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# TRANSITION AND IMPLEMENTATION: THE NASA AUTHORIZATION ACT OF 2010

## HEARING

BEFORE THE

## COMMITTEE ON COMMERCE, SCIENCE, AND TRANSPORTATION UNITED STATES SENATE

ONE HUNDRED ELEVENTH CONGRESS

SECOND SESSION

DECEMBER 1, 2010

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ONE HUNDRED ELEVENTH CONGRESS

SECOND SESSION

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# CONTENTS


| | Page |
|---|---|
| Hearing held on December 1, 2010 | 1 |
| Statement of Senator Nelson | 1 |
| Prepared statement | 1 |
| Prepared statement of Hon. Orrin G. Hatch | 2 |
| Statement of Senator Hutchison | 4 |
| Statement of Senator Vitter | 5 |
| Prepared statement | 6 |
| Statement of Senator Begich | 7 |
| Statement of Senator Warner | 33 |
| Statement of Senator LeMieux | 35 |
| Statement of Senator Cantwell | 36 |
| WITNESSES | |
| Hon. John P. Holdren, Ph.D., Director, Office of Science and Technology Policy, Executive Office of the President of the United States | 8 |
| Prepared statement | 10 |
| Hon. Elizabeth M. Robinson, Chief Financial Officer, National Aeronautics and Space Administration | 12 |
| Prepared statement | 13 |
| Cristina T. Chaplain, Director, Acquisition and Sourcing Management; and Susan A. Poling, Managing Associate General Counsel, U.S. Government Accountability Office (GAO) | 21 |
| Prepared statement | 22 |
| APPENDIX | |
| Hon. John D. Rockefeller IV, U.S. Senator from West Virginia, prepared statement | 47 |
| Response to written questions submitted to Hon. John P. Holdren, Ph.D. by: | |
| Hon. Kay Bailey Hutchison | 47 |
| Hon. David Vitter | 49 |
| Hon. Orrin G. Hatch | 50 |
| Response to written questions submitted to Hon. Elizabeth M. Robinson by: | |
| Hon. Kay Bailey Hutchison | 51 |
| Hon. Maria Cantwell | 59 |
| Hon. Mark Begich | 63 |
| Hon. Roger F. Wicker | 63 |
| Hon. Orrin G. Hatch | 64 |
| Response to written questions submitted by Hon. Kay Bailey Hutchison to Cristina T. Chaplain | 65 |
| Letter dated December 7, 2010 to Hon. David Vitter, from John P. Holdren, Director, Office of Science and Technology Policy, Executive Office of the President | 67 |

# TRANSITION AND IMPLEMENTATION: THE NASA AUTHORIZATION ACT OF 2010

**WEDNESDAY, DECEMBER 1, 2010**

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

The Committee met, pursuant to notice, at 10:33 a.m. in room SR–253, Russell Senate Office Building, Hon. Bill Nelson, presiding.

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

Senator NELSON. Good morning. I am going to invite all the witnesses to come up to the table.

And without objection, a statement from Senator Hatch on an opening statement will be entered.

[The prepared statements of Senators Nelson and Hatch follows:]

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

We are here this morning with a plan in hand—the NASA Authorization Act of 2010—a plan agreed to unanimously by this body, overwhelmingly in the House, and with a signature from the President. OUR collective plan builds upon our fundamental national drive to explore, discover, and expand a human presence across new frontiers.

For our nation's civil space program, this has indeed been a challenging year. We are in the midst of a major transition to retire the Space Shuttle and develop a new architecture for the human exploration of space. One thing has become very clear during this transition: people care passionately about our nation's space program and we have channeled our collective passion for NASA into a clear blueprint for the agency's future.

With competing national interests and a difficult fiscal environment, now, more than ever, is the time for a new way of doing business—a results-oriented and cost-effective way forward. This law gives NASA the tools it needs to do just that. Building off of existing resources and knowledge, NASA can fulfill our nation's aspirations while avoiding the management and financial pitfalls of the past.

The bipartisan NASA Authorization Act of 2010 codifies our shared vision. The Act directs NASA to develop a new heavy-lift launch vehicle and multipurpose crew vehicle to explore beyond low-Earth orbit; extends the mission of the International Space Station through at least 2020; adds a Space Shuttle mission to reduce the gap in our access to and from the space station; makes use of American innovation in the commercial rocket industry; and maintains our commitment to aeronautics, scientific research, and educating the nation's future explorers.

NASA itself has two sayings that I think are relevant to the topic of today's hearing. The first is to "show results soonest." The Authorization Act is the roadmap to get us moving out on the new plan. The second is "hardware wins." This means that action trumps studies on paper. We have studied, we have reviewed, we have evaluated. Now it's time to DO. I would like to welcome our witnesses and thank them for joining us here today to discuss what needs to be done for the most effective transition and implementation of the Authorization Act.

Dr. Holdren is the President's Science Advisor and Director of the Office of Science and Technology Policy. Dr. Holdren, I look forward to hearing from you on how the administration intends to implement our shared vision outlined in the Authorization Act. Consistent top-level leadership is vital during this transition period.

Dr. Beth Robinson is NASA's Chief Financial Officer. Dr. Robinson, this is the first time you have testified in front of this committee since your confirmation hearing over a year ago. As NASA moves forward with the implementation of the Authorization Act under a Continuing Resolution, yours is a most difficult task indeed. It is critical that the Administrator receive the best financial advice, and while we are encouraged by improvements in the agency's most recent independent audit, the major cost and schedule overruns for the James Webb Space Telescope program are of great concern. I hope to hear your perspective as NASA's CFO how the Agency intends to improve its financial management for successful implementation of the new law.

