive efforts are not being funded by a supplemental appropriation. You are trying to execute four major tasks in the human space flight program: return the Shuttle to flight, fly the Shuttle safely until 2010, complete the assembly of the International Space Station, and have a new CEV available in a timeframe consistent with Shuttle retirement. How much money has been spent on return to flight?

Answer. NASA's estimate for Space Shuttle Return to Flight (RTF) costs from fiscal year 2003 through the end of fiscal year 2006 is just over $1.4 billion. Overall, Return to Flight costs are stabilizing as technical solutions have reached maturity and implementation of solutions nears completion. The estimates provided in the latest Implementation Plan for Space Shuttle Return to Flight and Beyond, dated June 3, 2005 (attached), remain valid and have not substantially changed since November 2004. Management tools are in use to monitor progress and provide early warning of potential problems. However, the potential exists for additional content that may be required in the post-Return to Flight timeframe depending on the ongoing work addressing issues seen during STS–114 and the results of the Shuttle's performance on the second Return to Flight mission, STS–121.

Current estimates for RTF costs are: Fiscal year 2003—$42 million; fiscal year 2004—$496 million; fiscal year 2005—$602 million; and fiscal year 2006—$288 million.

If there are any increases in Return to Flight costs, NASA is committed to accommodating them within its total budget request.

Actual costs to date are tracking very closely with the November 2004 estimate provided to Congress. The total estimated cost for returning the Shuttle to flight status through fiscal year 2009 is approximately $1.98 billion. The out-year costs are associated with added manpower for Systems Engineering. NASA's plan and our budget reflect the end of RTF after the second RTF mission and subsequent post-flight assessment actions. These milestones will take the Agency through most of fiscal year 2006. RTF, from a budget perspective, will end in fiscal year 2006, and will no longer be tracked as a separate effort, beginning in fiscal year 2007.

Question. What is your strategy for executing the other three priorities while coping with the cost impact of return to flight?

Answer. NASA has completed the Exploration Systems Architecture Study (ESAS), which outlines NASA's approach to implementing the Vision for Space Exploration. The Vision calls for the Agency to return the Space Shuttle to flight, complete the International Space Station, return to the Moon, and move on the exploration of Mars and beyond. Based on ESAS recommendations, NASA has now laid out a detailed plan to support sustained human and robotic lunar exploration, operations, accelerate the development of the Crew Exploration Vehicle and launch systems for missions to the International Space Station, Moon, and Mars, and identify key technologies required to enable this exploration architecture. This plan is a safe and sustainable approach that seeks to affordably accelerate the pace of space exploration. An important aspect of this plan is that it is a "go-as-you-can-afford-to-pay" approach," within planned budgets for Exploration Systems, through redirection of funding for longer-term and lower-priority research and technology (R&T) elements within the Exploration Systems Mission Directorate.

NASA has also completed the Shuttle/Station Configuration Options Team (SSCOT) study to evaluate options for the assembly and utilization of the International Space Station, taking into account the President's decision to retire the Space Shuttle by 2010, while still honoring U.S. commitments to the Space Station International Partners. Based in part on this assessment, NASA has developed a plan, subject to the normal budget and appropriations process, as well as ongoing return-to-flight considerations, to move forward and begun discussions with our international partners.

Question. In an ideal world, I suspect that your agency would be relieved if some of the return-to-flight costs could be funded through a supplemental appropriation so as not to detract from other activities, many of which have been supported in the past by the Congress. What would the supplemental requirements be were the supplemental avenue open to NASA?

Answer. The President requested budgets for NASA that were sufficient to return the Shuttle to flight without the need for a supplemental appropriation, and NASA does not expect to need any future supplemental to pay for residual return to flight costs. As stated in response to Question 2(a), actual costs to date for RTF are tracking very closely with the November 2004 estimate provided to Congress. If there are

any increases in RTF costs, NASA is committed to accommodating them within its total budget request.

