

NASA FY 2008 BUDGET

HEARING

BEFORE THE

SUBCOMMITTEE ON SPACE, AERONAUTICS, AND
RELATED SCIENCES

OF THE

COMMITTEE ON COMMERCE,
SCIENCE, AND TRANSPORTATION
UNITED STATES SENATE

ONE HUNDRED TENTH CONGRESS

FIRST SESSION

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FEBRUARY 28, 2007
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ONE HUNDRED TENTH CONGRESS

FIRST SESSION

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NASA FY 2008 BUDGET

WEDNESDAY, FEBRUARY 28, 2007

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

The Subcommittee met, pursuant to notice, at 2:36 p.m. in room SR-253, Russell Senate Office Building, Hon. Bill Nelson, Chairman of the Subcommittee, presiding.

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

Senator NELSON. Well, good afternoon. It's been a long time since I chaired one of these Space Subcommittee hearings. I was Chairman from 1985 to 1990 of the Space Subcommittee of the House of Representatives. There are actually a few faces out there in the audience that were around at that time. So, thank you all for hanging in there.

I want to take the occasion of introducing you all to our Shuttle crew that flew in December, Commander Mark Polansky and Mission Specialists Robert Curbeam, Joan Higginbotham, Nicholas Patrick, and Christer Fuglesang. They had a terrific mission so, let's all welcome them to Washington.

[Applause.]

Senator NELSON. You all do us proud. And, oh, boy, every time I see that Shuttle come back—it's just amazing, Mark, how you can just put it on a dime, and you don't have an engine. The only correction you have is in that vertical stabilizer, where you've got that speed brake. Other than that, it's your pure native talent that puts it down. And folks like Mark put it on a dime every time, coming back from a point way out in space. So, thank you for your expertise. Thank all of you for coming and visiting with us today.

We welcome Dr. Griffin. Senator Hutchison will be here momentarily. What I'd like you to do, Dr. Griffin, rather than hold up, I'd like us to go on. We're going to put your written testimony into the record.

Oh, here is Senator Hutchison.

What I'd like you to do, instead of reading your testimony, just talk to us, like you would when you come in to visit us in the office. Then we'll get into a dialogue in Q&A, later on.

So, Dr. Griffin, thank you for the leadership that you are offering, and for how you have turned the agency around. Thank you for tackling tough issues, like Hubble, and how you put 10 pounds

of potatoes into a 5-pound sack. Thank you for the team that you're leading, which included a Nobel winner this year, Dr. John Mather, who won the Nobel Prize in Physics. And thank you for getting us back into space, and doing it not once now but twice, with human missions.

If the crew would like to sit up here at the Committee table, please. No, come on up here. Look, I'm running the show. I have the authority to do this now.

[Laughter.]

Dr. GRIFFIN. Well, and for my part, I'm happy to let Roman do the hearing, too.

[Laughter.]

Senator NELSON. Well, he may be gone by that time.

Thank you, also, Dr. Griffin, as you try to keep that gap narrowed between the time that we have to shut down the Space Shuttle and when we fly the new Crew Exploration Vehicle. Thank you, also, in an uncertain budget year, where we haven't had budgets submitted by the White House that have matched with the authorization. We didn't even pass an appropriations bill last year. They went to something known as a continuing resolution or CR. And, thanks to Senator Hutchison and to Senator Barbara Mikulski, they had added another billion dollars, over and above the White House request, in the bill that was passed out of the Senate Appropriations Committee. And then, at the end of the year last year, we never could get the leadership to agree to take up the appropriations bill, so they did this pared-down thing, called a Continuing Resolution, and that just adds to your headaches.

We're looking forward to having your testimony. Again, your statement will be put in the record. If you will just talk informally with us, I would appreciate it.

[The prepared statement of Senator Nelson follows:]

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

Good afternoon and welcome to this hearing on NASA's 2008 budget request. We welcome as our witness today NASA's Administrator, Dr. Michael Griffin, and extend a special welcome to the crew of STS-116 who are here visiting this afternoon. In December, Commander Mark Polansky and Mission Specialists Robert Curbeam, Joan Higginbotham, Nicholas Patrick, and Christer Fuglesang successfully completed the latest construction mission to the International Space Station. This crew conducted four spacewalks and installed the Station's permanent power system. Congratulations on your success and thank you for being here today.

Since the last time we gathered to hear from Dr. Griffin in this forum, NASA has safely flown three Shuttle missions, bringing the International Space Station to 60 percent complete and restoring America's confidence in the Space Shuttle Program. NASA has successfully launched five science missions that will lead to better understanding of our home planet, our solar system, and the universe beyond. A NASA scientist, Dr. John Mather, was awarded the Nobel Prize in Physics this year, and the transition is underway to replace the Shuttle with the Orion Crew Exploration Vehicle and Ares Crew Launch Vehicle.

With the successes of the past year in mind, we are also aware of the challenges NASA faces in the future. First, it must safely complete the International Space Station and the remaining Shuttle flights. NASA must develop a new vehicle to take humans to the Space Station, the moon, and beyond—and do so with the shortest possible gap between the Shuttle and Orion/Ares programs. And, NASA must continue implementation of a balanced program of exploration, science, and aeronautics. This is an ambitious agenda that was accepted by this Committee and the Congress, in a bipartisan way, when we passed the NASA Authorization Act of 2005.

However, in each year since, the White House has requested less funding for NASA than authorized by that Act. For that reason, and due to the continuing resolution for this fiscal year, NASA will receive \$1.7 billion less than authorized in 2007. If the President's 2008 budget is adopted, NASA will have received three billion dollars less than the amount planned under the two-year authorization Act. These shortfalls are in addition to the \$2 billion that this little agency had to take from other programs to recover from the tragedy of the *Columbia* accident and return the Shuttle to flight. If we continue on the President's path, we face an extended period when the United States will have no human access to space. I say this is unacceptable—especially at a time when other nations are aggressively developing space technology. Last month's reckless anti-satellite test by the Chinese reminds us that we cannot afford to remain Earth-bound while others pursue space capabilities with questionable intent.

And so Dr. Griffin, we've invited you to tell us today about the challenges you face implementing NASA's program in this budget environment. We will also be looking into steps we in the Congress can take to help you meet some of those challenges, and I look forward to working with you to see if, together, we can find some helpful answers. Thank you for your presence here today, and I look forward to hearing your testimony.

Senator NELSON. Senator Hutchison?

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

Senator HUTCHISON. Well, thank you, Mr. Chairman. And I am very glad that we are having this hearing.

I will say, having been Chairman of this Subcommittee last year, and having Senator Nelson as the Ranking Member, that I can't see that there is one iota of difference in our goals for NASA. He was so helpful to me last year, and the year before that, in passing the reauthorization of NASA, which did, certainly, solidify our position that we wanted the Space Station to be finished, that we wanted good science to come out of the Space Station, and that we wanted a very small window—in fact, Senator Nelson and I tried to make it “no window”—but, working with you, Dr. Griffin, we came up with a very small window for the time that we would not have a Shuttle and would not yet have the Crew Exploration Vehicle.

But I think it is fair to say that Senator Nelson and I will continue to work in tandem to try to assure that that window is very small, which I know you agree with, but the budget is an issue.

So, I want to have the designation of the Space Station as the National Lab mean something. I think it is a very important, creative way for us to add funds to that scientific base of the Space Station. And I think that we are going to work with Senator Stevens and Senator Inouye, who are also very strong supporters of NASA, and Senator Mikulski, who has been a champion, to try to increase the funding that we see, either in the supplemental or in this 2008 budget.

The 2008 budget looks very strong, a 3.1 percent increase, but when you look at what happened last year with the flat funding, it still leaves us short of being able to achieve the goals that we have, which are “no window” and humans being able to go into space, and also real science being able to be done on the Space Station, which means finishing it properly.

I visited with the crew earlier, and was so impressed with the job they did of configuring the Space Station, and trying to make sure that it is going to be viable and have everything that we can

have working on it. So, we're glad that you're here and that we have an international component to the team. And, as I said to you earlier today, Senator Nelson and I are a bipartisan team. We have the Chairman and Ranking Member of the full Committee also in absolute sync that we want NASA to be the great treasure that it has been to our country in innovation, in defense leadership, security leadership, and also we want to make sure that it can support the scientific achievements that can keep the quality of life in our country and our world on the continuing rise.

So, thank you for what you're doing. We've certainly visited a number of times, and I hope that we will continue to be able to fund you, and that you will continue to be able to have the means to accomplish the priorities that we share. Thank you.

Thank you.

[The prepared statement of Senator Hutchison follows:]

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

Thank you, Mr. Chairman, for beginning the hearings under your leadership with this important discussion of NASA's FY 2008 budget request. I have always enjoyed our very strong and bipartisan working relationship, and look forward to working with you and your staff as we move forward with the work of the Subcommittee.

I also join you in welcoming the STS-116 crew to our hearing room today. I had the opportunity to visit with them briefly in my office earlier today, and, as always, am impressed with their enthusiasm and dedication to their missions and the vital and important role of human spaceflight and exploration.

This crew performed an extremely complex mission—perhaps the most complex one to date—and did it successfully and made it look easy. They literally began the process of bringing the backbone of the Space Station to life in preparation for the great promise of scientific research that lies ahead.

Thank you, Dr. Griffin, for joining us today to outline the President's FY 2008 budget request for NASA.

On the face of it, the request is a good budget, with a 3.1 percent increase over what had been requested for FY 2007.

However, as we all know, NASA did not receive the amount it requested in FY 2007—in fact, it has been, for all intents and purposes, held flat in FY 2007 with an appropriations level based on the amount it received in FY 2006.

That outcome, of course, was not known when this budget request was developed. The result is, however, that this budget request, in the context of the FY 2007 Continuing Resolution, is not an adequate budget and will not, by itself, allow NASA to move forward effectively with its plans for the future.

A little over a year ago, the Congress passed legislation, authored by this Subcommittee, authorizing NASA funding for FY 2007 and 2008. For FY 2007, we authorized \$17.9 billion; for FY 2008, we authorized \$18.7 billion. The amount appropriated for FY 2007 was \$16.2 billion; the amount requested for FY 2008 is \$17.3 billion. A combined total of \$3.1 billion less for those 2 years than we authorized.

As you know, Mr. Chairman, we did not pick those authorization numbers out of a hat. We—and our House counterparts—determined those were the appropriate numbers to ensure a healthy and balanced NASA budget that could effectively meet the challenges it was facing then—and continues to face now.

I am disappointed that the appropriations for FY 2007 were so far below even the amount requested. I am equally disappointed that the White House has not seen fit to request amounts even close to what we authorized. I believe those decisions have forced Dr. Griffin to make the kinds of painful choices we are hearing about from the scientific community.

I am further concerned that being forced to make those choices can have the effect of undermining the traditional constituency for NASA that is vital for this Nation to sustain an aggressive and viable space exploration program.

What is also becoming more and more certain, as we look at the world around us, is that if the U.S. does not sustain an active space exploration program, other nations will—and are preparing to—step into that vacuum.

The challenges are great, and the stakes are high, Mr. Chairman, and I look forward to working with you to find the right kinds of answers to meet them and keep our Nation at the forefront of space exploration.

Senator NELSON. Senator Stevens, we're honored to have you here today.

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

Senator STEVENS. Well, thank you very much. I would like to have my opening statement submitted.

I'm delighted to see the members of the crew that are here. And we were very pleased to have an Alaskan, Commander Bill Oefelein as the Pilot of the recent mission.

So, I don't want to prolong it. I'm here to hear Dr. Griffin and go on to another meeting. So, I appreciate your courtesy.

[The prepared statement of Senator Stevens follows:]

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

Thank you, Mr. Chairman, for holding this important hearing on NASA's FY 2008 budget request. NASA has an important role to play in helping this Nation expand its technological edge and conducting exciting exploration into the heavens—and in better understanding our own Earth.

I am also delighted to see some of the crew members of the most recent Space Shuttle mission—STS-116—join the Administrator briefly at this hearing, led by their Commander, Mark Polansky.

Their mission was extremely successful and marked an important turning point in assembling the International Space Station by getting its permanent power system ready to receive the research laboratories of our international partners, and come closer to being the great scientific laboratory we have always intended it to be.

Of course, I am always pleased when an Alaskan native is able to play a key role in a mission, as did Astronaut and Navy Commander Bill Oefelein, the Pilot for this mission, who is from Anchorage. I am sorry that he had a scheduling conflict and could not be here with you today, but I want to congratulate all of you on your fine service and dedication to space exploration.

The NASA budget request reflects the continued support of the Administration for NASA. In a very constrained budget, the President has recommended a little over 3 percent increase over what was requested for FY 2007.

As it happened, the amount appropriated in the year-long Continuing Resolution did not get approved, and so there will have to be some adjustments to the request, which I understand Dr. Griffin will be providing to the Congress in the near future.

I believe we need a strong commitment to NASA and its programs, and I hope we can find the best means of providing the resources to allow the agency to carry out all its objectives.

One area I am especially interested in is the research NASA is doing to help us understand the question of the causes and effects of global climate change.

This is an area of particular interest to Alaska, where we feel the impacts of many environmental changes sooner than much of the rest of the world.

There are complex relationships between such forces as ocean surface changes and temperature variations and air currents bringing warmer precipitation to places like Alaska, where the permafrost is affected, and causing increased release of methane gases, which in turn affects the ozone layer.

We need to understand these forces, and I will be interested to hear how NASA's Earth Science programs can help increase that understanding.

I look forward to your testimony, Dr. Griffin, and working with the Chairman and Ranking Member of this Subcommittee and the Chairman of the full Committee in charting a solid future for NASA.

Senator NELSON. Yes, thank you, Senator Stevens.

Dr. Griffin, one of the things that you might also comment on is this Chinese ASAT test that has put a huge debris field in space, which is probably—all of the debris that's up there, it's a huge percentage in addition, as a result of that ASAT test, and it's up there at about 500 miles, which means it's going to be a long time coming down. It is not only a threat to our meteorological and other sat-

ellites, but also a threat to the Space Station. So, at your pleasure, if you will share with us.

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

Dr. GRIFFIN. Mr. Chairman, Ranking Member Hutchison, and Mr. Vice Chairman, Senator Stevens, thank you for being here. It's always a pleasure to appear before you.

As you have all noted, we have goals in common. There is no difference between what you want and what we want. In fact, I ask your support, not really so much on behalf of NASA, but on behalf of the American space program and our mutual goal to be a leader in forging a spacefaring civilization. That is what we are about. That is what the vision is about.