Ms. Cristina Chaplain is the Director of Acquisition and Sourcing Management at the U.S. Government Accountability Office, and she is joined by Ms. Susan Poling, the Managing Associate General Counsel at GAO. Ms. Chaplain and Ms. Poling, your work over the past few years has provided guidance and recommendations for NASA to improve continuing financial and management difficulties. For that, this committee thanks you. I look forward to your latest assessment and expertise.

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PREPARED STATEMENT OF HON. ORRIN G. HATCH, U.S. SENATOR FROM UTAH

Senator Nelson, Senator Hutchison and members of the Senate Commerce Committee, thank you for affording me this opportunity to share my thoughts regarding the implementation of the 2010 NASA Authorization Act.

First, I want to reiterate my gratitude to Chairman Rockefeller, Senator Nelson, and Senator Hutchison, for all of their hard work in making the NASA Authorization Act a reality. I also wish to thank the Committee's staff members: Ann Zulkosky, Brian Hendricks, Tom Cremins, and Jeff Bingham, for their tireless efforts ensuring all stakeholders concerns were addressed.

The NASA Authorization Act might not be the perfect solution to all of the issues surrounding manned space flight, but it provides our nation with a strong plan—a plan embedded in law—which will define the future of our nation's exploration of space.

Implementation of the law will not be an easy task—it never is. However, the law is clear. NASA will build a new heavy-lift Space Launch System which can "access cislunar space [the region between the Moon and Earth] and the regions of space beyond low-Earth orbit." Public Law 111–267 specifies the minimum capabilities for the Space Launch System. These legal requirements include "[t]he Space Launch System shall be designed from inception as a fully-integrated vehicle capable of carrying a total payload of 130 tons or more into low-Earth orbit in preparation for transit for missions beyond low-Earth orbit." The law also states, "[p]riority should be placed on the core elements with the goal for operational capability for the core elements not later than December 31, 2016."

In addition, Section 304 of the NASA Authorization Act seeks to maximize taxpayers' previous investments when developing and building the new launch system. Therefore, it directs NASA "to the extent practicable, [to] utilize existing contracts, investments, work force, industrial base, and the capabilities for the Space Station . . . *Ares 1* projects, including . . . Space Shuttle-derived components and *Ares 1* components that use existing United States propulsion systems including . . . solid rocket motors . . ."

These are the Space Launch Systems legal requirements. They are the law of the land. The requirements were crafted by the members of the Senate Commerce Committee after careful and thoughtful consideration and consultation. The law must be implemented as written.

In addition, I have consulted with preeminent rocket experts about these requirements. They concluded these articulated directives for the development of the Space Launch System could only be realistically met by using solid rocket motors.

The use of solid rocket motors in the new Space Launch System is also the intent of Congress. The report, which was written by the Senate Commerce Committee's staff, and accompanied the NASA legislation clearly states:

> The Committee anticipates that in order to meet the specified vehicle capabilities and requirements, the most cost-effective and "evolvable" design concept is likely to follow what is known as an "in-line" vehicle design, with a large center tank structure with attached multiple liquid propulsion engines and, at a minimum, two solid rocket motors composed of at least four segments being at-

tached to the tank structure to form the core, initial stage of the propulsion vehicle. The Committee will closely monitor NASA's early planning and design efforts to ensure compliance with the intent of this section.

In sum, the NASA Authorization Act of 2010 was a carefully crafted piece of legislation. I have no doubt the members of the Commerce Committee, and Congress as a whole, will insist a piece of legislation—which passed the Senate by unanimous consent, voted on by the House under the suspension of the rules and signed by the President—should be fully and faithfully executed.

Therefore, over the past several weeks I have been concerned by a number of "trial balloons" where it appears, some have argued, that NASA has been seeking alternatives to the Space Launch Systems' legal requirements. Accordingly, I asked NASA Administrator Bolden and Deputy Administrator Garver to attend a meeting of the Utah Congressional Delegation 2 weeks ago.

During the meeting, Administrator Bolden stated that NASA was going to be in "full compliance" with the NASA Authorization Act. In a previous phone call I received a similar assurance from Deputy Administrator Garver. I take them at their word, and I trust that they will honor their word.

Yet, I must admit I found some of Administrator Bolden's comments troubling. He cited funding as a concern. Yet, I believe this issue has been robustly addressed by the Commerce Committee. Specifically, the law authorizes $1.63 billion in Fiscal Year 2011, $2.65 billion in Fiscal Year 2012; and $2.64 billion in Fiscal Year 2013. Furthermore, my staff has been assured by the Commerce Committee's staff these sums are more than sufficient to begin the development of a heavy-lift system which meets the legal requirements of the law, including achieving an initial operational capability by December 31, 2016.

On a related matter, I was surprised to learn some still question the cost of solid rocket motors as compared to other technologies. However, I have been assured by industry experts that solid propellant rocket motors, by their nature, are relatively simple in design and construct. Solid rocket motors provide a high energy density/high thrust-to-weight stage which yields an effective solution for the initial boost phase which is comparatively lower in cost than a liquid system of equivalent performance.