QUESTIONS SUBMITTED BY SENATOR PATTY MURRAY

Question. While the President's budget proposal would add resources for its plans to finish construction of the International Space Station, increase exploration of the solar system, and develop the technologies needed for future Moon and Mars missions it would cut a servicing mission critical for the survival of the Hubble Space Telescope, as well as drastically decrease aeronautics research.

In addition, I have concerns about the NASA education programs and their ability to work with community education efforts to inspire and prepare the next generation of scientists and engineers.

It is my understanding that many experts in the field claim that the Hubble Space Telescope is one of the most beneficial programs currently being operated by NASA, as it has helped expand our understanding of the universe in ways scientists never thought possible just 15 years ago. Administrator Griffin, if you were to move forward with a plan to end the Hubble program what research programs would take its place to keep increasing our scientific understanding of distant parts of the universe?

Answer. NASA has a number of missions capable of investigating distant parts of our universe. Currently we operate three Great Observatories: The Hubble Space Telescope, the Chandra X-ray Observatory, and the Spitzer Space Telescope. Each of these facilities (all of which will be operational until 2009 and possibly beyond) is used daily by the astronomical community to further our understanding of the heavens. In addition to these operating programs, we have a number of missions in development that will advance our understanding of the distant universe. The Gamma-ray Large Area Space Telescope (GLAST) will launch in 2008 and enable astronomers to study high-energy phenomena with unprecedented precision. The Wide-area Infrared Survey Explorer (WISE), scheduled for launch in 2009, will map the sky in infrared bands of light providing astronomers with a new catalog of objects (both near and distant) for additional study. The James Webb Space Telescope (JWST) will follow these missions in the middle of the next decade and will be the premier platform for observing the distant universe. By virtue of its large collecting area and infrared coverage, JWST will see the earliest galaxies to form in the universe. Finally, NASA also supports a number of cosmic microwave background studies, such as the Wilkinson Microwave Anisotropy Probe, or the Balloon-borne Large Aperture Submillimeter Telescope, that permit astronomers to study the remnants of the Big Bang, very first light ever emitted by the universe. These missions were designed to provide unique views of the universe beyond those obtainable from Hubble. Servicing Hubble would provide additional time to sequence some of these missions, but would not replace the need for this follow-on research.

Question. As you know NASA has been built around the dual missions of space exploration and aviation research. Representing an aviation rich state I am concerned that recent proposals by NASA demonstrate that its commitment to aeronautics and aviation is waning. Aeronautics experts from NASA have developed innovations throughout its history including the X–15 "rocket plane" of the 1950s and 1960s, de-icing systems, and the "supercritical wing"—the rounded-bottom wing design used today by virtually every commercial jetliner to increase speed, improve range and save fuel. Administrator Griffin, I am curious as to why it is that NASA has decided to move away from its critical mission on aeronautics and aviation? And what you foresee is NASA's role, if any, in helping to advance aviation technology in the future?

Answer. Dr. Lisa Porter was recently selected as Associate Administrator to lead NASA's Aeronautics Research Mission Directorate. In that role she has begun the process of reshaping NASA's Aeronautics research program allowing the Agency to take responsibility for the intellectual stewardship of the core competencies of Aeronautics for the Nation. This will require us to reinvest in the Agency's in-house expertise to ensure that we retain the world-class skills, knowledge, and facilities needed to guarantee our Nation's ability to consistently contribute world-class innovation to aeronautical challenges, both civilian and military.

The reshaped aeronautics program will strengthen our partnerships with the Department of Defense (DOD) and Federal Aviation Administration (FAA), capitalizing on each agency's unique capabilities and resources to strengthen the Nation's leadership in aeronautics. Our partnership with DOD will include close collaboration to establish an integrated national strategy for management of the Nation's most vital wind tunnels. We will forge new partnerships and continue to benefit from partner-

ships built in the past with academia and industry. We will seek long-term, intellectual partnerships with industry that will be able to rely on us to invest in the "seed corn" that is the critical ingredient in revolutionary technological advancement.