This year, above all years, we need your help. This is a Fiscal Year 2008 budget request. I can only say, at the outset—you've asked me not to read my statement; I won't. I will make a few points from it, if you don't mind, as if we were just talking in your office.

We accept the will of the Congress on the Fiscal Year 2007 continuing resolution, but it causes us a lot of pain. I will describe some of that. It is imperative that we have the full request for Fiscal Year 2008 if we are not to do great and lasting damage to the program. We need your help with that.

In fact, this Committee demonstrated enormous leadership in crafting the 2005 Authorization Act which sets the course for NASA and our country to go out again beyond low Earth orbit, to explore the Moon, Mars, the near-Earth asteroids, and to learn to utilize space for our benefit, building on the legacy of the International Space Station.

Last year, the budget I brought you recognized the changes we had made since the earlier years; in particular, prior to the loss of Space Shuttle *Columbia*. This year's budget contains no surprises. It continues on exactly in the tradition that we laid out for the FY07 budget, which, unfortunately, was not passed. But if you studied that budget—and I know you did—you will see no surprises this year.

Last year, we actually carried out, sir, three Shuttle missions, and the fourth since I assumed office. All of those have been very successful. We had a bit of difficulty returning the Shuttle to flight, dealing with external tank debris. I'm happy to report that we now have a much greater understanding of that problem than in the years before we lost *Columbia*, and our last three flights have been conducted with near-historic minimums of debris problems from the external tank.

As you know, because you just introduced them, we have here most of the crew from our December mission. Up until yesterday, we were looking forward to the March launch of Shuttle *Atlantis*, with Rick Sturckow, Marine colonel, commanding. That launch will now likely be toward the end of April, at the opening of the next window, because we had a major hail storm in Florida. Senator, I'm surprised, being from Florida, that you've not managed to get a handle on those hail storms. But we had some damage to the tank, and we're going to have to roll back.

By March 15th, I will present to this Committee, and, in fact, to the Congress, an operating plan outlining how we intend to cope with the reduction in the planned amount for Fiscal Year 2007. The reduction, I will tell you now, does not halt any planned work that we were going to do on the Crew Exploration Vehicle (CEV) or the Crew Launch Vehicle (CLV), the Orion and Ares. It does stretch it out. I know that you will want me to tell you how much of a stretch out. Our funding was extremely limited, as you know, coming in, and we were fighting to hold a renewed human spaceflight capability in 2014, the last year mandated by the President to do so. Regrettably, I am projecting a 4- to 6-month slip in our launch dates, our first launch date for the Orion and Ares, and I think we can expect them to slip into early 2015.

We are working, as we speak, to prioritize all of our funding at NASA and to orient all of it that we can toward the replacement of the Shuttle. But I am afraid that I do not have good news for you in that regard, particularly with your concern for minimizing the gap in human spaceflight.

We have deferred a great deal of the research on the International Space Station. If I have to prioritize, then I must prioritize completion of the International Space Station over utilization of the International Space Station. If I have to prioritize, I must prioritize access to the International Space Station over utilization of the International Space Station. So, we have deferred some research.

Despite that, we are aggressively, Senator Hutchison, seeking cooperation with other government agencies and with industry for the utilization of the National Laboratory, the U.S. Laboratory, on the International Space Station. Progress in that arena was going quite well, actually, until we lost *Columbia*. As you might anticipate, it dried up substantially at that time. We are now undertaking a renewed effort to make full and complete use of the Station, but it will have to await other priorities that I spoke of.

The biggest concern that I have is that we hold to the vision that was outlined in the months right after we lost *Columbia*. And here, sir, I would like to read a quote from the *Columbia* Accident Investigation Board (CAIB).

The CAIB noted that "the U.S. space effort has moved forward for more than 30 years without a guiding vision." I want to thank, explicitly, you, Senator Hutchison, Senator Stevens, for bringing your leadership to bear on this issue with our 2005 Authorization Act. It makes the law of the land exactly the right thing.

The CAIB went on to observe, "Because the Shuttle is now an aging system, but still developmental in character, it is in the Nation's interest to replace the Shuttle as soon as possible as the primary means for transporting humans to and from Earth orbit." Continuing on, quoting again, "The previous attempts to develop a replacement vehicle for the aging Shuttle represent a failure of national leadership."

Finally, the Board noted that, "This approach can only be successful if it is sustained over the decade, if, by the time a decision is made to develop a new vehicle, there is a clearer idea of how the new transportation fits into the Nation's overall plans for space, and if the U.S. Government is willing, at the time a development

decision is made, to commit the resources required to implement it.”

Now, you in this Congress and this President have removed the issues of lack of strategic vision. We have made a development decision based on an architecture. Our new crew vehicle fits into the larger architecture of human lunar return and later voyages to Mars. We have taken care of the major issues. We must take care now to sustain the commitment of resources necessary to finish the development, or we will fail to heed the lessons that were, I hope, learned in the aftermath of *Columbia*.

I want to conclude by noting that human spaceflight is a strategic asset for our Nation. It should not again be risked as we risked it during the 6-year gap between the end of Apollo and the onset of Shuttle. We must have a safe and orderly transition, both for the expert manpower that sustains this effort and for the position of the United States as the preeminent spacefaring nation of the world. By the time we retire the Shuttle and resume flights with our Orion and Ares systems, several other nations will have joined us in space with their own capability. For the United States not to be among them is tragic.

In our science portfolio, our request for Fiscal Year 2008 is for five and a half billion dollars. It maintains a balanced approach to our portfolio of four basic areas: astrophysics, planetary science, Earth science, and heliophysics. In aeronautics, our FY08 budget puts forth a stable plan for the next 5 years, without major increases, and certainly no decreases, allowing us to capitalize on the strategic vision that we developed last year at the behest of this Congress, and which was honored by an executive order from the President. So, we now have a new aeronautic strategic plan. I hope that you will see, and this Congress will see, the value in this plan that I see. I look forward to implementing it.

In closing, Chairman Nelson, I'd like to finish with a concern that I've raised in recent speeches. I think this concern needs a wider audience. I've reached the point where I believe that if NASA were to disappear tomorrow, if the space program were to disappear, if we never put another human into space, if we never put up another Hubble, never sent another spacecraft to another planet, Americans would be profoundly distraught. We would feel less than ourselves. We would feel that our best days were behind us, that our best days were consigned to the history books.

As you know better than most, NASA's mission leverages a broader American way of life that speaks to the best in us and to the best for our position in the world. We need your help in sustaining it.

We must not take for granted the leadership that we've had simply because our predecessors did great things. We must sustain the doing of great things, and I need your help in that.

Thank you.

[The prepared statement of Dr. Griffin follows:]

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

Mr. Chairman and Members of the Subcommittee, thank you for the opportunity to appear today to discuss the President's FY 2008 budget request for NASA. The President's FY 2008 budget request for NASA is \$17.3 billion. This represents a 3.1

percent increase over the FY 2007 request for the agency, but not the enacted FY 2007 appropriation. The FY 2008 budget request for NASA demonstrates the President's continued commitment to our Nation's leadership in space and aeronautics research, especially during a time when there are other competing demands for our Nation's resources. The FY 2008 budget request reflects a stable plan to continue investments begun in prior years, with some slight course corrections. Overall, I believe that we are heading in the right direction. We have made great strides this past year, and NASA is on track and making progress in carrying out the tasks before us.

Before I outline the FY 2008 budget request for NASA any further, in the invitation to testify today you asked that I address current NASA plans for the use of FY 2007 funding. On February 15, 2007, the President signed into law a joint resolution stipulating FY 2007 funding levels for NASA and other Federal agencies. This appropriation reduces overall funding for NASA by \$545 million from the President's FY 2007 request. The FY 2008 budget request could not possibly factor the impact of such a funding reduction from FY 2007 appropriation for NASA's carefully-considered multi-year programs, and thus, several programs in the FY 2008 budget request will be impacted. The FY 2007 appropriation further directs specific reductions to human spaceflight of \$677 million—\$577 million of that from Exploration Systems. This reduction may significantly impact our ability to safely and effectively transition from the Shuttle to the Orion Crew Exploration Vehicle and Ares I Crew Launch Vehicle. It will have serious effects on many people, projects, and programs this year, and for the longer term. As I noted during last year's Congressional hearings on NASA's FY 2007 budget request, we have a carefully balanced set of priorities to execute on behalf of our Nation. So as a result of these funding reductions in FY 2007, NASA is carefully assessing the implications to overall Exploration priorities and milestones, and will present detailed impacts after a full analysis is complete. The initial NASA Operating Plan for FY 2007, which will be finalized by March 15, will reflect the impacts of these reductions and the requisite decisions. As always, we are here to carry out our Nation's civil space and aeronautics programs with the resources made available by the Congress. All of our programs proceed in a "go-as-we-can-afford-to-pay" manner; so if we receive less funding than requested, we will adjust our pace. Our stakeholders have my commitment to continue to keep them informed as to what I believe is the best approach to carrying out NASA's space and aeronautics research missions with the resources provided. In this determination, I will be guided by the NASA Authorization Acts, annual Appropriations Acts, Presidential policy, and the decadal survey priorities of the National Academy of Sciences. If we determine that there is an agency objective that we will be unable to meet, I will inform our agency's stakeholders, including this Subcommittee.

Highlights of the NASA FY 2008 Budget Request

The FY 2008 budget request for NASA is a carefully considered and balanced request formulated over many months with the White House. Unfortunately, the Congress had not completed action on the FY 2007 budget at the time the FY 2008 budget was being finalized, so the impact of the final FY 2007 appropriation outcome is not accounted for in NASA's FY 2008 budget request. The FY 2008 budget request weaves together the Nation's priorities in space exploration, scientific discovery, and aeronautics research that will help fuel this Nation's future, creating new opportunities for scientific benefit, economic growth, national security, and international cooperation.

The greatest challenge NASA faces is safely flying the Space Shuttle to assemble the International Space Station (ISS) prior to retiring the Shuttle in 2010, while also bringing new U.S. human spaceflight capabilities online soon thereafter. We must understand that, given proper goals, human spaceflight is a strategic capability for this Nation, and we must not allow it to slip away. In January, we remembered those whom we have lost in the exploration of space. In the aftermath of the *Columbia* tragedy, President Bush addressed the NASA workforce, saying: "In your grief, you are responding as your friends would have wished—with focus, professionalism, and unbroken faith in the mission of this agency." We must commit ourselves to the focus of professionalism and unbroken faith every day in order to carry out the tasks before us.

In analyzing not only the root causes, but also the systemic reasons behind the *Columbia* accident, the *Columbia* Accident Investigation Board (CAIB) made critical observations that guided the formulation of our present civil space policy. I fear that with the passage of time and the press of other concerns, we may be losing sight of some of these principles, so let me reiterate some of them here today. First, the CAIB noted that, "The U.S. civilian space effort has moved forward for more than

30 years without a guiding vision.” Second, “because the Shuttle is now an aging system but still developmental in character, it is in the Nation’s interest to replace the Shuttle as soon as possible as the primary means for transporting humans to and from Earth orbit.” Third, “the previous attempts to develop a replacement vehicle for the aging Shuttle represent a failure of national leadership.” And finally, the Board noted that “this approach can only be successful: if it is sustained over the decade; if by the time a decision to develop a new vehicle is made there is a clearer idea of how the new transportation system fits into the Nation’s overall plans for space; and if the U.S. Government is willing at the time a development decision is made to commit the substantial resources required to implement it.”

Since then, the President, the Congress and NASA have charted a new course in U.S. civil space policy that addresses all of these points, and the President’s FY 2008 budget reaffirms that commitment with the necessary funds for the Space Shuttle and the ISS. NASA will continue forward at the best possible pace with the development of the Orion and Ares I crew vehicles. However, due to the cumulative effect of Space Shuttle Return to Flight and operations cost increases and the FY 2007 appropriation, NASA may not be able to bring these new capabilities on-line by 2014. If we do not quickly come to grips with this issue, America may have a prolonged gap between the end of the Shuttle program and the beginning of Orion and Ares I operational capability, a gap similar to the one that occurred from 1975 to 1981 when our Nation transitioned from Apollo to the Space Shuttle.

NASA has a lot of hard work ahead of it and many major milestones this year and next. The transition from the Space Shuttle to the Orion and Ares launch vehicles over the next several years must be carefully managed, and we must be focused, professional and committed to our mission. This is NASA’s greatest challenge, and I ask the Subcommittee’s help in meeting it.

In the important area of Earth Science, we recently received the first-ever Decadal Survey for Earth Science from the National Academy of Sciences, which NASA, the National Oceanic and Atmospheric Administration (NOAA), and the United States Geological Survey (USGS) requested in 2003. As the first of its kind, the Survey has drawn considerable attention, and we will observe the programmatic priorities for Earth Science which it advocates. In addressing the Survey’s Earth Science priorities, and consistent with ensuring that NASA maintains a balanced portfolio of science as directed by the NASA Authorization Act of 2005 (Pub. L. 109–155), we have added funding to the Global Precipitation Measurement (GPM) mission, the follow-on to the highly successful Tropical Rainfall Measuring Mission (TRMM), to improve our ability to keep this mission on schedule. Our plan is to launch the first Core satellite for the GPM mission not later than 2013, followed by the second Constellation spacecraft the following year. The FY 2008 budget request also augments funding for the Landsat Data Continuity Mission (LDCM) and Glory missions in order to help keep those projects on schedule. Within Planetary Sciences, funding has been identified for Lunar Science research project beginning in FY 2008 to leverage the many opportunities for payloads on NASA and other nations’ lunar spacecraft, such as India’s Chandrayaan–1, as well as to analyze the science data from these missions, including NASA’s Lunar Reconnaissance Orbiter. In 2008, we will launch a host of Heliophysics missions, many with international and interagency partners, to analyze the effects of solar flares, coronal mass ejections, and galactic cosmic rays. In Astrophysics, the final Hubble servicing mission is currently planned for a Space Shuttle flight in September 2008. And, as I advised the Congress and the science community last summer, NASA has reinstated the Stratospheric Observatory for Infrared Astronomy (SOFIA) mission. Though we know of no technical show-stoppers in regard to the airworthiness of the aircraft or operation of the telescope, this program has some remaining hurdles to overcome and so remains subject to a management review later this spring. NASA will launch or participate in seven science missions in FY 2007, followed by 10 missions in FY 2008, resulting in many new Earth and space science discoveries in the years ahead.