In conclusion, Mr. Chairman, I believe the Commerce Committee has crafted an important law—that law must be implemented in a full and in a timely manner. Nothing less will be acceptable to me and I know nothing less will be acceptable to the members of this Committee.

Mr. Chairman, members of the Committee, thank you again for the opportunity to discuss these matters with you.

Senator NELSON. Again, I want to say publicly my appreciation to Senator Hutchison. There are moments in your Congressional life that you enjoy, and at the end of the day, you have some degree of success in achieving a legislative goal. And the opportunity, the privilege that I had to work with Senator Hutchison, where the two of us worked seamlessly together back in the summer, first to get the NASA authorization bill through this committee, and then as one of the last agenda items, to be able to have it pass with unanimous consent late at night on the last night of the session in August.

And then in September, one of the last things to pass in the House of Representatives—I give great credit to Steny Hoyer who put it on the consent calendar. At the beginning of that last day of the House of Representatives' deliberations, people did not think we had the required two-thirds vote in order to pass the NASA bill. When the vote was tallied late that night, one of the last items in the House of Representatives, it was a three-quarters vote.

And again, I give great credit to Senator Hutchison, as I have stated many times before, the sheer pleasure of working with her and trying to correct the misstatements, the incorrect information, sometimes the mischief that was directed at the NASA authorization bill.

And so now we have a bill that has been signed into law. It is the law, and the purpose of this hearing is to have these very erudite folks explain to us the implementation of the law. We do this in this full Commerce Committee hearing not only in our oversight capacity to oversee the implementation of laws in the Executive Branch of government, but we do it also given some of the uncertainties that we face, the uncertainty of the actual funding level since we are well into the new Fiscal Year. And yet, we have a road map. We have a blueprint of what NASA can, should, and will do over the course of this fiscal year. And we are going to flesh that out in the course of this hearing. We are going to flesh it out as we see what is done in appropriations with a continuing resolution or an omnibus appropriations or whatever it is because something has to be passed because the U.S. Government has to continue to function.

But this authorization bill is more than that. It is a 3-year authorization because on a program like the space program, you simply have to give direction over a long period of time. And that direction is now law.

So with that, let me turn to the lady who has been such a great partner. Thank you, Senator Hutchison.

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

Senator HUTCHISON. Well, thank you, Mr. Chairman. I certainly appreciate what you have said and agree that we worked hand-in-hand, hand-in-glove, completely together in a bipartisan way, helped by Senator Vitter, Senator Landrieu from Louisiana, from many of our colleagues, Senator LeMieux from Florida, Senator Hatch who has submitted a statement, and Senator Bennet, Senator Shelby, and Senator Sessions, and Senator Cochran, of course, and Senator Wicker. So many people came together on a very bipartisan basis, and the law was passed overwhelmingly, overwhelmingly in the House and unanimously in the Senate.

And it started, of course, when a plan came out from the President that really did not have Congressional consultation. That is the President's right to lay out his vision, of course. But we worked then from that proposal, took some parts of it, and rejected some parts of it, and I think came together, working with the Administration, in a productive way for a way forward that would have both Congressional support and with the consent of the President, who did sign the bill.

I think that the Chairman and I and many others are concerned about some of the delays in implementation, and if I had to summarize my view, it would be that delay could cost success. If we are going to succeed in the new launch vehicle, we have to have a design based on as much of the technology that has already been developed and tested as possible, and certainly the heavy lift booster and capsule design has to be the first priority. And if there are any concerns about that implementation or if there are impediments to it, we want to know right now because we do still have the opportunity to put other words in the law if that is what it takes. But in order to succeed, we must be able to count on the Administration fulfilling the requirements of the law and working

with Congress in a collegial spirit, I hope, to do what the direction is that has been passed overwhelmingly by Congress and, of course, signed by the President.

We are going to have hearings. We are going to have oversight, and I would say that any of us are available, going forward, to hear the impediments, if there are impediments, right up front as opposed to getting reports from other sources that there are some in the industry who would like to only implement the original plan of the President and some within the agency who might have that view. The original plan is not now the law of the land. And so we want to work in a spirit of cooperation.

I will just end by saying that space exploration is part of the golden history of this country. It is also essential to our future. If we are going to use the International Space Station in a productive way, if we are going to innovate, create, have the capability to look into things like sources of energy, that can best be done at the space station or beyond, and we are going to have to go forward with the plan that has been put forward by Congress and signed by the President for us to be successful. If it is dragged out and we do not have a design and we do not have a budget that would meet the test of the design, we could lose the whole thing and see other countries take precedence over America in the exploration of space.

So, I hope that we learn something today that either says, yes, we are all full steam ahead, yes, we are going to use all the brains in the agency to put together the budget that will allow our new design and our goals that I know are similar to go forward and succeed, or if there are impediments, what are they? Let us work on them together.

Thank you, Mr. Chairman.

Senator NELSON. Senator Vitter?

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

Senator VITTER. Thank you, Mr. Chairman. I certainly join in your and Senator Hutchison's remarks and thank you both for your leadership on this issue. It has been a pleasure for me to work with you all and others, including on the authorization bill.

I was very pleased with that outcome as well, but now we need to implement that bill, and really the question at this hearing is, is the Administration going to be a full, active, positive partner in implementing that bill? That is the question. I think that is exactly what Senator Hutchison was talking about.

From my perspective, the evidence so far is that the answer is no, and I hope to God that changes, and I hope to God I am wrong. But quite frankly so far, the evidence is not there that the Administration wants to be a full, active, positive partner.