As a first step, NASA is reshaping the three major programs within the Aeronautics Mission Directorate. The previous Vehicle Systems Program is being renamed the Fundamental Aeronautics Program in order to reflect properly its new focus on basic aeronautical sciences. Within Fundamental Aeronautics, and consistent with direction we received from the Congress, we will re-establish the Agency's dedication to the mastery of core competencies in subsonic, supersonic, and hypersonic flight. We will create projects that provide continual, long-term investment in the fundamentals and that build upon that investment to develop system-level, multidisciplinary capabilities that will enable both the civilian and military communities to build platforms that meet their specific needs. As part of our investment in fundamental aeronautics, we are positioning the program to continue important long-term research activity in fiscal year 2006 that preserves the core competencies in rotorcraft and hypersonics, drawing upon NASA's critical inhouse expertise. We are transforming the Aviation Safety and Security Program into the Aviation Safety Program, where we will focus research on safety areas that are appropriate to NASA's unique capabilities. Projects in Aviation Safety will address integrated vehicle health management, resilient aircraft control, intelligent flight deck technologies, and aging aircraft. The Airspace Systems Program is being realigned to directly address the air traffic management needs of the Next Generation Air Transportation System (NGATS) as defined by the Joint Planning and Development Office (JPDO).

Leading scientists and engineers from the NASA field centers participated in workshops in September and October to lay the foundation for a technical plan to reshape the Aeronautics Research program. As the year progresses, this technical plan will be guided by the National Aeronautics Policy that is being developed by Office of Science and Technology Policy and NASA in collaboration with other agency partners. (Dr. Porter is co-chair of the National Science and Technology Council's Aeronautics Science and Technology Subcommittee.) In addition, the National Research Council is currently conducting a decadal survey for aeronautics, which will also provide inputs to our plan.

Question. On the issue of NASA's education programs I have several questions. As you know the Office of Space Science once operated a widely-respected program that focused on all of NASA's core missions. Under Administrator O'Keefe there was a major shift to centralize the education programs and focus efforts on space-exploration focused schools and sending a teacher into space. Furthermore it is my understanding that the NASA Explorer Schools have been focused on manned space flight instead of broad scientific endeavors. Can you explain why NASA made this shift in the focus on education and what the thoughts and analysis behind eliminating and or altering the old programs were? At a broader level, what is NASA doing within its education program to develop lasting enthusiasm in science to truly help create the scientists of the future?

Answer. Early in fiscal year 2003 NASA did indeed shift management responsibility for some of its education programs by establishing its Office of Education, separate from the Mission Directorates but to address and coordinate within NASA and for NASA education endeavors with other federal agencies. This shift did not eliminate or significantly alter any education programs conducted by either the Office of Space Science or the Office of Earth Science.

In August 2004, the Office of Space Science and Office of Earth Science were merged to create the new Science Mission Directorate. The education programs of these predecessor organizations have continued and efforts are underway to exploit synergies to enhance the science education program. These efforts will build on the strengths of the current programs and focus on engaging learners of all ages in the NASA mission of exploration and discovery. In fact, for the most recent reporting year [2004] the space science programs reached over 400,000 direct participants in workshops, community and school visits, and other interactive special events; 7 million Internet participants for web casts, web chats, and other web events, and, a potential audience of over 200 million for lectures, planetarium shows, museum exhibitions, conference exhibits, radio, television, and other forms of public media. Through the NASA Science Mission Directorate, NASA backed science education can be found in all 50 states, the District of Columbia, Puerto Rico, and the Virgin Islands. The Mission Directorates continually assessing the educational opportunities and content presented to ensure

The NASA Explorer Schools (NES) project, launched in 2003 and managed by NASA Office of Education as one of four Pathfinder Initiatives, is designed to en-

gage all NASA Centers and the four Mission Directorates, has six primary objectives:

—To increase student interest and participation in mathematics, science, technology and geography;
—To increase student knowledge about careers in mathematics, science, engineering and technology;
—To increase student ability to apply mathematics, science, technology and geography concepts and skills in meaningful ways;
—To increase the active participation and professional growth of educators in science, mathematics, geography and technology resulting in higher quality education for K–12 students;
—To increase the academic assistance for and technology use by educators in schools with high populations of underserved students; and
—To increase family involvement in children's learning.