The FY 2008 budget request increases the budget profile for Aeronautics Research over the President’s FY 2007 request, aligns our aeronautics activities with the President’s recently issued Aeronautics Research and Development Policy, and advances U.S. technical leadership in aeronautics. NASA has made significant progress in reformulating its approach to aeronautics research by collaborating with the broad research community including industry, academia, and other government agencies including the Federal Aviation Administration (FAA) and the Department of Defense (DOD). Through these changes, NASA will help ensure that America continues to lead the way in aeronautics research.

NASA continues to monitor and manage our “uncovered capacity” (employees not directly assigned to specific projects and programs). A little over 18 months ago, nearly 3,000 of NASA’s 19,000 employees were designated as “uncovered capacity.”

Today, largely with the work defined in the Constellation program, we have greatly reduced that problem to manageable levels. As of February 2007, we have fewer than 200 uncovered capacity employees in FY 2007 and FY 2008. More importantly, many of our best engineers are working diligently on the great challenges before us. Every NASA Center is now vested in our space exploration mission. While we are proud of the progress that has been made, significant human capital challenges remain. These include matching available skills with the important work to be done, managing attrition, retraining and hiring, and improving our workforce planning for future years in FY 2009 and beyond. To address these challenges and any potential impacts resulting from the FY 2007 funding reductions, we have established a new intra-agency Workforce Planning Technical Team.

In addition, beginning in FY 2007, the agency revised overhead allocations to simplify how we manage under full cost accounting. These changes will ensure a uniform cost rate for all NASA civil servants across the agency's government field centers. All changes are revenue-neutral to programs and projects; none of NASA's missions gain or lose funding as a result of this accounting change. At first glance, this accounting change appears to reduce the Aeronautics Research budget because so much of that work is done at our smaller research Centers. However, in actuality, NASA's direct spending for Aeronautics Research has increased in the FY 2008 budget runout by \$205 million through FY 2011 compared to the FY 2007 budget runout.

Beyond our budget request, NASA is beginning to transition the workforce, infrastructure, and equipment from the Space Shuttle to new Exploration systems. Many of our most experienced people will be considering retirement between now and 2010. We will need the means to manage this attrition in a targeted manner to achieve better alignment of the workforce with our mission without creating unwanted losses and skills imbalances. One tool we may be using is the authority for the agency to be able to re-employ selected retirees without an offset to their annuity—thus giving them an incentive to see a project or program to completion. To assist employees with transition to the private sector, and ease that upheaval, another tool would authorize NASA to continue their coverage under the Federal Employees Health Insurance for 1 year after departure.

We will also need better tools to manage the transition of our facilities. The agency is proposing slight changes and expansion to existing authority to permit leasing of under-utilized facilities and related equipment. The agency would retain the proceeds of those leases to be deposited in a NASA capital asset account and invested in activities to improve and sustain our facilities and infrastructure. We plan to discuss the details of these legislative requests with Members of Congress in the weeks and months ahead.

The remainder of my testimony outlines the FY 2008 budget request for NASA in greater detail.

Science Mission Directorate

This past year was truly remarkable for science discovery about the Earth, Sun, solar system, and universe. NASA was responsible for 11 percent of *Science News* magazine's top stories (covering all fields of science) for 2006, which is an all-time record in the 34 years of tracking this metric. NASA's findings ranged from new observations of familiar phenomena like hurricanes, thunderstorms, and rainfall, to the identification of 16 new extra-solar planets orbiting distant stars near the center of our galaxy. As NASA continues to add observations from long-lived assets such as the Spirit and Opportunity Mars Exploration Rovers, it continues to successfully develop and launch the next generation of missions and to support a vigorous scientific community.

In 2006, NASA launched four new science missions, one technology demonstration mission, and partnered with other Federal and international agencies to launch three other science and technology missions, as well as the GOES-O satellite, to bring the current total number of operational science missions to 52. In January 2006, we launched the New Horizons spacecraft to the planet Pluto. Scheduled to arrive at Pluto in 2015, the spacecraft is making its closest approach to Jupiter as we speak. With the April 2006 launch of the CloudSat and Cloud-Aerosol Lidar and Infrared Pathfinder Satellite Observations (CALIPSO) spacecraft, NASA added to the "A-train" of satellites flying in close proximity around Earth to gain a better understanding of key factors related to climate change. In October 2006, NASA's twin Solar Terrestrial Relations Observatories mission (STEREO) spacecraft were launched to help researchers construct the first-ever 3-dimensional views of the sun. Although the two spacecraft will not return images until later this year, initial results from STEREO have provided us with an unprecedented look at solar activity. A few weeks ago, we also recently launched five Time History of Events and

Macroscale Interactions during Substorms (THEMIS) microsatellites to study the Earth's magnetosphere, and we are on track to launch the Dawn mission to main belt of asteroids between Mars and Jupiter and the Phoenix Mars mission later this year.

NASA's FY 2008 budget requests \$5.5 billion for the agency's Science portfolio. This represents an increase of \$49.3 million (or 1 percent) over the FY 2007 request and will enable NASA to launch or partner on 10 new missions, operate and provide ground support for more than 50 spacecraft, and fund scientific research based on the data returned from these missions. For FY 2008, NASA separated the Earth-Sun System theme into two themes: Earth Science and Heliophysics, and programmatic responsibility for studies of Near Earth Objects is transferred to the Exploration Systems Mission Directorate

The Earth Science budget requests \$1.5 billion, an increase of \$27.7 million over the FY 2007 request, to better understand the Earth's atmosphere, lithosphere, hydrosphere, cryosphere, and biosphere as a single connected system. This request includes additional funding for the Global Precipitation Measurement (GPM) mission to improve schedule assurance in response to the high priority placed on GPM in the Decadal Survey. As the follow-on to the highly successful Tropical Rainfall Measuring Mission, NASA's plans to launch GPM's first Core satellite no later than 2013, followed by the second Constellation spacecraft the following year. The Earth Science budget also includes increased funding for the Landsat Data Continuity Mission and Glory in order to help keep them on their schedules, and provides funds for the National Polar-orbiting Operational Environmental Satellite System (NPOESS) Preparatory Project (NPP) to reflect instrument availability and launch delays. Funds are requested for continued development and implementation of the Ocean Surface Topography Mission to launch in 2008, the Aquarius mission to measure the ocean's surface salinity to launch in 2009, and the Orbiting Carbon Observatory mission planned for launch in 2008. NASA will continue to contribute to the President's Climate Change Research Initiative by collecting data sets and developing predictive capabilities that will enable advanced assessments of the causes and consequences of global climate change. Over the coming months, NASA will evaluate opportunities for implementing the recommendations of the National Research Council's Earth Science Decadal Survey and responding to challenges to the continuity of climate measurements resulting from the Nunn-McCurdy recertification of the NPOESS program.

The Heliophysics budget request of \$1.1 billion will support 14 operational missions to understand the Sun and its effects on Earth, the solar system, and the space environmental conditions that will be experienced by astronauts, and to demonstrate technologies that can improve future operational systems. During FY 2008, the Explorer Program will launch the Interstellar Boundary Explorer (IBEX) mission, focused on the detection of the very edge of our solar system, and the Coupled Ion-Neutral Dynamics Investigation (CINDI) Mission of Opportunity conducted by the University of Texas. The Solar Dynamics Observatory (SDO) to study the Sun's magnetic field will complete launch readiness milestones in FY 2008 and is presently scheduled for launch in August of 2008. The Geospace Radiation Belt Storm Probes (RBSP) mission, presently in formulation, will undergo a Preliminary Design Review and a Non-Advocate Review in FY 2008 in preparation for entering development in early FY 2009. RBSP will improve the understanding of how solar storms interact with Earth's Van Allen radiation belts. While the ST-7 and ST-8 missions are on track for launches in 2009, the New Millennium ST-9 mission, along with follow-on missions, is delayed.

The Planetary Science budget request of \$1.4 billion will advance scientific knowledge of the solar system, search for evidence of extraterrestrial life, and prepare for human exploration. NASA will get an early start on Lunar science when the Discovery Program's Moon Mineralogy Mapper (M3) launches aboard India's Chandrayaan-1 mission in March 2008, along with the Mini-RF, a technology demonstration payload, supported by NASA's Exploration and Space Operations Mission Directorates and the Department of Defense, which may glean water in the Moon's polar regions. In addition, the budget requests \$351 million from FY 2008 to FY 2012 for new Lunar Science research, including Missions of Opportunity, data archiving, and research. The budget supports the Mars Exploration Program by providing for a mission every 26 months, including the Phoenix spacecraft, scheduled for launch in 2007, and the Mars Science Laboratory, with a launch scheduled for 2009. The Discovery Program's Dawn Mission is scheduled to launch later this year, and the Mercury Surface, Space Environment, Geochemistry and Ranging (MESSENGER) spacecraft is already on its way to Mercury. Three Discovery mission proposals and three Missions of Opportunity were selected in 2006 for Phase A studies, and the Discovery Program will invite proposals for additional new missions in

2008. With the New Horizons spacecraft continuing on its way to Pluto, the New Frontiers Program's Juno Mission will undergo a Preliminary Design Review and a Non-Advocate Review in FY 2008 in preparation for entering development. The New Frontiers Program will release its third Announcement of Opportunity (AO) in late 2008.

The Astrophysics budget requests \$1.6 billion to operate NASA's astronomical observatories, including the Hubble Space Telescope (HST), Chandra X-Ray Observatory, and Spitzer Space Telescope, and to build more powerful instruments to peer deeper into the cosmos. HST is scheduled for a final servicing mission in September 2008 using the Space Shuttle *Atlantis*. Along with service life extension efforts, two new instruments will be installed during the servicing mission that are expected to dramatically improve performance and enable further discoveries, including enabling some science observations that have been affected by the recent failure of the Advanced Camera for Surveys. After the servicing mission, HST will once again have six fully operational instruments (including a suite of cameras and spectrographs that will have about 10 times the capability of older instruments) as well as new hardware capable of supporting at least another 5 years of world-class space science. The ESA Herschel and Planck missions, both of which include contributions from NASA, will launch in FY 2008 aboard an ESA-supplied Ariane-5. The Kepler instrument and spacecraft integration and test will be completed in preparation for launch in November 2008, to determine the frequency of potentially habitable planets. The Gamma-ray Large Area Space Telescope (GLAST) will launch in FY 2008 to begin a five-year mission mapping the gamma-ray sky and investigating gamma-ray bursts. The James Webb Space Telescope will undergo Preliminary Design Review and a Non-Advocate Review in FY 2008, in preparation for entering development. The SOFIA observatory has been reinstated. Though we know of no technical showstoppers in regard to the airworthiness of the aircraft or operation of the telescope, this program has some remaining hurdles to overcome and so remains subject to a management review later this spring chaired by the NASA Associate Administrator. The SOFIA program baseline will be finalized at that time.

Exploration Systems Mission Directorate

The FY 2008 budget request for the Exploration Systems Mission Directorate (ESMD) is \$3.9 billion to support continued development of new U.S. human spaceflight capabilities and supporting technologies, and to enable sustained and affordable human space exploration after the Space Shuttle is retired in 2010. With this budget, ESMD will continue to try to operate our next-generation Crew Exploration Vehicle by 2014, while also providing research and developing technologies for the longer-term development of a sustained human presence on the Moon. ESMD will also continue to work with other nations and the commercial sector to leverage its investments and identify opportunities for specific collaboration on lunar data and lunar surface activities. New human spaceflight development of this magnitude, such as the Orion Crew Exploration Vehicle, occurs once in a generation. The next 5 years are a critical period in our Nation's space flight efforts.

The Constellation program includes the Orion Crew Exploration Vehicle; Ares I, a highly reliable crew launch vehicle; Commercial Orbital Transportation Services (COTS) demonstrations of cargo and crew transport to the International Space Station; Ares V, a heavy-lift launch vehicle; spacesuits and tools required by the flight crews and; associated ground and mission operations infrastructure to support either lunar and/or initial low Earth orbit (LEO) missions.

For FY 2008, pending a full analysis of the FY 2007 budget impacts, ESMD is on track to maintain its commitments for Ares I and Orion, and to continue meeting major milestones. This year Constellation will continue to mature and develop overall. Formulation of the Constellation elements will continue, leading to the Preliminary Design Review in 2008, at which time the program will be baselined. NASA will conduct an update for the overall Constellation Systems Requirements Review (SRR) in 2007 after the completion of all the Program Element SRRs. ESMD recently released the Ares I Upper Stage Request for Proposals (RFP). The RFP for the Ares I Avionics Ring is scheduled for release in May 2007, with selection and contract award scheduled for November 2007.

Facility, equipment, and personnel transitions from Space Shuttle to Constellation will be the major emphasis of the FY 2009 budget process. NASA transition activities are focused on managing the evolution from current operations of the Space Shuttle to future operations of Constellation and emerging commercial services, in a safe, successful and smooth process. This joint effort between the Space Operations Mission Directorate (SOMD) and ESMD includes the utilization and disposition of resources, including real and personal property, personnel, and processes, to leverage existing Shuttle and International Space Station assets for NASA's future

Exploration activities. Formalized Transition Boards are working to achieve this outcome. A Human Spaceflight Transition Plan was developed in 2006, updates are in work, and metrics for the plan are being refined and will be implemented in 2007.

In August 2006, NASA signed Space Act Agreements with Space Exploration Technologies Corporation, of El Segundo, California, and Rocketplane-Kistler, of Oklahoma City, Oklahoma, to develop and demonstrate Commercial Orbital Transportation Services (COTS) that could open new markets and pave the way for commercial providers to launch and deliver crew and cargo to the ISS. The Space Act Agreements establish milestones and identify objective criteria to assess their progress throughout Phase 1 of the demonstrations. In the FY 2008 budget, funding for the purchase of crew and cargo transportation services, either from international partners or preferably from commercial providers, is transferred from ESMD to SOMD. COTS demonstration funding remains in ESMD to better exploit potential synergies with the Constellation Program.