Now, I know from reading your testimony, that there is concern specifically about language in last year's appropriation bill prohibiting the cancellation of Constellation programs and starting new programs. Let me say that all of us are working on language to correct that and to take away any impediment that provides what we hope to insert in a CR or an omnibus bill or whatever. So I think we are all on the same page working on clarifying language.

Having said that, I really think pointing to that language and justifying a lot of inactivity so far on that—I am not saying that language is irrelevant, but I really think it is largely an excuse. I mean, the irony is pretty clear. Before this new authorization bill, the Administration was doing absolutely everything it could administratively to shut down Constellation programs. Now, after the new authorization bill has passed, the Administration is pointing to that language saying, oh, we cannot possibly end Constellation and stop those programs, essentially arguing exactly the opposite.

Now, again, I am not saying that language does not have some effect, does not impose some limits, but I think the Administration could be doing a whole lot more implementing the vision of the new authorization bill if it were really committed to do that. And I think what we are here today to talk about is that level of commitment and how we move forward on the same page to implement that vision in the authorization bill. Again, I think so far the evidence is that the Administration is not there, but I hope that is wrong and I hope that changes. And I am eager for that to change and certainly committed to working on anything we need to work on legislatively to clear away any remaining hurdles like the language from last year's appropriation bill.

So that is what I came to talk about and to hear from these key Administration officials.

Thank you for calling the hearing, and I look forward to the discussion.

[The prepared statement of Senator Vitter follows:]

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

Thank you, Mr. Chairman, for calling this hearing today. And thank you to our witnesses for appearing before this committee. I hope that we can have a forthright and open dialogue, and I'd like to place particular emphasis on those words, about what NASA is doing to move forward with implementing the provisions of the 2010 Authorization Act, and what, if anything, Congress needs to do to address any possible contradictions in existing law impeding that implementation.

Reading the written testimony of our witnesses, it is clear that they believe they are hindered from moving forward with implementing the programs outlined in the Authorization Act by language in last year's appropriations bill prohibiting the cancellation of Constellation programs and the starting of new programs. If that is indeed the case, then let me assure NASA now that my colleagues and I will work together to find a solution to fix that discrepancy.

That being said, I want to brace those here today from NASA, and all those at NASA HQ who are not present, for what I am about to say, because I intend to speak quite frankly and quite harshly.

I mentioned earlier that I want these proceedings to be forthright and open, and I stress that because, quite frankly, in the course of the past year the NASA leadership has been anything but forthright and open in its dealings with Congress. I would, in fact, argue that there are those within NASA's senior management who have done everything within their power to thwart the will of Congress and the word of law and instead advance their own agenda. I am deeply concerned that what we are witnessing here today, and the arguments being made about why NASA has not moved forward with implementing the programs the Authorization Act directs them to—even if technically correct—are simply more of the same stonewalling and recalcitrance to follow Congress' direction that we have sadly become all too accustomed to in the past year.

I find the fact that NASA is now claiming that it cannot currently move forward with the development of the Space Launch System prescribed in the Authorization Act because it cannot terminate existing Constellation programs particularly bemusing. I say that because, as everyone here well knows, in the time between the President's announced FY 2011 budget for NASA and the passage of the Authorization Act, NASA was doing everything it could to shut down Constellation programs, de-

spite Congress giving them no approval to do so, without technically terminating them. I am of course referring to the agency's excuse of using the Anti-Deficiency Act and the tool of termination liability, mentioned often before in this chamber, to effectively shut down production on Constellation programs without technically terminating them. The GAO report on the matter may have found that doing so was within the limits of the law since the programs were not technically terminated, but the intent behind the actions was clear—to kill Constellation before Congress had given its blessing to do so.

Now here we are, with an Authorization Act specifically describing NASA's way forward for developing our next generation of human space flight, an act that was passed by an overwhelming majority of Congress and endorsed by the President and is now law, and NASA is now claiming that it cannot move forward because it cannot legally terminate Constellation programs, the very programs it has been using termination liability in the past several months to try and stop production on. You can see how one could find this amusing, if it wasn't also so infuriating.

It's infuriating because it shows, I believe, a troubling pattern. It shows me that there are those within NASA's leadership that will do anything and use any excuse available to them to do anything but what Congress directs them to do, who believe that they simply know better than anyone else what the way forward should be, and whose ideas for what NASA's role should be do not necessarily even include human space flight and space exploration as a priority, even though that is the founding mandate of the agency.

I fear that what we have is a cabal within NASA that is determined to do everything possible to prevent the development of the Space Launch System the Authorization Act directs them to proceed with within the timetable the law clearly stipulates. I would point to the reports we are now hearing that NASA is assessing acquisition strategies for the multi-purpose crew vehicle defined in the Authorization Act.

This is concerning on a number of levels, first and foremost because the Act clearly defines and identifies—and I know this because I personally insisted on this language—the multi-purpose crew vehicle as being a continuation of the Orion Crew Capsule. The law also states that NASA shall extend and modify existing contracts to facilitate the timely development of the Space Launch System. What purpose then could beginning a new procurement process for the crew vehicle serve, especially when *Orion* is so far along in development and, as recently announced, will be ready for an unmanned test flight in 2013? It only serves one purpose, to indefinitely delay the development of the Space Launch System so as to make meeting the conditions of the Authorization Act impossible. Besides being a gross violation of the law that clearly states that *Orion* is the crew vehicle for the Space Launch System, it shows, at best, a gross incompetence on the part of NASA management, and, at worse, a willful attempt to thwart the law and the direction of Congress.