The NES project is specifically designed to meet the individual needs of each competitively selected school. Upon entering the project, each school completes a needs assessment which NASA uses to create a multifaceted approach to meeting school needs, and which reaches far beyond the NES network to provide opportunities to highlight and implement all Mission Directorate programs. Content material includes: pre-algebraic concepts, inquiry-based math modules related to the science, engineering and technology of space flight, digital image processing and analysis (IPA) and geographic information systems (GIS), integrate NASA earth and space content, updated NASA-content as we learn more about the space environment, and providing symposia for participating schools in topics ranging from spaceflight to robotics to Mars exploration.

NES will also provide opportunities to all interested schools in the United States. These challenges focus on science, technology, engineering, and mathematics—subject areas needed for technical careers at NASA. Areas to be addressed included: Space Flight Opportunities; Imagine the Moon; Crew Exploration Vehicle Design; and Multi-media Explorations. Furthermore, the NASA Aerospace Education Services project utilizes all available NASA content and resources to support not only the NASA Explorer Schools but schools from across the country that express an interest in our assistance. Content and resources come from across NASA.

NASA education continues to create and promote educational materials and opportunities within all Mission Directorates—Aeronautics Research, Science, Space Operations, and Exploration Systems, as well as through its Office of Education.

Question. Furthermore, I am interested in how NASA can improve its education mission to build long-term partners with community based science and education efforts? Specifically, what ways are you looking at to take NASA resources and imbed them within the efforts of community based organizations in order to make NASA's education programs sustainable and ensure that those efforts become institutional and long-lasting?

Answer. NASA is continuing efforts to expand education in the sciences, technology, engineering and mathematics through numerous venues within the informal education community, to include museums, science centers planetariums, youth and community groups among others. These activities take place every day, conducted through the four Mission Directorates, the ten NASA Centers, and the NASA Office of Education.

In fact, one of the nationwide NASA Pathfinder Initiatives, the NASA Explorer Institutes (NEI) project is specifically designed to enhance the capabilities of the informal education community to inspire the next generation of explorers by:

—Providing access to NASA staff, research, technology, information, and/or facilities and by engaging the informal education community in discussions about how to involve the public in shaping and experiencing NASA-related missions;
—Identifying NASA-related instructional content, resources, and information, in collaboration with the informal education community that will enhance informal education program goals and objectives;
—Providing NASA-related professional development opportunities for members of the informal education community across the nation; and
—Facilitating the formation of collaborative partnerships between informal and formal education communities.

The project is in the second full year of its 3-year roll out. In fiscal year 2004, activities involved organizations in 46 states, the District of Columbia, Puerto Rico, the Virgin Islands, and the Overseas Military Program. Organizations represented science centers, museums, planetariums, libraries, parks, aquariums, nature centers, youth groups, community-based organizations, and state and federal agencies.

In fiscal year 2004, NASA conducted eleven focus groups across the nation on a variety of topics, with each group focused on a different set of strategies. But, each

shared similar goals of improving the public's understanding and appreciation of science, technology, engineering, and mathematics (STEM) disciplines; establishing linkages that promote new partnerships/relationships between providers of informal and formal education; exciting youth, particularly those who are underrepresented and underserved, about STEM disciplines; and expanding STEM informal education programs and activities to communities/locations that have been traditionally underserved by such opportunities. Many of the focus groups resulted in previously unconsidered collaborations, such as now-growing connections in Native American communities with space scientists, and connections in nascent or changing industries, such as data visualization and digital productions. Participants of these focus groups represented over 200 institutions (museums, science centers, community groups, industry, etc.), and they expressed support at NASA's willingness to listen and openness to new ideas.

NASA Explorer Institutes also supported six pilot professional developments workshops, connecting informal educators to NASA's unique facilities and expertise. These workshops led to a number of successful follow-up projects, including a number of regional collaborations by workshop attendees. Based upon results of the workshops and focus groups, the NASA recently released a new solicitation for NASA Centers to host NASA Explorer Institutes later this year.