With activities in the Advanced Capabilities program, NASA seeks to understand the space environment as it relates to human performance by addressing respective recommendations from the Exploration Systems Architecture Study that was conducted in 2005. This included refocusing biomedical research and human life-support activities through new milestones and requirements to target the timely delivery of research products. Accordingly, ESMD created two new programs under Advanced Capabilities: the Human Research Program (HRP) to study and mitigate risks to astronaut health and performance and the Exploration Technology Development Program (ETDP) to enable future Exploration missions and reduce cost and risk. Plans for 2008 include:

- Testing of prototype ablative heat shield materials, low-impact docking systems, and landing attenuation systems;
- Testing of advanced environmental control systems on the ISS;
- Developing a lightweight composite command module test article for the Orion;
- Conducting studies to assess risks of long-term radiation exposure and continuing the use of the ISS as a testbed for studying human health and safety in space;
- Spacecraft integration and testing in preparation for the Lunar Reconnaissance Orbiter (LRO) launch in October 2008;
- Next-generation spacesuit capable of supporting exploration; and
- Developing jointly with the USAF the RS-68 engine that will be used on the Ares V.

Finally, the LRO and the Lunar Crater Observatory Sensing Satellite (LCROSS) to the Moon is planned to be launched in early FY 2008. These dual-manifested spacecraft have completed Critical Design Review and are currently in development. The science yielded from these missions will enable future outpost site selection and new information about the deep craters at the lunar poles. The LRO/LCROSS missions represent NASA's first steps in returning to the Moon.

Aeronautics Research Mission Directorate

In 2006, NASA's Aeronautics Research Mission Directorate (ARMD) conducted a significant restructuring of its aeronautics program, allowing NASA to pursue high-quality, innovative, and integrated research that will yield revolutionary tools, concepts, and technologies to enable a safer, more flexible, environmentally friendly, and efficient national air transportation system. As such, ARMD's research will continue to play a vital role in supporting NASA's human and robotic space activities. The reshaped Aeronautics Program content and direction is consistent with the National Aeronautics Research and Development Policy, signed by the President on December 20, 2006.

A primary goal across all of the programs in ARMD is to establish strong partnerships involving NASA, other government agencies, academia, and industry in order to enable significant advancement in our Nation's aeronautical expertise. Because these partnerships are so important, NASA has put many mechanisms in place to engage academia and industry, including industry working groups and technical interchange meetings at the program and project level, Space Act agreements for cooperative partnerships, and the NASA Research Announcement (NRA) process that provides for full and open competition for the best and most promising research ideas. During 2006, ARMD's NRA solicitation resulted in the selection of 135 proposals for negotiation for award from 72 different organizations representing 29 different states plus the District of Columbia. NASA's FY 2008 budget request for Aeronautics includes \$51 million for NRA awards.

In FY 2008, the President's budget for NASA requests \$554 million for Aeronautics Research. This budget reflects full cost simplification, which significantly reduces the Center overhead and infrastructure allocated to Aeronautics programs.

NASA's Airspace Systems Program (ASP) has partnered with the Joint Planning and Development Office (JPDO) to help develop concepts, capabilities and technologies that will lead to significant enhancements in the capacity, efficiency and flexibility of the National Airspace System (NAS). Such improvements are critical to meet the Nation's airspace and airports requirements for decades to come. In FY 2008, NASA's budget request would provide \$98.1 million for ASP to conduct further research in operational concepts and human-in-the-loop simulation modeling that supports advancements in automated separation assurance capabilities. In addition, ASP will pursue enhanced development of airport surface movement trajectory models to provide a basis for optimized use of super density airports, integrated airport clusters, and terminals where demand for runways is high. Last year, ASP took an important step toward this goal by completing development of a system-wide operational concept that provides a detailed description of future NAS capacity enhancements while assessing the benefits of such system improvements. Key to the analysis of the operational concepts was program-developed tools such as the Airspace Concepts Evaluation System and the Future Air Traffic Management Concepts Evaluation Tool, both of which have successfully transitioned from NASA to the Federal Aviation Administration and the JPDO.

NASA's Fundamental Aeronautics Program (FAP) conducts research in the engineering and scientific disciplines that enable the design of vehicles that fly through any atmosphere at any speed. The FY 2008 budget request, amounting to \$293.4 million, will enable significant advances in the Hypersonics, Supersonics, Subsonic Fixed Wing, and Subsonic Rotary Wing projects that make up the FAP. These projects focus on creating innovative solutions for the technical challenges of the future: increasing performance (range, speed, payload, fuel efficiency) while meeting stringent noise and emissions constraints; alleviating environmental and congestion problems of the Next Generation Air Transportation System (NGATS) through the use of new aircraft and rotorcraft concepts; and facilitating access to space and re-entry into planetary atmospheres. A wide variety of cross-cutting research topics are being pursued across the speed regimes with emphasis on physics-based multi-disciplinary analysis and design, aerothermodynamics, materials and structures, propulsion, aero-servo-elasticity, thermal protection systems, advanced control methods, and computational and experimental techniques. A number of key activities are planned for FY 2007 and 2008 including the launch of a suborbital rocket to conduct flight experiments in hypersonic boundary layer transition and re-entry shapes, the flight test of scale models of the X-48B Blended Wing-Body concept to assess this advanced unconventional airframe configuration for its potential to decrease aircraft noise while also improving performance, the evaluation of radical new concepts for variable-speed rotor technologies that can result in highly improved performance, and the evaluation of actively-controlled inlets for supersonic transports.

The FY 2008 budget request for NASA's Aviation Safety Program (AvSP) is \$74.1 million. The four projects within the Program (Integrated Intelligent Flight Deck, Integrated Resilient Aircraft Control, Aircraft Aging and Durability, and Integrated Vehicle Health Management) will develop cutting-edge tools, methods, and technologies with close coordination among them to improve the intrinsic safety attributes of current and future aircraft that will operate in the NGATS. In FY 2008, the Program will complete a study of human-automation technology that will improve safety during approach and landing operations by allowing for active operator assistance that maintains appropriate levels of workload and will be conducted to evaluate neural networks for direct adaptive control that will maximize adaptation to simulated in-flight failures while minimizing adverse interactions. At the same time, onboard sensor technology will be developed and validated to achieve significant improvement in measuring atmospheric water content that will improve the ability to detect the onset of potential icing hazards. Challenges related to aircraft aging and durability will also be addressed by developing models capable of simulating the initiation and propagation of minute cracks in metallic materials.

Finally, NASA's Aeronautics Test Program (ATP) will continue to safeguard the strategic availability of a critical suite of aeronautics test facilities that are deemed necessary to meet agency and national aeronautics needs. The FY 2008 budget request for ATP is \$88.4 million, which will enable strategic utilization, operations, maintenance and investment decisions for major wind tunnel/ground test facilities at Ames Research Center, Glenn Research Center and Langley Research Center and for the Western Aeronautical Test Range support aircraft and test bed aircraft at Dryden Flight Research Center. In FY 2006, NASA implemented procedures to ensure affordable and competitive pricing of its aeronautics facilities for use by other

parties, including industry and university researchers. In FY 2008, ATP plans to continue ensuring competitive prices for ATP facilities, reducing a backlog of maintenance issues and investing in advanced technologies such as installing consistent angle of attack instrumentation at the research Centers.

Space Operations Mission Directorate

This was an extraordinary year for the Space Shuttle and International Space Station (ISS) Programs. NASA celebrated Independence Day 2006 by launching Space Shuttle *Discovery* on the STS-121 mission. The second of two test flights (the first was STS-114 in July/August 2005), STS-121 helped validate the improvements made to the Space Shuttle system since the loss of *Columbia* on February 1, 2003. The mission also marked the return of a complement of three crewmembers to the ISS. The Space Shuttle *Atlantis* (STS-115), which launched on September 9, marked a return to sustained Space Shuttle operations and placed NASA on track to completing assembly of the ISS by 2010. STS-115 delivered the critical P3/P4 truss to the ISS, which will provide a quarter of the power services needed to operate the completed research facility. The last flight in December 2006, STS-116, was devoted primarily to deactivating the electrical power systems on the U.S. segment of the ISS and making a series of electrical and coolant connections between the P3/P4 truss segment and the rest of the Station. To do this, flight controllers at the mission control centers in Houston and Moscow uplinked over 17,900 commands to the ISS during the mission—all without a single unplanned or command error. STS-116 crewmember Robert Curbeam also set a record for the most spacewalks ever conducted by an astronaut on a single Space Shuttle mission, with four excursions totaling over 25 hours.

Operational activities onboard the ISS have continued into 2007, with a series of spacewalks that reconfigured the thermal system on the Station and prepared us for future assembly tasks. The Station is now able to provide additional power to the Space Shuttle, allowing two extra docked days, and we have connected permanent systems in place of temporary ones. The sequence of three complex spacewalks within 9 days also demonstrated capabilities we will need later this year to fully install Node 2 following its delivery on STS-120.

These mission achievements reflect the NASA team's dedication to safely and successfully flying out the Space Shuttle program and meeting our Nation's commitments to our international partners. The program's successes also led to the decision in October 2006 to move forward with plans for a final servicing mission to the Hubble Space Telescope (HST). Following an extensive review by the relevant NASA offices of all safety and technical issues associated with conducting such a mission, it became clear that an HST servicing mission could be carried out effectively and safely. While there is an inherent risk in all spaceflight activities, the desire to preserve a truly international asset like the HST makes doing this mission the right course of action.

The Space Shuttle FY 2008 budget request of \$4,007 million would provide for five Shuttle flights, including four ISS assembly flights as well as the HST servicing mission. The ISS assembly flights include the launch of major research facility modules from the European Space Agency and Japan. The Canadian Special Purpose Dexterous Manipulator robotic system will also be flown in 2008. These flights are a major step toward fulfilling U.S. commitments to NASA's international partners as specified in the ISS agreements and the Vision for Space Exploration.

The FY 2008 budget request includes \$2,239 million for ISS activities. NASA has consulted with our international partners on the configuration of the ISS, and is working closely with them to determine the detailed plans for logistics required during and after assembly. The FY 2008 budget request provides the necessary resources to purchase Soyuz crew transport and rescue for U.S. astronauts as well as Progress vehicle logistics support for the ISS from the Russian Space Agency.

As the Shuttle approaches its retirement, the ISS Program intends to use alternative cargo and crew transportation services from commercial industry. Once a capability is demonstrated in Phase 1 of the Commercial Orbital Transportation Services (COTS) Space Act Agreements, NASA plans to purchase cargo delivery services competitively in Phase 2 and will decide whether to pursue crew demonstrations. In the FY 2008 budget, funding for the purchase of crew and cargo transportation services, either from international partners or preferably from commercial providers, is transferred from the Exploration Systems Mission Directorate to the Space Operations Mission Directorate. One item of significance in the FY 2008 budget runoff, especially in the out-years, is that it allows for increases to our previously estimated costs for purchasing commercial cargo and crew services to support the ISS, assuming these commercial services are successfully demonstrated and are cost-effective. Should costs for those services be greater than what is presently budgeted, NASA

has accepted a management challenge to scale back on our space operations costs and will curtail some of our robotic lunar exploration or long-term exploration technology development in the out-years. COTS demonstration funding remains in ESMD to better exploit potential synergies with the Constellation Program.

The Space Shuttle Program's highest priority is to safely complete the mission manifest by the end of FY 2010, using as few flights as possible. Working through formalized Transition Control Board processes, the Space Shuttle Program will also play a key role in coordinating the smooth transition of Space Shuttle assets and capabilities to the next generation of Exploration systems without compromising the safety of ongoing flight operations. The greatest challenge NASA faces is safely flying the Space Shuttle to assemble the ISS prior to retiring the Shuttle in 2010, while also bringing new U.S. human spaceflight capabilities online soon thereafter. There are a number of major transition milestones set for FY 2008, including the transition of one of the four high bays in the Vehicle Assembly Building and Launch Pad 39B to the Constellation Systems Program. Space Shuttle *Atlantis* may also be retired in FY 2008 after the HST SM-4 mission and its systems and parts would be used to support the remaining Space Shuttle Orbiters, *Discovery* and *Endeavour*, during the program's last 2 years of operations. The FY 2008 budget request reflects the current assessment of costs to retire the Space Shuttle. Over the next year, NASA will develop additional detail and refine our cost estimates for the transition.

The FY 2008 budget also provides for the procurement of two additional Tracking and Data Relay Satellite System (TDRSS) satellites to replenish the constellation. NASA projects that the availability of aging TDRSS satellites to support overall user demand will be reduced by 2009 and depleted by 2015. In order to continue to support all users, NASA must begin the procurement process immediately, with planned launches in FY 2012 and FY 2013. By replenishing the satellites, NASA will be able to meet overall user demand through 2016. The Space Operations Mission Directorate has partnered with non-NASA users to provide a proportionate investment in the replacement capabilities.

Cross-Agency Support Programs

The FY 2008 Budget Request for activities within the Cross-Agency Support Programs (CASP)—Education, Advanced Business Systems, Innovative Partnerships Programs, and Shared Capabilities Assets Program—is \$498.2 million. Within this amount, \$34.3 million is for the Shared Capability Assets Program (SCAP), which is designed to ensure that critical capabilities and assets (*e.g.*, arc jets, wind tunnels, super computing facilities, rocket propulsion testing, etc.) required agency-wide are available to missions when needed. The FY 2008 budget request for Advanced Business Systems, comprising the Integrated Enterprise Management Program (IEMP), is \$103.1 million. FY 2007 and FY 2008 funding will support IEMP in implementing capabilities that improve NASA's tracking and accountability of its property, plant, and equipment; integrate human capital information, providing employees and management with new, secure tools for accessing personnel data, and planning and budgeting NASA's workforce; and, provide more relevant and accurate financial information in support to NASA's programs and projects. This funding also supports ongoing operations and maintenance of NASA's financial system and other agency-wide business systems.

For NASA's Education activities, the FY 2008 budget request totals \$153.7 million and sustains our ongoing commitment to excellence in science, technology, engineering, and mathematics (STEM) to ensure that our agency is equipped with the right workforce to implement the Vision for Space Exploration. NASA will continue the tradition of investing in education and supporting educators who play a key role in preparing, inspiring, exciting, encouraging, and nurturing the youth who will manage and lead the laboratories and research centers of tomorrow. NASA Education is committed to three primary objectives to help improve the state of STEM education in our country: strengthen the Nation's and NASA's future workforce; attract and retain students in the STEM discipline and; engage the American people in NASA's missions through partnerships and alliances.

The Innovative Partnerships Programs (IPP) provides leveraged technology investments, dual-use technology-related partnerships, and technology solutions for NASA. The FY 2008 budget request for IPP activities is \$198.1 million. The IPP implements NASA's Small Business Innovative Research (SBIR) and Small Business Technology Transfer (STTR) Programs that provide the high-technology small business sector with an opportunity to develop technology for NASA. Recently, NASA has made some changes to the management structure of these two programs to better enable technology infusion and to increase the efficiency of the operations. IPP also manages the Centennial Challenges Program. NASA has already benefited from the introduction of new sources of innovation and technology development even

though the Program is relatively new and no prizes have yet been awarded. In addition, ongoing and future prize challenges will continue to inspire brilliant young minds.