Having said all that, I would now like to call on the Administration to take these things into consideration and decide if it is indeed serious about supporting the path set forward in the Authorization Act. If it is, then I would recommend that the Administration take a long hard look at NASA management and take into consideration that changes are in order. There are a group of people within NASA management whose continual attempts to outflank Congress and the law has created, at best, a strained relationship with its members, and, at worst, a toxic one. Their actions and attitudes have simultaneously led to a precipitous drop in the morale of the NASA workforce to historically low levels. In order for NASA to come back strong again, restore morale, move forward unhindered with the development of the Space Launch System defined in the Authorization Act, and repair the relationship with Congress so that this body and the agency are working together, not against one another, I believe it is imperative that the persons within the agency's management responsible for causing all this discord be immediately identified and removed. Only then can the agency be prepared to move forward to a brighter future.

Thank you, Mr. Chairman.

Senator NELSON. Senator Begich?

## STATEMENT OF HON. MARK BEGICH, U.S. SENATOR FROM ALASKA

Senator BEGICH. Mr. Chairman, I do not have any comments. I am anxious to hear how they are doing the implementation and their presentations.

Senator NELSON. Well, I just want to comment, Senator Vitter, that unfortunately I think your comments are well founded. Your concerns are well founded because there were too many times in the course of building consensus to pass it in this committee with the legislative clock running out, pushed up against the August work recess; and then the same thing repeating itself again in the House of Representatives running up against the legislative clock, going right up to the end, that we found too many times in the attempts of building consensus that there was too much evidence that the Administration was not helping. Now, I might say that was not from the highest levels of the White House. To the contrary, I found it elsewhere.

And that brings us to the table today to—now that the President supported this bill, in the Committee, on the floor, and then through the situation in the House where we had run out of time, we did not have time to sit down and negotiate differences between the House and the Senate, and they ended up being in the position of having to accept the Senate bill or no bill. And I give great credit to Chairman Bart Gordon and Ranking Member Ralph Hall. Without their leadership, this never would have happened. And yet, we were finding forces that were trying to undo us.

Now, this is history. We passed it. The President signed it into law, and now we want that law implemented. And given the uncertainties of the funding, which I think at the end of the day is going to be less uncertain than you would think because this authorization bill authorizes $19 billion in Fiscal Year 2011, and if we just get a continuing resolution of Fiscal Year 2010, NASA's funding there is $18.7 billion. That is, in this context of this economic recession that we are in, $300 million less than a $19 billion authorization. That is 1.67 percent less than the total authorization. We want to see this law implemented without a lot of griping and moaning and groaning if we are able to get that kind of appropriation.

So it is in that spirit that we come here to the table for this hearing, and we are very honored to have the President's Science Advisor, Dr. Holdren; Beth Robinson, the Chief Financial Officer of NASA; Cristina Chaplain, Director of Acquisition and Sourcing Management from GAO, accompanied by Ms. Susan Poling. So we are going to ask for your comments. If I could ask you all to keep your comments somewhere around 5 minutes, and then we can get into the give-and-take that this committee likes to do.

So, Dr. Holdren, welcome.

**STATEMENT OF HON. JOHN P. HOLDREN, PHD., DIRECTOR, OFFICE OF SCIENCE AND TECHNOLOGY POLICY, EXECUTIVE OFFICE OF THE PRESIDENT OF THE UNITED STATES**

Dr. HOLDREN. Well, Chairman Nelson, Ranking Member Hutchison, members of the Committee, I am happy to be here today to discuss America's future in space and how to maximize the probability of success following the recent passage and signing of the 2010 Authorization Act for NASA.

Under the direction provided by that legislation, NASA will be entering a new era of innovation, of exploration, of discovery. And I want to commend and thank Chairman Nelson and Ranking

Member Hutchison and, indeed all of the members of the Committee and your staffs for the work you did in forging the key agreements that were necessary to get this legislation done and for the work you did to bring it into effect.

When I testified before this committee in May, I talked about the President's strategy for U.S. human exploration activities in space as reflected in his Fiscal Year 2011 budget request and further elaborated in the speech he gave in Florida at the Kennedy Space Center on April 15. That new approach, as you know, included fostering the development of path-breaking new technologies, partnering with industry in new and more effective ways, advancing innovation and scientific discovery, pursuing human exploration of space with a more flexible, achievable, and affordable set of goals, and of course, addressing the overarching need to match program goals with resources. That approach was developed in order to take us to more places sooner but also more affordably, while spurring the creation of new industries, new technologies, and jobs.

The 2010 NASA Authorization Act that you folks worked so hard to bring about represents a crucial step forward toward achieving the President's goals and I think the country's goals in this arena, including extending the International Space Station effort until at least 2020 and supporting the goal of using that research outpost effectively; including helping to advance a U.S. commercial crew transportation industry that can become the primary means of access to the International Space Station, thereby harnessing the nation's entrepreneurial energies in more effective ways, and creating new jobs while at the same time, of course, meeting a critical national need; including accelerating the development of a heavy lift vehicle relative to what was planned under the Constellation program; including reinforcing an approach to human space exploration that will enable us to reach a range of destinations, including near-Earth asteroids, the moons of Mars, and eventually Mars itself; including initiating a new space technology program to increase our capability and decrease the cost of these activities; including supporting the President's proposal to modernize the space launch complex in Florida which will help those facilities more effectively support future NASA, other government, and commercial launches; including supporting a revitalized program in earth science, enabling NASA to develop new satellites and other capabilities that are priorities in our efforts to enhance U.S. leadership in global climate change research; including authorizing a robust aeronautics research program that will invest more in green aviation and in a more efficient national air transportation system which will help to promote both the economic and the environmental health of this country.