Through the NEI project NASA also leveraged partnerships with several organizations to share NASA's discoveries and experiences: (1) For the Nation's afterschool programs, the American Museum of Natural History conducted an eighteen-month study and demonstration project that included a scan of existing science programming in afterschool environments, the development of prototype curriculum packets based on NASA resources, pilot testing and staff training in three afterschool programs in New York City, a review of science education research and promising practice literature, and consultations with experts in science education, afterschool, and curriculum development. (2) With the National Park Service, NASA developed an agreement that resulted in the design of professional development experiences for interpreters that include NASA content to enhance the compelling stories of natural and cultural resources of the parks.

Workshop participants adapted space science and earth sciences resources for use in their parks, and developed new interpretive material. (3) With the Girl Scouts of the USA (GSUSA), NASA broadened the knowledge of national master trainers to increase their understanding of an integrated NASA Earth and Space Science Story. These master trainers are now mentoring trainers across the nation, competitively selected from GSUSA councils with significant populations of ethnically, economically, and/or geographically underserved girls. (4) Finally, several NASA Centers are collaborating to produce the Workshop for Informal Education Specialists, a Return to Flight public engagement event with over 80 informal education venues (museums, science centers, planetariums) to prepare partners to help NASA positively engage the public in experiencing the excitement of exploration and human space flight.

Question. Finally, Mr. Administrator, as you know, the country needs capability to deliver cargo to and recover it from the International Space Station. NASA has indicated that it intends to release a "request for proposal" (RFP) this year for the International Space Station commercial cargo transportation services. What is NASA's timetable for its release and response?

Answer. NASA has undertaken a number of steps to assess its future requirements for crew and cargo transportation in support of the ISS and future human exploration. A Request for Information (RFI), issued in September 2004, solicited information regarding capabilities and market interest from existing and emerging domestic commercial space transportation providers. NASA also conducted an ISS Cargo Industry Day earlier this year to exchange technical information with potential commercial providers. Within the next month, NASA will issue a draft solicitation requesting commercial service demonstrations for ISS crew and cargo delivery and return. Where commercial providers have demonstrated the ability to meet NASA needs and safety requirements, commercial services will be purchased instead of using government assets and operations.

QUESTIONS SUBMITTED BY SENATOR BYRON L. DORGAN

UPPER MIDWEST AEROSPACE CONSORTIUM

Question. Last year, Congress earmarked a number of projects in the fiscal year 2005 Omnibus bill including $2,000,000 to the University of North Dakota in Grand

Forks for the Northern Great Plains Space Sciences and Technology Center under the Earth Science account. What is the status of these funds?

Answer. NASA has completed review of the proposal from the University of North Dakota for the Northern Great Plains Space Sciences and Technology Center, and funding has been approved for release. Grant award is expected within the next few weeks.

SPACE AND EARTH SCIENCE

Question. NASA conducts both Space and Earth Science. Earth Science appears to be more weakly supported within the agency. What role do you envision for Earth Science?

Answer. NASA maintains a vigorous program in Earth science that makes important contributions to several interagency Administration initiatives, including Climate Change Science, Earth Observations, and Ocean Action, as well as NASA's Vision for Exploration. As an example, NASA's contribution to the Administration's Climate Change Science Program (CCSP) is far and away the largest of any Federal agency, constituting some 60 percent of the total CCSP investment by the U.S. government. NASA's support for Earth science has remained consistent, and recent statements by Dr. Griffin emphasize NASA's commitment to a robust portfolio across Earth and space science disciplines that will continue NASA's historic support.

WINDOW OBSERVATIONAL RESEARCH FACILITY (WORF)

Question. The University of North Dakota has been developing AgCam, a sensor intended to operate on the International Space Station. With the problems with the Shuttle, and getting equipment to the Space Station, there is some question as to when AgCam will be able to go up. AgCam was designed to go into the WORF (Window Observational Research Facility). The WORF provides an enclosed environment at a comfortable temperature and pressure, so that AgCam did not have to be built to the specifications of devices in the vacuum of interplanetary space. However, the WORF is not scheduled for a shuttle flight until May 2007 and may not be sent then.