Conclusion

NASA has many challenges ahead of us, but we are on track and making progress in managing these challenges. The FY 2008 budget request demonstrates commitment to our Nation's leadership in space and aeronautics research, and while we may face a significant funding reduction for FY 2007, we will carry on, though not at the pace we had previously hoped.

I ask your help to ensure this Nation maintains a human space flight capability. Without stable funding as requested in this budget, we face the very real possibility of allowing that capability to slip away for the foreseeable future—even as other nations continue to develop similar capabilities.

I also need your help to effectively transition key elements of our Space Shuttle workforce, infrastructure, and equipment to our Nation's exploration objectives. The provisions I referenced earlier, as well as stable funding, will help ensure we preserve a critical and unique industrial base capability that has allowed the United States to lead the world in space exploration.

Again, thank you for the opportunity to appear before you today. I would be pleased to respond to any questions that you may have.

Senator NELSON. Thank you, Dr. Griffin.

Senator Stevens, if you need to leave, go ahead.

Senator STEVENS. You're very kind.

As I listened to you, I think you're right, in your last statement. But, you know, we have never made it available to the public to express their support, in terms of space bonds. Have you ever explored the concept of some space bonds so that we could purchase them and leave them to our grandchildren or something to collect, at a very low rate of interest? I think everyone in the country would contribute to keeping us in space. But the ability to get all the needed money out of the budget is almost impossible.

Dr. GRIFFIN. Yes, sir, I understand. We've not looked at space bonds. I don't think that's within our authorization. That would be a prerogative of the Congress.

Senator STEVENS. What would you think about it?

Dr. GRIFFIN. I think, as you think, sir. I think most Americans would be willing to buy such things to contribute to the space program. I mean, Americans have bought government bonds for many other important initiatives. I believe many would do so for this one.

Senator STEVENS. Thank you.

Senator HUTCHISON. Let's work on it. That's great.

Let me say thank you for always shooting straight. Sometimes I don't like the message, but you always shoot straight.

Dr. GRIFFIN. I'm sorry, Senator.

Senator HUTCHISON. But I know that when you say you're going to do something, you do it, also. Let me ask you a couple of things.

We had a very important meeting, Senator Nelson and I, with you and the appropriations staff, because I was alarmed at what the Appropriations Committee did, without our acquiescence, in cutting back on certain programs and adding certain programs in NASA without ever having a hearing, without ever consulting us. And we were very concerned. However, the appropriations staff person made it very clear that you had the ability to transfer according to need, and that you would have the flexibility to cover the priorities that you saw.

I wanted to ask you if you are seeing that in actuality? Do you feel that you are able to cover some of those costs for the Crew Ex-

ploration Vehicle, continuation of its early—not production, but the early research and development? And do you feel comfortable that you have the flexibility that was described?

Dr. GRIFFIN. Senator, no, I don't think we have a lot of flexibility. The programmatic instruction in the FY07 bill is very clear. We have a \$545-million, in round numbers, cut for all of NASA. That cut is administered in particular ways that result in taking about \$675 million out of human spaceflight in order to produce increases in other areas or smaller reductions in other areas. So, no, I cannot sit here and say that I feel that I've been granted much flexibility by the Congress in apportioning that money.

Senator HUTCHISON. Well, was that your impression in the meeting, that you would not have that flexibility? Or were you hearing what I thought he was saying, and suggesting language that would give you that flexibility?

Dr. GRIFFIN. I was in that meeting with you. I was not certain what really could be inferred from it. But a careful reading of the law tells us that I do not, in fact—we have taken a nearly \$700-million cut in human spaceflight in order to address a \$545-million cut across the agency. And the language is most specific. And I do not feel that I have much flexibility. I think my assistant just made the point that we do have a certain amount of flex on the institutional side to address the needs of full-cost accounting. So, with regard to our accounting system, we do have flexibility. Of course, that is very helpful, because we have changed our accounting approach this year. But I do not have programmatic flexibility.

Senator HUTCHISON. So, have you had to slow down the Crew Exploration Vehicle buildup?

Dr. GRIFFIN. Yes, Senator. We will be slowing the development of the Crew Exploration Vehicle.

Senator HUTCHISON. Well, I'm very disappointed to hear that, because it was my impression that the appropriations staff person was saying that you would have the flexibility to continue the priorities, which have been human spaceflight, and that continuation—

Senator NELSON.—Senator Hutchison, let me interrupt here to ask a question. Wasn't that administrative flexibility about \$200 million, Dr. Griffin?

Dr. GRIFFIN. I need to distinguish between accounting flexibility and programmatic flexibility. I do not have the flexibility to move money from one area to another. For example, I do not have the flexibility to minimize the delays to the Crew Exploration Vehicle, other than by taking other human spaceflight money. And I don't have extra money in the Shuttle and Station accounts, as you well know—

Senator HUTCHISON. Right.

Dr. GRIFFIN.—so, I do not have that flexibility.

Senator NELSON.—Excuse me for interrupting, but wasn't there one program that you told us, for example, in the development of the heat shield, that you could take out of exploration and put into aeronautics?

Dr. GRIFFIN. Although we were always planning to do this—we can, and will, use our Aeronautics Research Mission Directorate to help with the development of the reentry heat shield for the Crew

Exploration Vehicle. It was always planned that they would do that. I mean, the Aeronautics Research Mission Directorate is where that work would be done, and specifically at the Ames Research Center, is the headquarters for that. The question is, who pays for it? In years where aeronautics received less funding, we would have had the Exploration Systems Mission Directorate pay for it. In this year, we would contemplate having the Aeronautics Research Mission Directorate help pay for it. That is helpful. That is helpful. So, there's no change in the work. It's always been aeronautics work, and it was always planned to be done. The aeronautics account can help pay for that, yes.

Senator HUTCHISON. So, that's—

Dr. GRIFFIN. That is a help.

Senator HUTCHISON. But you're still going to have a slowdown?

Dr. GRIFFIN. As I said a moment ago, the net result of the decrease will be a 4- to 6-month delay, as best we can tell, in delivery of the Orion Crew Vehicle.

Senator HUTCHISON. I would like to ask you if you would give me the detail of how much you would need in transferability to continue the Crew Exploration Vehicle—I don't know—is the research or engineering—

Dr. GRIFFIN. Right, it's—

Senator HUTCHISON.—or planning or development stage—how much would you need transferred back in order to fulfill the timeline, if you were able to start in a month or so, and have the rest of this fiscal year?

Dr. GRIFFIN. I'll have to take that question for the record, but we'll get you the information on the money needed to remain on schedule, where we were before. It would be approximately the amount which was reduced this year, because most of the reduction came from that account. But we will get you that information.

[The information referred to follows:]

Based on the technical baseline and flight tests planned for the Orion Crew Exploration Vehicle (CEV) and the Ares I Crew Launch Vehicle (CLV) and the current projected budget available for Constellation Systems, NASA's estimate for the CEV Initial Operational Capability (IOC) is September 2015, with a schedule variance around this IOC date of approximately 4 months based on NASA's cost estimates. This CEV IOC date may be moved up if we delete other activities in the exploration budget to shore up funding for the CEV and CLV. Further, this projected IOC date is based on the NASA Exploration Systems budget resources not eroding below the current five-year runout or being re-directed to other activities. Initial Operational Capability (IOC) for the Orion and Ares I launch vehicle is defined here as the major milestone when test pilot astronauts fly the CEV for the first time to the International Space Station to conduct full-up testing of the new spacecraft. This is not planned to be a crew rotation flight. The second major milestone is Full Operational Capability (FOC) when the CEV and CLV will be capable of transporting crew to the International Space Station, remaining at the Station for up to 180 days, and safely returning a crew to Earth. This FOC is projected to occur approximately one year following IOC of the CEV and CLV.

In order to meet a CEV IOC of 2014, NASA would require additional funds in the out-years to meet that IOC schedule with a 65 percent cost confidence level in our budgeting. The ideal time phasing of such funds would be approximately \$350 million in FY 2009 and an additional \$400 million in FY 2010, though funding from FY 2008 may be obligated in FY 2008 and FY 2009 to the CEV and CLV development. The schedule variance around the IOC date is approximately 4 months, based on NASA's cost estimates.

Senator HUTCHISON. All right, thank you very much.

Senator NELSON. May I interject right there? Now, let me get the math. \$700 million minus \$200 million that you have in flexibility administration, so that's \$500 million. So, \$500 million, you're in deficit for the Fiscal Year. But the Fiscal Year started October the 1st. This is now the end of February. So, there is 7 months left of the Fiscal Year. So, 7/12ths of \$500 million is something around \$300 million. Is that a ballpark of what you would need juiced up for this fiscal year?

Dr. GRIFFIN. Well, I think we're mixing apples and oranges here, because, again, the institutional flexibility is mostly involved with the spreading of agency overhead, OK, among our accounts. Every business has direct costs and overhead. So, when we talk about flexibility, we do have the flexibility to apportion the overhead correctly, in accordance with our accounting roles. We don't have the flexibility to move direct funding. With all due respect, Senator HUTCHISON asked for an answer, on the record, that gives the right amount of money, and I can't do that in my head, so I'd rather provide that to you offline.

Senator NELSON. We're trying to help you.

Dr. GRIFFIN. I know, Senator. Let me try to get at it another way. Increases were provided to facilities and aeronautics. Small decreases were taken in our science account—much less than the percentage of the cut we had. In order to allow the rest of that to happen, we had to take nearly \$700 million out of human spaceflight. Almost all of that came from the Orion Crew Exploration Vehicle, which is now in development. Senator, you were asking about research or whatever. It's in the development stage. We've selected a contractor. They're busy working away, as are the folks at the NASA field centers. So, in truth, there isn't enough transfer authority to make up that much money, because that amount of money was bigger than the cut we took.

Senator HUTCHISON. But you do have the offset of what is being done within aeronautics.

Dr. GRIFFIN. There is some work that can be done on the heat shield, and is being done in the Aeronautics Research Mission Directorate, but it isn't \$200 million worth of work, by any stretch of the imagination.

Senator HUTCHISON. Well, that's why I would like to have the accurate—

Dr. GRIFFIN. Yes.

Senator HUTCHISON.—number, because maybe—

Dr. GRIFFIN. Exactly.

Senator HUTCHISON.—we would have another way to restore some of that—

Dr. GRIFFIN. Exactly.

Senator HUTCHISON.—through a supplemental.

Dr. GRIFFIN. I will get you that. I certainly know that you're trying to help. And I'm trying to help you. But, you know, the bottom line is that we're down over half a billion dollars, and most of that came from the Shuttle replacement vehicles.

I would emphasize, I know that all of you know this, but, for the record, I want to make the point that many have said, "I'm not worried about the Moon right now." And I would say to them, "Well, I'm not worried about the Moon right now, either. I'm wor-

ried about replacing the Shuttle.” The budget cuts we have taken largely come out of replacing the Shuttle. And I will get you the exact figures.

Senator HUTCHISON. Thank you. And I have another question, but, since Senator Dorgan has not yet questioned, I will defer.

Senator NELSON. Before I turn to Senator Dorgan, are your figures calculating that you’re going to be reimbursed for the money that you spent on hurricane repairs?

Dr. GRIFFIN. We have asked for transfer authority. As I think you know, we took money out of the Shuttle and Station accounts to pay for the Hurricane Katrina repairs. We’ve asked for transfer authority to be able to pay that back from the Hurricane Katrina supplemental that we did receive. That money is not involved, either way, with the exploration account. So, that was money that came out of Shuttle and Station. We’d like to put it back in Shuttle and Station.

Senator NELSON. And how much money is that?

Dr. GRIFFIN. I will have to get you that for the record.

[The information referred to follows:]

Total Katrina requirements are currently estimated at \$432.4 million, made up of \$384.8 million in direct Katrina-related requirements and \$47.6 million in Shuttle/ISS payback needs.

- MAF—\$181.0 million
- SSC—\$197.2 million
- NSSC—\$3.2 million
- Other—\$3.4 million
- Shuttle/ISS Payback—\$47.6 million

The \$384.8 million in total direct Katrina requirements includes all Center recovery and operations activities and all high priority catastrophic loss mitigation projects, approved as of November 1, 2006.

The \$47.6 million in Shuttle/ISS payback needs reflects a reduction from NASA’s earlier figure of \$54 million, a result of the September 2006 reprogramming to the ISS program of \$6.4 million in Shuttle/ISS funds loaned for Katrina needs, which had not yet been spent.

NASA currently has funding availability of \$432.4 million to meet Katrina-related requirements:

- \$384.8 million in supplemental funding from P.L. 109–148 (\$349.8 million) and Pub. L. 109–234 (\$35.0 million)
- \$47.6 million loaned from Shuttle/ISS programs (already obligated)

NASA is seeking to transfer up to \$48 million from the \$384.8 million in emergency supplemental funds to pay back the remaining Shuttle/ISS loan. The ISS program has content requirements in excess of budget availability in FY 2007 due to budget reductions over the past several years and impacts of the *Columbia* accident. This has resulted in a negative ISS reserve posture (more requirements and threats than available funding) for FY 2007, which ISS is closely monitoring. These negative reserves are currently booked in Operations and the program may have to consider potential content reductions in order to execute the next Fiscal Year. Payback to ISS for Katrina would go to ISS Operations to help implement the current program requirements and reduce the risk of potential content deletions, which could prevent the program from meeting its International Partner commitments and supporting the Vision for Space Exploration. The Space Shuttle Program (SSP) requires the payback of funds to mitigate both schedule and operational risk in FY 2007. The SSP is also projecting more requirements and threats than available funding, which reduces its programmatic ability to deal with unexpected requirements. Proposed language is as follows: “Up to \$48,000,000 of amounts made available to the National Aeronautics and Space Administration in Public Law 109–148 and Public Law 109–234 for emergency hurricane and other natural disaster-related expenses may be used to reimburse hurricane-related costs incurred by NASA in Fiscal Year 2005.”