This important change in direction not only helps to chart a new path forward in space, it also helps us invest in the foundation for the skilled jobs and industries of the future. At the same time, it furthers our goal of placing NASA's programs on a more stable footing and enhancing the long-term sustainability of those efforts. As with any space-related endeavor of the scope and complexity of those outlined in the Authorization Act, there will be, of course,

technical, cost, and programmatic challenges going forward as the projects are undertaken and future appropriations are provided.

Indeed, obviously, a lot of work lies ahead in terms of translating this important new law into programmatic success. One immediate challenge, as has already been noted, is the current lack of appropriations for Fiscal Year 2011, and the Administration very much hopes that Congress will act swiftly to provide the funding and budgetary guidance that will enable NASA to fully implement the direction provided in the NASA Authorization Act of 2010 and bring that new plan to fruition.

Whatever the challenges that may be faced, I am confident that Administrator Bolden and the dedicated men and women of NASA's workforce have the commitment, the wherewithal, and the passion that will be needed to pursue those initiatives and continue to make progress toward achieving our ambitions in this renewed journey of innovation and discovery in space. I am looking forward to continuing to work with Administrator Bolden and the other involved offices and agencies in the government as NASA moves to develop more detailed implementation and acquisition approaches in the months ahead.

Let me close by reiterating that this Administration, starting with President Obama himself, remains steadfast in our commitment to space exploration and to NASA's mission. As the President said in his speech at the Kennedy Space Center—and I now quote, "I am 100 percent committed to the mission of NASA and its future. Because broadening our capabilities in space will continue to serve our society in ways that we can scarcely imagine. Because exploration will once more inspire wonder in a new generation—sparking passions and launching careers. And because, ultimately, if we fail to press forward in the pursuit of discovery, we are ceding our future and we are ceding that essential element of the American character."

The Administration looks forward very much to continuing to work with this committee and the rest of Congress to achieve our shared goals and ambitions in space as we move forward with these programs.

Thank you very much.

[The prepared statement of Dr. Holdren follows:]

PREPARED STATEMENT OF HON. JOHN P. HOLDREN, PH.D., DIRECTOR, OFFICE OF SCIENCE AND TECHNOLOGY POLICY, EXECUTIVE OFFICE OF THE PRESIDENT OF THE UNITED STATES

Mr. Chairman, Ranking Member Hutchison, and members of the Committee, I am pleased to appear before you today to discuss America's future in space and our ability to maximize the probability of success following the recent signing of the 2010 Authorization Act for the National Aeronautics and Space Administration (NASA). Under the direction provided by this legislation, NASA will be entering a bold new era of innovation, exploration, and discovery. I would like to commend Chairman Nelson and Senator Hutchison in particular for your efforts in forging the key agreements necessary for this legislation and ultimately helping to bring it into effect.

When I testified before this Committee in May, I laid out the President's ambitious new strategy for U.S. human exploration activities, as reflected in his FY 2011 budget request and further elaborated in his landmark speech at the Kennedy Space Center in Florida. This new approach included fostering the development of path-breaking new technologies; partnering with industry in new and more effective ways; advancing innovation and scientific discovery; pursuing human exploration with a more flexible, achievable, and affordable set of goals; and of course address-

ing the over-arching need to match program goals with resources. This new approach was developed in order to take us to more places sooner but also more affordably, while spurring the creation of new industries, technologies, and jobs that will be vital for long-term economic growth.

The 2010 NASA Authorization Act represents a critical step toward achieving the President's goals in this arena, including:

- Extending the International Space Station (ISS) effort until at least 2020 and supporting the goal of using this research outpost effectively; as the President proposed, the ISS can be a platform to further science and technology innovation, foster the creation of new industries, and help advance human exploration;
- Helping to advance a U.S. commercial crew transportation industry that can become the primary means of access to the ISS, thus harnessing our nation's entrepreneurial energies in more effective ways and creating new jobs, while also meeting an important national need;
- Accelerating a heavy lift vehicle development effort relative to what was planned under the Constellation program;
- Reinforcing an approach to human space exploration that will enable us to reach a range of destinations including Lagrange points, near-Earth asteroids, the moons of Mars, and eventually Mars itself;
- Initiating a new space technology program to increase the capability and decrease the cost of NASA, other U.S. government, and commercial space programs;
- Endorsing the Summer of Innovation education initiative proposed by the Administration;
- Supporting the President's proposal to modernize the space launch complex in Florida, which will help these facilities more effectively support future NASA, other government, and commercial launches;
- Supporting a revitalized program in Earth science, enabling NASA to develop new satellites and other capabilities that are priorities in our efforts to enhance U.S. leadership in global climate change research; and
- Authorizing a robust aeronautics research program which will invest more in green aviation and in a more efficient national air transportation system, thus helping to promote both the economic and environmental health of this country.