Is the Window Observational Research Facility (WORF) scheduled for a launch on the Space Shuttle? When?

Answer. NASA has assessed its plans for the utilization of the ISS, and focused its research and technology development goals toward those activities that most closely support the Vision for Space Exploration. In this environment of limited opportunities for the launch of facility-class payloads, it is critical that utilization planning align as closely as possible with the needs of the human exploration planning effort. The only missions for which specific payloads have been manifested on the Space Shuttle are the first two Return to Flight missions. Consistent with the Vision, the Space Shuttle will be retired by 2010. Prior to its retirement, it will be utilized primarily for the assembly of the ISS. Our top priority will be to make each flight safer than the last. As we noted in our November 2004, correspondence to you on this topic, in the event that a future flight opportunity does become available on the Space Shuttle, the WORF facility will be considered for delivery to the ISS. The University of North Dakota has been apprised of the situation and is aware that NASA cannot commit to the flight of WORF on the Space Shuttle.

Question. If the WORF cannot be launched to the ISS, could AgCam be accommodated some other way?

Answer. The AgCam hardware has been designed and built to be operated in the WORF. The WORF would provide resources such as power, thermal control, data and mounting positions for operations of the AgCam. The hardware as designed could not operate independently of the WORF. It might be possible to redesign the AgCam hardware and its operations concepts, but the University would require additional funding, testing, and development time; even with such a redesign, it is unclear whether the redesigned hardware could achieve the expected scientific value without the WORF.

Question. What are the plans for Earth observations from the International Space Station?

Answer. While NASA is not pursuing new Earth sciences research on the ISS because of the limited launch opportunities on the Space Shuttle, we are continuing with two Earth observations programs already on-orbit.

The Earth Knowledge Acquired by Middle Schools (EarthKAM) program allows middle school students to command, via computer, a digital camera mounted in a window of the ISS and integrate Earth images taken by the camera with inquiry-based learning for 5th–8th grade students. Photos are made available on the Web

for viewing and study by participating schools around the world. Educators use the pictures in conjunction with curricula for projects involving Earth Science, geography, physics, math, and technology. To date, over 80 schools with more than 1,600 students from the United States, Japan, Germany, and France have participated in the EarthKAM program.

The Crew Earth Observations (CEO) program continues, with the ISS crew photographing various Earth sites on a daily basis. Hand-held photography of the Earth from human spaceflight missions, spanning more than 40 years, provides insights and documents changes on the Earth. The ISS crew members are building on this time series of imagery, which was started in 1961.

INTERNATIONAL SPACE STATION PROPOSAL

Question. Mr. Administrator, it is my understanding that in the coming months NASA is expected to release a "request for proposal" (RFP) for International Space Station (ISS) commercial cargo transportation services, which would provide the necessary means for getting cargo to and from the ISS. In order for markets to have time to plan, could you provide a general timeframe for the RFP's release and the expected response time?

Answer. NASA has undertaken a number of steps to assess its future requirements for crew and cargo transportation in support of the ISS and future human exploration. A Request for Information (RFI), issued in September 2004, solicited information regarding capabilities and market interest from existing and emerging domestic commercial space transportation providers. NASA also conducted an ISS Cargo Industry Day earlier this year to exchange technical information with potential commercial providers. Within the next month, NASA will issue a draft solicitation requesting commercial service demonstrations for ISS crew and cargo delivery and return. Where commercial providers have demonstrated the ability to meet NASA needs and safety requirements, commercial services will be purchased instead of using government assets and operations.

SUBCOMMITTEE RECESS

Senator SHELBY. The subcommittee will now stand in recess until 10 o'clock, on Tuesday, May 24, when we will hear testimony from the Attorney General, Alberto Gonzales, and the Director of the Federal Bureau of Investigation, Robert Mueller, on the Department of Justice's budget for 2006.

The subcommittee is recessed.

[Whereupon, at 3:28 p.m., Wednesday, May 11, the subcommittee was recessed, to reconvene at 10 a.m., Tuesday, May 24.]