If \$47.6 million were transferred from the supplemental funds to repay the remaining Shuttle/ISS loan, the total available funding remaining for Katrina would be \$384.8 million, the same amount as appropriated in the emergency supplemental measures. The full amount of \$384.8 million would still be available for Katrina needs; no content would be affected by the transfer. NASA is able to fund all Katrina recovery and operations activities as well as all high priority catastrophic loss mitigation projects and still repay remaining borrowed Shuttle/ISS funds if transfer authority is provided by Congress.

Senator NELSON. But whatever that is, it's some tens of millions.

Dr. GRIFFIN. Oh, many tens of millions, yes.

Senator NELSON. Well, then, that's newfound money, isn't it? That would go into the Shuttle account.

Dr. GRIFFIN. Correct.

Senator NELSON. Well, then, that's like additional money that you wouldn't absolutely have. What we'd like you to come up with is a figure that is realistic that we could go out and try to find for you, so you can keep on the schedule of 2014 or earlier for Orion/Ares.

Dr. GRIFFIN. We will do that.

Senator HUTCHISON. Exactly.

Senator NELSON. Senator Dorgan?

**STATEMENT OF HON. BYRON L. DORGAN,
U.S. SENATOR FROM NORTH DAKOTA**

Senator DORGAN. Mr. Chairman, thank you very much.

Dr. Griffin, thank you for being here. You don't lift off from North Dakota. I don't have a large population of employees up in my part of the country, but I'm interested in NASA, and I especially am interested in the last comment you made, because I share that sentiment. I think when a society stops exploring, it stops progressing. I just think it's very important for us to continue to explore, and space exploration is very important in that exploration.

I especially became interested, in the last decade, in the concept of Mission to Planet Earth, which NASA was very interested in, and that is developing the massive—or the substantial amount of information that you collect and create, and using it for beneficial purposes here on Earth. And so, that is one of the things that's piqued my interest, as well.

Let me ask about the budget request, just for a moment. And, if I might, the \$545 million that you're losing is from the President's 2007 request.

Dr. GRIFFIN. Yes, sir.

Senator DORGAN. Our funding, though, in the continuing resolution, is a continuation of the 2006 level, isn't it?

Dr. GRIFFIN. That's correct.

Senator DORGAN. And so, you will not replace the \$545 million that was requested in 2007, because we're not going to have another opportunity on that. We passed a CR at the 2006 level, and the Chairman is right that we're 5 months into the fiscal Year. Seven months remain, but the \$545 million comes off of the 2007 request, rather than the CR, which embodies the 2006-level extension. So, you will have lost all of the \$545 million for the fiscal year and not recapture that. I think that's your concern.

Dr. GRIFFIN. That was part of the point I was making.

Senator DORGAN. What I don't understand is, your loss of \$545 million from the 2007 request, how that relates to the \$677 million that you were directed in reductions to human spaceflight. Can you explain that to me? Because I don't understand that.

Dr. GRIFFIN. I can best illustrate by saying what I normally would have done if given a reduction in planned spending because of a continuing resolution. I would have normally apportioned it approximately in accord with the way money is spent within the agency. Roughly 60 percent of our money is spent on human spaceflight, so I would have taken a cut of 60 percent of \$545 million and applied it to human spaceflight. Thirty-two percent of our money goes to science; I would have cut science by 32 percent, and done so in a *pro rata* fashion. I was not provided that flexibility. Other portfolios within NASA were either increased or were cut only slightly, and the human spaceflight account was decremented quite severely to make up for that. So, the cuts were not applied in a *pro rata* fashion according to how we spend the money within the agency.

Senator HUTCHISON. That language was changed, in the continuing resolution, from the Senate-passed bill and the authorization that came out of this Committee.

Senator DORGAN. Let me ask, with respect to the Orion Crew Exploration Vehicle, can you tell me the timeline and the estimated costs of that project?

Dr. GRIFFIN. The estimated cost of the project is in the \$10-billion, 9-point-something—and it was intended to deliver human flight-quality hardware not later than 2014. In fact, we were aiming for 2014.

Senator DORGAN. And you indicated, today, you've slipped that 6 months?

Dr. GRIFFIN. With this cut, we will slip 4 to 6 months, on an—if nothing else changed, apples-to-apples basis, we'd slip 4 to 6 months.

Senator DORGAN. And how many Shuttle flights will occur between now and that period of time?

Dr. GRIFFIN. Well, the Shuttle will be retired in 2010. We have about 13–14 flights to go.

Senator DORGAN. Can I ask you about the Earth science portion of your work?

Dr. GRIFFIN. You are the Senator, and I am the witness. You can ask about anything.

[Laughter.]

Senator DORGAN. All right, then, let me start each question with, "How do you justify"—no, I won't do that.

Let me ask you about the science portion of your budget. As I indicated, there are many Members of Congress that don't offer a home in their home state to the dedicated people in your agency, but we're very interested in the opportunity that your science programs offer the rest of the country. Give me your assessment of that. I know that some of the priorities have changed in recent years in NASA, but give me your sense of the Earth science programs.

Dr. GRIFFIN. Well, the science program, as a whole, is an extraordinary American accomplishment. It is just extraordinary. It is also

cooperative, internationally. It's one of the best things we do to advance international cooperation. Something like two-thirds of our missions have an international component, and we are not always the leader; sometimes we are the follower, supplying instruments on another country's spacecraft. So, overall, our science program is just extraordinary.

Now, with regard to Earth science, we have—and, as I mentioned in my opening remarks, we have four major portfolios. We have astrophysics, as exemplified by the Hubble Space Telescope; planetary science—I think you're familiar with the Mars Rovers; heliophysics on space science—you might not be familiar with particular missions there, but you might recall that, just a few months ago, we launched the STEREO mission, which will study the sun from opposing angles around it, and be able to get stereoscopic views of it, and help us understand coronal mass ejections, which are our key to space weather and to electrical interference with Earth; and then, finally, we have Earth science. So, we have four portfolios. The Earth science portfolio occupies, in Fiscal Year 2008, 27 percent of the budget, so just slightly over one-fourth. The Earth science portfolio is the section of NASA which is responsible for returning all of the information on climate research, which you have seen much ballyhooed in the media lately on global warming. That is NASA work that has produced that data, and we're quite proud of it.

The Earth science program had fallen on, I would say, difficult days, a few years ago. Almost the first thing that I did when I returned to the agency—as I think you know, I've been with NASA before in my career—almost the first thing I did when I returned was to remove a planned increase for the robotic Mars program and put that money back into Earth science to bring the Earth science portfolio up to the levels that it should enjoy, consistent with our other science mission portfolios. So, today it's healthy. We have also a very recently released Decadal Survey for Earth Sciences. We will use that to reshape our planning portfolio in the next few years. We have a recently released report from the IPCC on their thoroughly scientific assessment of global warming, which I think will help to inform the debate.

So, I'm actually pretty pleased with, and pretty proud of, the program. And, you know, I think it's in good shape.

Senator DORGAN. Well, I want NASA to succeed. And as I indicated to you, I feel very strongly that our country needs to continue to explore and find the edges of exploration and science.

Let me, finally, ask you one very delicate question. Well, you know that NASA was the subject of a 24/7 discussion about one instance, a very difficult circumstance with an astronaut, a former astronaut. And, frankly, watching all of that on television, it's pretty depressing to watch the 24/7 news cycle these days—a lot like blackbirds on a telephone wire, one flies on; they all fly on, one flies off, they all fly off. And in this circumstance, there was a lot of publicity about a former NASA astronaut. I watched that, and one of the things that I admired is other NASA astronauts came and spoke publicly and said, "We worry about the human being here." But having mentioned that, is there anything in that circumstance, or anything with respect to what you saw and heard,

that required or urged you to think about any changes in screenings or any other aspect of training and seeking astronauts?

Dr. GRIFFIN. Well, sir, that is exactly what we are looking at. The allegations against Captain Nowak are, of course, very serious. It's a legal matter. It's in the legal system. I just will not address those allegations. But clearly she is in major trouble, and clearly we failed, as an institution, to recognize that she was very troubled. So, as I speak to you, we are looking, with two separate groups, at exactly that issue, as well as the issue of prescreening and to continue screening.

The two groups are drawn, first of all, from across the Federal Government from other high-performance, high-stress organizations in the military services, from the aeromedical or other medical specialists, and then also a second group from inside NASA to look at how we support our astronauts. When results from those studies become available, you will have them.

Senator DORGAN. All right. I should hasten to say, I don't mean to suggest that was not a news story. It clearly was a news story, and clearly the charges are serious. But it was very high profile, simply because it was an astronaut who had recently flown on a mission.

I thank you for the response. I hope you'll share what you have learned, with the Committee, when you learn it.

Dr. GRIFFIN. We absolutely will. I would like to close that particular question by noting that I have known and worked with our astronauts for the better part of 30 years, in one capacity or another, and they are, of course, highly selected and highly filtered, and extremely capable, and extremely conscientious, and I don't think one incident should ever be allowed to paint a picture for an entire group of people, for any group, and certainly not for our astronauts.

Senator DORGAN. Well, I've met many of them, and they are an unbelievable group of American men and women, courageous. And we certainly wouldn't want to disparage astronauts in the sight of one who's flown here, as well, the Chairman of our Subcommittee.

Let me thank you, Dr. Griffin. And I'm anxious to work with you and the folks in NASA to see that you succeed in your missions.

Dr. GRIFFIN. Thank you, Senator Dorgan.

Senator NELSON. Senator Dorgan, since you are a member of the Appropriations Committee, one of the things that maybe you, Senator Mikulski, and Senator Hutchison could all explore is language that would give additional flexibility, coming up on this vehicle that we're going to consider in a couple of weeks on moving money from one account to another.

Dr. Griffin—Senator Hutchison, you want to continue on?

Senator HUTCHISON. Yes.

Senator NELSON. I've got a bunch of questions, and I don't want to hold you up.

Senator HUTCHISON. OK. Let me ask one.

Senator NELSON. You go ahead.

Senator HUTCHISON. All right, thank you. I just have one, and that is the Alpha Magnetic Spectrometer (AMS) that we have discussed, that Dr. Sam Ting is working on, both in Switzerland, and other countries, and would like to have the spectrometer go on the

Space Station, because it is his contention, as we had heard from him in this very Committee last year, that he thinks the study of cosmic rays and the dark matter could have a potential impact on our future energy sources. And the Department of Energy has, since that hearing that we had, validated his contention that it would have a strong scientific basis. My question is, since it is not on the list of priority pieces of equipment that would be in the last of the Shuttles, which I think you've already designated, is there any other way that that piece of equipment could be taken to the Space Station, perhaps through other agencies or private funding? And do you think it would be worth pursuing that for the scientific work that could be done once the Space Station is completed?

Dr. GRIFFIN. I'm certainly not able to comment on private funding sources or what other agencies can do. I need to stay in my running lane. Yes, of course, the Alpha Magnetic Spectrometer can be put in space by other means than the Shuttle. We've analyzed that problem fairly carefully, and, if it were put on an Atlas or Delta EELV, Air Force Expendable Vehicle, it would take us about \$350 million, we estimate, to buy that launch and to outfit it with the necessary automated docking mechanisms. The automated docking mechanisms would be very similar to what the European ATV or the Japanese HTV will use when they dock with the Station. So, certainly it can be done, but it's the \$350 million. Just as Shuttle flights, following *Columbia*, are now a nonrenewable resource—I have a very limited number of Shuttle flights available to finish building the Station, and so, I just simply can't add a Shuttle flight—so, also, I don't have \$350 million to put that payload into space by alternate means.

Senator HUTCHISON. Is it totally foreclosed that that would be able to go up on a Shuttle when you are taking something else in this group that you have in the schedule?

Dr. GRIFFIN. The Alpha Magnetic Spectrometer weighs many tons, and we have looked carefully, believe me. The Alpha Magnetic Spectrometer flight is one of the many examples of collateral damage to the Nation's space program which followed the loss of *Columbia*. It is very visible. I know it is very visible to you. But there have been many other things we lost as a result of that accident. We are still digging out of that hole, leaving entirely aside, of course, the tragedy of losing seven crew members. The Alpha Magnetic Spectrometer is one of those losses. We have looked very carefully to see whether it could be co-manifested with any other piece of Space Station hardware, and to go up in that fashion. But, as you know, the pieces of Space Station hardware that we have are, themselves, large and voluminous. We just can't fit the AMS in with the Space Station hardware. Other than the Hubble flight, which needs the whole cargo bay—the Hubble servicing mission, sorry—needs every bit of payload we can get to get to the right altitude—we have no other Shuttle missions available that don't take up Space Station hardware. So, all of our missions are devoted either to servicing the Hubble or to building the Space Station, and all of the ones devoted to building the Space Station have too much hardware in the cargo bay to put the AMS in. So, we just can't get there from here.

Senator HUTCHISON. And there's no outside source that would probably consider the \$350 million able to be recovered from the science?

Dr. GRIFFIN. I'm not aware of one. Of course, I'm an engineer and not a scientist. I know that Dr. Ting has much broader connections in the science community than I will ever have. And I am told that the science is good science. I'm simply not casting any aspersions on it at all. But if no other science agency or entity has stepped up to say that they want to fund it, then I would assume that they don't think that it is capable of being funded.

The AMS was approved—I know you know this, but, for the record, before we lost *Columbia*, the entire logistical support of the Space Station was to be by means of the Shuttle. So, there were many Shuttle flights that would go up for crew rotation or to bring consumables, which had a lot of extra payload capacity. So, in that sense, transport aboard the Space Shuttle was a free good. It was a free thing that we could offer to worthy payloads. The AMS was one of those. In the post-*Columbia* world, transportation aboard the Shuttle is not a free good. It is an extraordinarily limited resource. If we are to finish the Space Station in the manner that you spoke of in your opening remarks, every Shuttle flight that I have left has got to be used for the Station. Then, last year's legislation, 2006 legislation, made one exception to that, in law—was the Hubble servicing mission, directing us to spend \$293 million to continue with that mission, if it were possible to fly it. As you know, I spent a lot of personal time—not just agency time, but personal time—involved in the study of whether or not the Hubble servicing mission was technically possible, given the new rules under which we fly Shuttles. We came to the conclusion that it was, and that is the only non-Space Station exception, at this point.

Senator HUTCHISON. Thank you.

Thank you, Mr. Chairman.

Dr. GRIFFIN. Thank you, Senator. And I'm very sorry, but that is the answer.

Senator NELSON. And according to your answer on AMS, the same would be true of the Deep Space Climate Observatory?

Dr. GRIFFIN. You've caught me at a loss. I don't know what the Deep Space Climate Observatory is; but, if it was intended to go up on a Shuttle, it isn't now.