This important change in direction not only helps chart a new path forward in space, it also helps us invest in the foundation for the skilled jobs and industries of the future. At the same time, it furthers our goal of placing NASA's programs on a more stable footing and ultimately enhancing the long-term sustainability of these efforts. As with any space-related endeavor of the scope and complexity of those outlined in the 2010 NASA Authorization Act, however, there will be technical, cost, and programmatic challenges going forward as these projects are undertaken and future appropriations are provided.

Indeed, much work lies ahead in terms of translating this new law into programmatic success. One immediate challenge is the lack of appropriations for FY 2011. We urge Congress to act swiftly to provide the funding and budgetary guidance that will enable NASA to implement the direction provided in the NASA Authorization Act of 2010 and bring this new plan to fruition. As we move further into FY 2011, it is my hope that we can work with you in resolving this situation as quickly as possible.

Whatever the other difficulties that may be faced over the long run, I am confident that Administrator Bolden and the dedicated men and women of NASA's workforce have the commitment, wherewithal, and passion necessary to pursue these initiatives and continue making progress toward achieving our boldest ambitions in this renewed journey of innovation and discovery in space. I look forward to working with Administrator Bolden, and other involved offices and agencies in the U.S. Government, as NASA moves to develop more detailed implementation and acquisition approaches in the months ahead.

Finally, let me reiterate that this Administration remains steadfast in its commitment to space exploration and to NASA's mission. As the President said in his speech at the Kennedy Space Center:

> *I am 100 percent committed to the mission of NASA and its future. Because broadening our capabilities in space will continue to serve our society in ways that we can scarcely imagine. Because exploration will once more inspire wonder in a new generation—sparking passions and launching careers. And because, ul-*

*timately, if we fail to press forward in the pursuit of discovery, we are ceding our future and we are ceding that essential element of the American character.*

I think all of us here fully understand the space program's singular capacity to inspire future generations of scientist and engineers, and we recognize the crucial role that it plays in advancing scientific discovery, stimulating technological innovation, enhancing international leadership, and buttressing our economic vitality and strength. The Administration looks forward to continuing to work with Congress to achieve our shared goals and ambitions in space as we move forward with these programs.

Senator NELSON. Thank you.

Dr. Robinson?

**STATEMENT OF HON. ELIZABETH M. ROBINSON,**
**CHIEF FINANCIAL OFFICER,**
**NATIONAL AERONAUTICS AND SPACE ADMINISTRATION**

Dr. ROBINSON. Thank you. Chairman Nelson and members of the Committee, thank you for the opportunity today to discuss how NASA is implementing the Authorization Act under the continuing resolution, otherwise known as the CR.

Most importantly, due to the enactment of the Act, NASA has clear direction and has begun to move forward, and we are very excited and committed to the path that we are on. NASA appreciates the significant effort that advanced this bipartisan legislation, particularly efforts by the leadership and members of this committee. There are still details that the final appropriations outcome will provide, but broad outlines are now clear in law and that makes the road ahead much easier and clearer. And this is a time of excellent opportunity for NASA to shape the promising future for the nation's space program.

There is also no doubt that this year has been challenging to the NASA workforce, both the civil service and contractors. They have put in long hours planning new missions for which funding was uncertain, while at the same time continuing to work on missions for which the future was uncertain. And still, NASA's workforce rose to the challenge. They always do, and it is to be commended for the outstanding accomplishments over this year. Moreover, now with the Authorization Act, the workforce can look forward to many more accomplishments yet to come.

For the immediate future, as with other federal agencies, NASA is operating under a CR which can be a complex juggling act. First, we must read the Authorization Act and the CR in concert wherever possible. For example, NASA program funding levels below the account level are generally controlled by the Authorization Act.

Second, NASA must take heed of the pending appropriations bills because when the final appropriation is adopted, NASA must apply its constraints in funding levels back to the beginning of the—throughout the entire Fiscal Year.

And finally, there are specific restrictions in the CR, which we have already discussed. In particular, the CR continues any restrictions that were present in last year's appropriation including, in NASA's case, the prohibition on termination of components of the Constellation program. Moreover, the CR requires that work not begin on new starts, which is a legal term of art about which GAO has given us guidance in their May report, and using that guidance, we have been working through what is and is not a new

start. And we have not yet found anything in the Authorization Act on which we cannot proceed, but we are not done with our analysis, this unfortunately lengthy analysis, and we are working the issue daily.

However, there are some areas in which we can clearly proceed. For example, planning efforts for the heavy lift and multipurpose crew vehicle activities, both authorized in the Act, are proceeding and are assessing the transition from the Constellation efforts to the new programs. Moreover, on November 8, NASA announced the results of a broad agency announcement under which NASA selected 13 companies to conduct studies on various heavy lift technologies. These studies are focused on achieving affordability, operability, reliability, and commonality at the system and subsystem levels with multiple users, including other government, commercial, science and international partners.

Further, although requirements for the multipurpose crew vehicle have not yet been fully vetted, NASA expects this vehicle to be based on the existing Orion work. The ground test article for Orion will be completed within the coming months, which is very exciting, and in early 2011, the GTA will be shipped to Denver for performance testing that will help validate the cabin design.

Additional effects of the CR on NASA's programs are detailed in my written statement, but for now, Chairman Nelson and members of the Committee, thank you for the opportunity to appear before you. NASA is at the beginning of a path that will create opportunities and discoveries for generations, and so like you, NASA is very eager to get started on implementing the Act. Thank you and I look forward to your questions.