Senator NELSON. It was. It was engineered to go in the payload bay. In fact, it is a completed spacecraft.

Dr. GRIFFIN. Oh, I believe you're talking about what used to be called Triana.

Senator NELSON. That's correct.

Dr. GRIFFIN. I'm sorry. I disconnected on the acronym. Excuse me. Yes, sir, if we were to fly DSCOVER, it would have to go on an expendable vehicle. There would have to be some reengineering done to it, because expendable vehicle loads are substantially greater than the Shuttle, as you, of course, know. So, it was designed for Shuttle launch. So, the entire loads environment would be different. So, there would be money to spent there. Then, we would have to buy the expendable vehicle. So, I think, there again, you're talking about at least a couple of hundred, maybe several hundred million dollars to fly that particular spacecraft.

Senator NELSON. Picking up on Senator Hutchison's comment about private entrepreneurs offering a ride, one thing that you are looking at is the ability to send crew or cargo to the Station during the gap.

Dr. GRIFFIN. Yes, sir.

Senator NELSON. Instead of relying just on the Russian Soyuz or the European ATV, which, itself, hasn't flown. You have this COTS contract, the Commercial Orbital Transportation System. Talk to us about that.

Dr. GRIFFIN. I'm happy to, Senator. That particular effort is my initiative, so, if it fails, you'll know where to look.

The genesis of that effort lies with the observation that, over the decades of space development—in contrast to aviation, where we had a strong public-private synergy, a lot of private money in aviation during the hundred years of its development to its present state, and a lot of public money—in space, we have pretty much only had public money and public programs, civil or defense, but all funded by the American taxpayer. We've had relatively little private space development.

I believe that that fact is responsible for a slower growth of space capability than we witnessed in the development of aviation. Many private concerns have said that, if the government would provide a certain amount of seed money, that they could attract other private capital, and that they would be able to develop basic space infrastructure—transportation to and from low Earth orbit, if the government would provide seed capital, they could provide such capability at costs much lower than the government could provide.

I don't think any amongst us would believe the proposition that the government is the most efficient provider of goods and services. So, if such commercial space capability could be brought into being, I think that most of us believe it would be more efficient than the government, and, therefore, a good deal.

In my tenure, another of those things that I started very early, we set aside some money—about half a billion dollars over the 5-year runout—we set aside some money to be used as seed money—not enough money for the development of this commercial capability, but seed money—to help the winning companies attract other capital. We labeled it the Commercial Orbital Transportation Services (COTS) program, as you duly noted.

Over the course of the last year or so, we conducted a competition among all parties for two funded Space Act Agreements. Space Act Agreements fall under the category of other transactional authority, like the DOD has in many areas for special transactions that are not what you would classify as conventional prime contracts or service contracts. They're other transactional authority that is granted to NASA in its founding legislation. It was determined by our Office of General Counsel that the Space Act Agreement was an appropriate mechanism to conduct this particular piece of business. We held competitions. We found two winners. We have awarded the money to the two winners. They are now busily about their business of seeking private capital to augment the government capital and moving down the road to advance the capability.

We certainly hope that both will succeed, but this is not something over which the government has control. By the very nature of an attempt to bring about commercial space capability, we must severely restrict our oversight. In fact, this whole question of the development of commercial space capability comes down to an attempt to answer the question, is the American aerospace industrial base capable of developing spaceflight hardware without the close oversight of the U.S. Government? We have conducted the experiment to know that, with the close oversight of the U.S. Government, such capability is possible. The question is, can it be done on an arms'-length basis? I believe the answer to that is yes, and that is what we're doing with the COTS contracts. If one or both are successful, in a few years we will be able to transition from Space Act Agreements to routine purchases of commercial service to low Earth orbit, and that is our hope.

Senator NELSON. And then, you would have to have the government oversight, because it's going to interface with a government facility, the Space Station.

Dr. GRIFFIN. Well, of course. We try to do that through appropriate interface requirements. We have published visiting-vehicle requirements for any vehicle which would wish to dock at the Station. We have certain standards on human rating that we would apply. But those are known in advance to the companies developing the capability. It's not something to be imposed on them by surprise at the last moment. I mean, the government has standards on commercial aviation, as you well know, Senator. So, commercial airplanes are developed with those standards in mind. That's exactly what we're doing in the space arena.

Senator NELSON. If successful, would that be a source of a ride for DSCOVR or for AMS?

Dr. GRIFFIN. I don't know, but I'm initially doubtful, because both—well, possibly for DSCOVR, which is of lower mass. AMS weighs many tons, and I'm skeptical that that particular payload could be carried up. We are talking about a couple of tons of cargo for this commercial space capability at the entry level, a few tons of cargo. We're talking about being able to provide crew rotations for a few people. We're not talking about the kind of mass that the AMS has.

Senator NELSON. But possibly DSCOVR.

Dr. GRIFFIN. Possibly.

Senator NELSON. And it would be a lot cheaper than the \$350 million you're talking about to get on an Atlas or a Delta.

Dr. GRIFFIN. Well, certainly, sir, because if the developed commercial capability was not cheaper than what the government could do, then we wouldn't purchase it. We won't spend more money than is necessary to buy a government capability.

Senator NELSON. Let's go back to the gap, which you now say is going to be early Fiscal Year 2015.

Dr. GRIFFIN. As we project, today, yes, sir.

Senator NELSON. So, between October 1, 2014, and sometime in the first part of calendar year 2015 is what you're projecting.

Dr. GRIFFIN. That is what I'm projecting.

Senator NELSON. What do you think is going to be the impact upon the work force, both civil servants and contractors?

Dr. GRIFFIN. I am worried about it. From the end of Fiscal Year 2010 until early in Fiscal Year 2015, from the end of one Shuttle period to the onset of the Orion and Ares period, our human spaceflight expertise will be depleted, to a certain extent. In fact, if we kept all the same people onboard that we have today on Shuttle, we would obviously save no money, because, in the end, all the money goes to pay people to do things we want them to do. Even when we buy hardware, we are paying other people in other places to make that hardware.

Now, there would be fewer people involved in the Orion and Ares launch systems anyway, because we intend them to cost less, and we certainly want to divert some of that talent to other enterprises. But when you don't fly for 4 or more years, people become stale; the very good people often move into other enterprises where there is more action; facilities degrade. It's not a good thing. This Nation went through a period like that between the end of Apollo and the onset of Shuttle, and it was very damaging. I expect it will be damaging again, which is why, with you, I have devoted a considerable amount of personal energy to minimizing that gap. The funding that we have today supports flying in early 2015. That is about the best that I can offer you.

Senator NELSON. Theoretically, that would be 4 years; October 2010 until October, November, or December of 2014, because that's Fiscal Year 2015.

Dr. GRIFFIN. Sometime in early 2015 would be 4-plus years.

Senator NELSON. What are the strategic implications of this 4-year-plus gap in our Nation's ability to send humans into space?

Dr. GRIFFIN. Assuming that commercial capability does not materialize, and that we have only government capability, then it would be at least 4 years. Personally—I mean, we—that calls for a conclusion of the witness, because we can only really assess the strategic impact by looking back on it, not looking forward to it. But, as I look forward to it, my conclusion is that, first of all, the United States will be, as a Nation, in a position of purchasing crew and cargo services from other governments—Russia, Europe, Japan—because our existing barter arrangements for the Space Station did not ever contemplate the lack of availability of the Shuttle. So, we are purchasing extra services, which they are not obligated to provide. I will tell you that I find it unseemly for the United States to be in a position where we must do such a thing.

Now, we have reached the point where that is the state of affairs, and so, my finding it unseemly does not alter that fact. But it is a fact. I don't like it. I think it is an improper position for the world's leading spacefaring nation to be in. Moreover, to be in such a position greatly reduces any bargaining power we might have in what is a very limited marketplace, so we should not expect the cost of purchasing such services to be cheap. The money then spent on purchasing such services goes to the aerospace industries of other nations, rather than our own.

That can't cheer anyone up.

Senator NELSON. No. Why did NASA, to begin with, decide that there was going to be a gap until 2014?

Dr. GRIFFIN. Sir, we have a budget. It is a very good budget in any sense that one can assess it in the suite of domestic nondefense

discretionary programs in the Nation. The President's request for NASA is incredibly generous. But the money only goes so far, and, as you know we have many legacy commitments on Shuttle and Station, which none of us want to see abrogated, between now and Fiscal Year 2010, that leaves a very limited amount of development money to nurture the new systems. The way that development programs work is, for a fixed amount of money, the normal development program profile would require more money, earlier rather than later. The early years for Orion and Ares are exactly the years when we have less money. And so, given the fact that we have a generous budget, but given the fact that we have legacy commitments between now and the end of 2010, we simply do not have the money available to provide an early capability for Orion and Ares.

Senator NELSON. Why don't you, in addition to the figures that you're already going to supply to the Committee, supply us with the figures that you think would get us back onto a track to have it fly in human flight? Because you're going to do several unmanned flights prior.

Dr. GRIFFIN. We will do a couple of unmanned test flights prior to putting people onboard, yes, sir.

Senator NELSON. So, human flight being the target of 2014, 2013, and 2012.

Dr. GRIFFIN. So, you want funding requirements to provide first human launch in—IOC, we're calling it, Initial Operational Capability—you want funding requirements for IOC in 2012, 2013, and 2014.

Senator NELSON. Since you just announced to us that it's going to be early Fiscal Year 2015.

Dr. GRIFFIN. At best, at this point. Yes, sir, we will get you those funding requirements.

[The information referred to follows:]

Assessment of Orion Crew Exploration Vehicle Schedule

Based on the technical baseline and flight tests planned for the Orion Crew Exploration Vehicle and the Ares I Crew Launch Vehicle and the current projected budget available for Constellation Systems, NASA's estimate for the CEV Initial Operational Capability (IOC) is March 2015, with a schedule variance around this IOC date of approximately 4 months based on NASA's cost estimates. This CEV IOC date assumes that NASA's proposal to terminate certain Exploration Systems projects in FY 2007 and the outyears (approximately \$630 million between FY 2007–2011) will be approved, so that we may shore up funding for the CEV and CLV. Further, this projected IOC date is based on the NASA Exploration Systems budget resources not eroding below the current 5-year runout or being re-directed to other activities. Initial Operational Capability (IOC) for the Orion and Ares I launch vehicle is defined here as the major milestone when test pilot astronauts fly the CEV for the first time to the International Space Station to conduct full-up testing of the new spacecraft. This is not planned to be a crew rotation flight. The second major milestone is Full Operational Capability (FOC) when the Orion Crew Exploration Vehicle and Ares I Crew Launch Vehicle will transport crew to the International Space Station, remain at the Station for up to 180 days, and then safely return a crew to Earth. This FOC is projected to occur approximately 1 year following IOC of the Orion and Ares I.

NASA was asked to examine how much in budget resources would be necessary to meet earlier CEV IOC milestone dates, and the following is NASA's estimate of three scenarios based on the assumptions noted herein.

CEV IOC in 2012—Because of earlier decisions in response to funding limitations, a CEV IOC milestone is no longer technically achievable in 2012. In 2005, in an effort to preserve a 2012 IOC, NASA was considering a Block-1 version of the Crew

Launch Vehicle, which utilized the standard 4-segment Shuttle Reusable Solid Rocket Booster (RSRB) and a modified, air-start version of the Space Shuttle Main Engine on the second stage. The use of the Block-1 CLV would have preserved the 2012 IOC, but at a higher overall life-cycle cost for the Constellation Program. NASA planned a later upgrade to a Block-2 CLV, with a 5-segment RSRB and J-2X upper stage engine, both of which are essential elements for the lunar Cargo Lift Vehicle (CaLV), but which could not be available for use in 2012. The use of these common elements across the architecture minimizes life-cycle cost. By late 2005, because of funding reductions to the Constellation Program to support the Space Shuttle and the International Space Station, it became clear that funds to support development of CEV and CLV by 2012 would not be available. Thus, in order to minimize life-cycle cost, in early 2006 NASA chose to proceed directly to the J-2X upper stage and 5-segment RSRB, which again are common to both the CLV and CaLV. In order to develop and test these components of the CLV, the earliest technically achievable CEV IOC milestone is June 2013.

CEV IOC in 2013—In order to meet a CEV IOC of September 2013, NASA would require additional funding in Fiscal Years 2008–2010 to meet that IOC schedule with a 65 percent cost confidence level in our budgeting. The ideal time-phasing of such funds would be approximately \$400 million in FY 2008 and an additional \$1.6 billion in FY 2009–2010. The schedule variance around the September 2013 IOC date is approximately 4 months, based on NASA’s cost estimates.

CEV IOC in 2014—In order to meet a CEV IOC of September 2014, NASA would require additional funds in Fiscal Years 2008–2010 to meet that IOC schedule with a 65 percent cost confidence level in our budgeting. The ideal time-phasing of such funds would be approximately \$350 million in FY 2009 and an additional \$400 million in FY 2010, though funding from FY 2008 may be obligated in FY 2008–2009 to the CEV and CLV development. The schedule variance around the September 2014 IOC date is approximately 4 months, based on NASA’s cost estimates.

Senator NELSON. OK. Is the Administration’s FY 2008 budget request sufficient to support full implementation of the missions recommended by the National Academy’s decadal survey in Earth science?

Dr. GRIFFIN. On what time-scale, sir? I want to be very clear with the addition of Earth sciences to this practice, we now obtain, from the National Academy of Sciences, decadal surveys in all of our four portfolios. I’m very pleased about that. I was one of the people requesting such a decadal from the Earth science community. Now, we never have had enough money to do all of the missions in any of the decadal. So, practically speaking, we have missions in the flow in any of those areas to address the top two or three or four missions. We absolutely will prioritize our money in Earth science to address the decadal survey priorities in Earth science, but we will never have enough money to address all of the priorities for Earth science.

Senator NELSON. Is it correct that in order to meet their recommendations, it was basically about \$2 billion annually?

Dr. GRIFFIN. I don’t know. I would have to get back to you on that.

[The information referred to follows:]

According to the Decadal Survey, the authors believed that the program they recommended could be substantially accomplished for a total NASA Earth science annual budget of \$2 billion in constant FY 2007 dollars. We are using the detailed cost and programmatic expertise available to NASA to examine whether all of the technical challenges and implementation costs associated with their recommended program were captured in this figure.

From *Earth Science and Applications from Space: National Imperatives for the Next Decade and Beyond*: “The overall cost to implement the recommended NASA program (~\$7 billion over twelve years for the 15 missions) is estimated to exceed currently projected program resources.” The report also states that “The committee sees the need for a rapid growth in the NASA Earth Science budget from approxi-

mately \$1.5 billion per year to \$2 billion per year beginning in 2008 and ending no later than 2010.”

NASA is embarking on an aggressive series of concept studies, to look carefully at the notional missions that were endorsed, especially the early, highest-priority ones from the Decadal Survey. The objectives of these studies are to understand the technological challenges inherent in getting the measurements that were identified by the Decadal Survey, and the full costs of these missions including the launch vehicle and especially also the science and the validation. We expect that in 6 months, we will have relatively accurate estimates of the full costs of those missions.

Dr. GRIFFIN. I think there was a strong feeling among those of us who looked at it, that the projected cost of those missions in the decadal was substantially underestimated, a not-uncommon practice, by the way. When we get a decadal survey, we pay great attention to the priority order. Frankly, the National Academies of Sciences is not the best body to estimate what the cost of those missions is likely to be, and, in fact, the track record of history would indicate that they are among the least qualified bodies to estimate what the cost of those missions would be.

Senator NELSON. In other words, you’re saying that they underestimate the cost.

Dr. GRIFFIN. Correct.

So, we respect their priorities. We do not necessarily believe the funding estimates they provide.

Senator NELSON. But the White House’s budget goes the other way, because they are estimating this to be at \$2 billion for each year, and the President’s budget requests 1½ billion dollars.

Dr. GRIFFIN. That’s correct, sir. Each of the other scientific portfolios which we have would also request more money for their portfolio than is available. Again, science—I must remind the Committee, science today is funded at a historic high within NASA. It is 32 percent of our overall funding for FY 2008, the President is requesting five and a half billion dollars. That is a historic high in both categories. Earth science is getting 27 percent of—more than one-fourth—of a science mission directorate with four major portfolios. So, unless the Nation chooses to allocate substantially more money to NASA, and substantially more money to science, Earth science is getting its share and a little bit more.

Senator NELSON. All right. Let’s talk about another program, NPOESS. This was polar orbiting satellites that are run by NOAA and the Air Force with NASA’s participation. What are we going to do to recover the client measurement capabilities lost from NPOESS due to Nunn-McCurdy?

Dr. GRIFFIN. Well, we will be relying on the NPP, the NPOESS Preparatory Project. We have the Landsat Data Continuity Mission, which will fly. Frankly, we are going to have to look at other missions in the future to make up for the descoping of NPOESS following the Nunn-McCurdy breach. So, we have some scrambling to do, to make up for the loss of climate research from NPOESS.

Senator NELSON. Can you fly some of those instruments on other satellites?

Dr. GRIFFIN. Well, of course, the instruments, sir, don’t exist, so, can we fly instruments that would accomplish what those instruments would have accomplished on other satellites? Yes. But, of course, that represents a funding requirement that we don’t have.

Senator NELSON. All right. Let me ask you something that you can easily answer. And I'll state, preparatory to my question to you, thank you for what you've done in the agency in stopping this muzzling of scientists. Can you give assurance to the Committee that the actions that you have taken, and the policies that you've implemented to make sure there's free flow of communication of scientific information from the NASA scientists, that those policies and procedures are in place?

Dr. GRIFFIN. Yes, sir, I can. I think people have, on many occasions, stated that the technical and scientific communication policy that we have outlined for the agency—people have stated that they believe it should be a model. I'm quite proud of it. We place no restrictions on what people say. In fact, looking back in the past, I'm not able to find cases where we did. But, leaving aside the interpretation of history by disputing parties, I can assure you that we are absolutely not, and will not, restrict the ability of anybody working at NASA to express their technical opinion.

Senator NELSON. I want to thank you, personally, for what you've done to try to straighten that out.

Let's go back to the Space Station. Yesterday, the Space Station Independent Safety Task Force released a report with the following recommendation: "The International Space Station program should place the highest priority on options to decrease the risk of micrometeoroid and orbital debris." Tell us about this, given the fact that, much to the chagrin of a lot of folks, the Chinese have just put a bunch of debris up there with their ASAT test.

Dr. GRIFFIN. Yes, sir. Well, certainly, we agree with the recommendation. That was a very good committee, and, in general, we are in consonance with their recommendations. With regard to debris, let me put some numbers on it. This is a nice, round number, but it's approximately right. Each day, there is about a 1-in-100,000 chance that the International Space Station will be fatally damaged by a piece of orbital debris. You will appreciate that that's not a large risk, but it is substantial; and, of course, it adds up over time. We do fly specific orientations of the Station intended to minimize such concerns. We have, in the past, done collision-avoidance maneuvers when a particular piece of debris catalogued on radar tracking posed a threat. So, we do pay attention to orbital debris, quite carefully.

The Chinese ASAT test temporarily just about doubled that risk. So, a daily risk of 1-in-100,000 went, for—we can argue about the time period—let me just say, a couple of weeks. So, for a few weeks, the Chinese ASAT test approximately doubled that risk. Now, we, at NASA, have, I will say with some pride, the best orbital-debris analysts in the world. It happens to be a subject I know more than a passing amount about. I have asked them about all that. Our current debris risk from the Chinese ASAT test has now, at this point, receded into the background. The longer-term effects of the Chinese ASAT test are now indistinguishable from the 1-in-100,000 background level that we have. At this point, I cannot sit here and say, technically, that that is a concern anymore. The period of concern has abated. Certainly, any addition to the orbital-debris environment by any nation for any reason is not to be countenanced. It's something we don't want to do. There has

been for 20, and more, years, considerable activity through multinational bodies, including the United Nations, seeking to control and mitigate debris. We want that to continue. We, at NASA, are a major part of such discussions. But currently, the specific test to which you refer, the threat from that test has receded.

Senator NELSON. Well, the Chinese are going to hear that, and they're going to say, "Well, see? We haven't appreciably added to the problem." But, in fact, with all that debris, as a result of the Chinese ASAT collision with an old Chinese weather satellite, as it descends how does that, over time, how does that lessen the doubling of that probability of a strike?

Dr. GRIFFIN. Because the debris is greatly dispersed throughout low orbital space. The debris is most threatening to the Station or a Shuttle or an EVA astronaut when it is concentrated immediately after the test. If we get through that initial more dangerous period, and it has time to disperse, as it naturally does, then it becomes statistically much less of a threat. I don't want my remarks to be interpreted as a ho-hum, that it's OK to create debris. In fact, I specifically said that we don't want to create debris, and we, at NASA, are part of multinational coordinating bodies to prevent exactly that. But with regard to the specific test that you cite, I have to tell the technical truth, as best we can tell, the immediate post-tests effects of debris—we got by those effects, and the situation has now receded to the point where the Chinese debris has retreated into the background with the other debris.

Senator NELSON. Isn't it true, with those additional thousands of pieces of debris in orbit, that fuel will have to be expended in order to have some way of maneuvering out of the way of some of those pieces that you're tracking?

Dr. GRIFFIN. That could happen. We have done it before, for other pieces of debris, and it could happen again.

Senator NELSON. And that could happen on all the weather satellites and other surveillance satellites that are up in orbit, owned by many nations.

Dr. GRIFFIN. Certainly. Absolutely, sir. That is a primary reason why we seek to mitigate the critic—to mitigate the creation of any additional debris.

Senator NELSON. Do you know, from your present tracking of the debris, when that maneuvering might have to occur?

Dr. GRIFFIN. We don't project any immediate need to do so. But our ability to project out more than, you know, weeks and months at a time is severely limited. It is not knowable in advance, which is why we continue to track—because we wish to avoid an unpleasant surprise.

Senator NELSON. NASA's outside auditors have been unable to certify NASA's financial statements. And you now have this new accounting system, and there are continuing reports of problems at the field centers with the new accounting system. What are you proposing to try to straighten this out?

Dr. GRIFFIN. I would want to distinguish between our new accounting rules, which have been welcomed by everybody, and the problems with our audit and finance, which is looked upon favorably by nobody. We are still, overall, red from our auditors. We have made strides. We have hugely improved the issue we once

had of funds balance with the Treasury. We've hugely improved our auditing of environmental funds and environmental cleanup and all of that. It has been said that we are now in a green, yellow, and red scale, we've moved out of red, we're in yellow, and we're headed for green in those areas. So, that's good news.

We've made great strides in creating a single agency-wide accounting system with all ten centers, plus headquarters, operating on the same rules of the road. That is software development work in process by the contractor, but it is going well.

Where we are still deficient is in property management. In the old days, there was far less accounting for the disposition of property than one would prefer. It is nearly impossible to go back and historically fix that. So, our effort is being put on correctly cataloguing and locating, knowing the disposition of all property which is coming into the agency, and which will come into the agency.

Our own Audit and Finance Committee on our Advisory Council recently quizzed our auditors on exactly those same points. I think, what might only be characterized as a fulsome discussion, and they agreed that we have a good ways to go. We're looking at 2009 as being a point by which time you would be able to look at it and see considerable improvement.

Senator NELSON. Do you think that NASA will pass its audits this year?

Dr. GRIFFIN. No.

Senator NELSON. So, it's 2009.

Dr. GRIFFIN. FY 2009 is what we're shooting for, best case.

Senator NELSON. Back to the question of the gap, because this is obviously going to be the news item that comes out of this hearing today. I want to point out to those that are listening that the Administrator has said early Fiscal Year 2015, which could be at the end of calendar year 2014.

Dr. GRIFFIN. December 2014 would be the very best case we're looking at right now.

Senator NELSON. Of 2014.

Dr. GRIFFIN. Correct, which is early Fiscal Year 2015. That would be the very best we're looking at. When money is extracted from the program, either there needs to be less content or the dates will slip.

Senator NELSON. I have another question, though.

Dr. GRIFFIN. Yes, sir.

Senator NELSON. And that is that you are going to pick up some efficiencies by virtue of the fact that your selection of the contractor for the CEV is going to have some savings and efficiencies by doing a number of the assemblies of the new CEV there at the Kennedy Space Center. That should lessen some of the impact on that work force there.

Dr. GRIFFIN. Yes, Lockheed Martin, the winning contractor for the Orion CEV, did, as part of their proposal, that proposal was made, subject to the assumption that they would be doing assembly in Florida. As I think you know, we, just within the last few weeks, turned what we call the O&C building, the Operations and Check-out building on Kennedy Space Center, which was used for Shuttle processing—we just recently turned that over to Orion processing, that was a real milestone for us. We're building a new vehicle for

the first time now in decades. That certainly will help the workforce around the Kennedy Space Center, as it was designed to do.

There are, however, no increased efficiencies in that move which are going to help with the calendar slippage, because the Lockheed bid was provided, subject to the assumption—they had already factored into their bid the fact of assembly in Florida, so there's no additional efficiency to be obtained over that which they provided in their winning bid.

Senator NELSON. But there are jobs that will be provided that otherwise wouldn't have had the selection of that particular contractor not been made.

Dr. GRIFFIN. Absolutely.

Senator NELSON. OK. Now, the President's Council on Integrity and Efficiency has just sent you a report on the conduct of the NASA inspector general. When will you brief this Committee on the results of that investigation and your proposed corrective actions?

Dr. GRIFFIN. When the investigation is complete, sir. There is a very formal process through which we must work, in which I must work. We are at the stage of that process where they have provided to me the assessment of the Integrity Committee. I am now required to assess that report and to propose corrective actions. Those corrective actions go back to the White House and to the chairman of the Integrity Committee, and they are then forwarded to that Integrity Committee for their assessment and comment. When that process is complete, a redacted—meaning personal information has been extracted—a redacted version of the report can be made available to the Congress.

Senator NELSON. It seems that that language that sets up the process you just described is a little vague. And this Committee is quite interested in receiving that report, and receiving it in a timely fashion.

Dr. GRIFFIN. Yes, sir.

Senator NELSON. Although this is not something that's in your hands, because you've just stated the process, you have 60 or 90 days with which to review this thing before you send it back, under the present procedures. This Committee isn't going to wait around very long, because of information that we have received *ex parte* about the subject of this investigation. I would encourage you to move with deliberate speed so that we can see, and the people's representatives on this Committee can do our own examination, by receiving that report. If that thing gets drug out, we're going to have to do our own investigation.

Dr. GRIFFIN. I understand, sir. I have, actually, 30 days, with the possibility of a 30-day extension. I am trying to, and fully intend to, return my proposed corrective actions within the 30-day period. Then, they will, as I say, go back to the White House for appropriate disposition under the executive order dealing with the Integrity Committee.

I do not have it within my power to decide to release the report to you. I do have it within my power to expedite my handling of the report. And I am doing that.

Senator NELSON. And we thank you for that, Dr. Griffin. It's been a rather detailed and extensive hearing, and we appreciate your expertise.

The meeting is adjourned.

[Whereupon, at 4:12 p.m., the hearing was adjourned.]

A P P E N D I X

PREPARED STATEMENT OF HON. DANIEL K. INOUE, U.S. SENATOR FROM HAWAII

The National Aeronautics and Space Administration's missions are vital and important to our understanding of the Universe and to improving our existence on Earth.

NASA's dilemma is deciding which exciting projects to tackle first. The agency must maintain its strong legacy in science, aeronautics, education, and human spaceflight while preparing for the future through recapitalizing the human spaceflight program with new vehicles, and longer flights.

Whether we are talking about the International Space Station or the Moon, the biggest challenge is getting there and returning home safely. I look forward to hearing more about the planning and development activities that NASA is undertaking to ensure a smooth transition from the Space Shuttle to the Orion and Ares, along with associated cargo systems.

We also must keep the commitments we have made to our international partners, particularly Japan and Europe. The international community is relying on the United States to honor its commitments to the Space Station program. Those commitments are not only for assembly but also for utilization. We cannot achieve our plans for exploration of the Solar System if we go it alone, and our performance today will impact our ability to recruit partners for the future.

Ultimately, the Nation and this Congress choose to invest in a space program not because we dream of far off planets but because we want to leave Earth a better place to live. Beyond the spin-off technology that the space program has developed, NASA satellites help us understand the Earth's changing climate and its impact on humans. While the agency restored some funding to Earth science in the President's FY 2008 budget request, I am dismayed that the request significantly cuts NASA's investment in the interagency Climate Change Science Program.

I look forward to examining these issues today along with the Subcommittee's new Chair, Senator Bill Nelson, who knows first hand of NASA's importance to U.S. technological leadership and competitiveness.

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