[The prepared statement of Dr. Robinson follows:]

PREPARED STATEMENT OF HON. ELIZABETH M. ROBINSON, CHIEF FINANCIAL OFFICER, NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

Chairman Nelson and members of the Committee, thank you for the opportunity to appear before you today to discuss the NASA Authorization Act of 2010 and how NASA is implementing direction in that Act, while NASA is operating under a FY 2011 continuing resolution.

With the President's signing the NASA Authorization Act of 2010 (P.L. 111–267), NASA has a clear direction and can begin making plans for moving the Agency forward. NASA appreciates the significant effort that has gone into advancing this bipartisan legislation, particularly efforts by the leadership and Members of this Committee. There are still details that the final FY 2011 appropriations outcome will provide but broad guidelines have now been enacted into law, making the road ahead much clearer. This is a time of excellent opportunity for NASA to shape a promising future for the nation's space program. Today it is no longer a question of IF we will explore, but how.

The NASA Authorization Act of 2010 represents an important step forward in that, among other things, it:

- Authorizes continued investment in Science and Aeronautics, including an increase to accelerate deployment of important Earth Science observation satellites.
- Extends the International Space Station (ISS) to 2020 and makes funding available for the NASA Launch Support and Infrastructure Modernization Program.
- Supports current commercial cargo efforts and supports expanding commercial crew development activities. Facilitation of the nation's commercial spaceflight sector is a key component of the U.S. strategy to maintain safe and affordable space exploration capabilities throughout the next century.

- Authorizes development of a heavy-launch vehicle and continues the development of a crew capsule that will transport astronauts to many exciting destinations beyond low-Earth orbit (LEO).
- Authorizes a new space technology program that will provide cutting-edge, transformative technologies to support our future space exploration endeavors.

There is no doubt that this year has been a challenging one for the NASA work force, both civil service and contractors. These men and women have been asked to put in long hours planning new missions for which funding was unknown, while at the same time, they were asked to steadfastly continue work on missions for which the future was uncertain or which were soon to be retired. Still, NASA's workforce rose to the challenge because they are people who make the impossible happen every day. They are to be commended for their outstanding accomplishments over this past year. And, based on enactment of the NASA Authorization Act of 2010, the NASA workforce can look forward to many accomplishments yet to come.

**FY 2011 Continuing Resolution**

As noted earlier, NASA is looking forward to the completion of the FY 2011 appropriations process, so that the Agency can begin the important new work authorized by Congress.

As with other federal agencies, NASA is operating under the restrictions set forth by the FY 2011 Continuing Resolution (CR). While NASA is funded to continue work that was already underway on programs and projects across the Agency, work may not begin on "new starts," which may prevent NASA from moving forward on elements of the new programs and projects outlined in the NASA Authorization Act of 2010. Implementation of the NASA Authorization Act of 2010 provisions during the period of the current CR must, as a general rule, rely on existing authority. Each of these must be assessed on a case-by-case basis, and must be individually and specifically tied to prior authorization and appropriations acts, legislative history, and budget requests. The NASA Office of General Counsel (OGC) is conducting this analysis on an ongoing basis, and we will keep the Committee informed of our progress. Attached to my testimony is an assessment by the OGC which outlines the legal issues that need to be considered, the conclusions that have been reached to date, and a timeline for evaluating and reaching a conclusion on the critical initiatives in the NASA Authorization Act. To-date, however, NASA has not identified any particular activity authorized in the NASA Authorization Act of 2010 that would be considered a new start under guidelines set forth in the Government Accountability Office legal opinion issued on July 26, 2010 (B–320091).

While work within Exploration may begin to address the provisions of the Authorization Act, the CR restrictions maintain prohibitions on program element terminations within the Constellation Program, which may eventually limit application of funding needed for key Exploration activities.

In general, NASA is following several principles as we proceed under the FY 2011 CR:

1. The current FY 2011 CR directs funding at the FY 2010 "current rate." As such, NASA has released funds to all programs in proportion to FY 2010 enacted controls, generally at the appropriations account level.

2. Since a CR generally provides a lump sum for each appropriations account, the sub-allocations outlined in the Authorization Act become the controlling factor, and would continue to govern unless specifically modified by the final FY 2011 appropriations act.

3. Any provisions of the NASA Authorization Act of 2010 that affect NASA operations must be followed unless or until modified by an Appropriations Act. The one exception is Authorized provisions deemed to be "new starts," if any, that were not funded by a previous appropriations bill, *i.e.,* FY 2010 appropriations. (See item 4 below.)

4. All administrative and other provisions from the FY 2010 appropriation continue to apply and NASA cannot begin or resume activities that were not funded the previous year. The FY 2010 Appropriations Act (Section 505) and the CR itself prohibit new starts and, other than continuing low-level planning activities, NASA is not providing funding for any activity that may be deemed a new start until a final FY 2011 appropriations bill is enacted.

5. Exploration work can begin to address direction included in NASA Authorization Act of 2010, so long as no program element terminations prohibited in the FY 2010 Omnibus Appropriation occur, and as long as NASA meets the restrictions outlined in item 4 above.

As programs proceed under CRs, NASA has been cognizant of what the House and Senate have included in their legislation with regard to the Agency, and we are reading the Authorization Act and the CR in concert wherever possible. NASA also continues to observe the FY 2010 Omnibus Appropriations limitations with regard to continuing work on Exploration activities during the period of the CR. When the final bills are adopted, NASA will have to apply constraints and funding levels in the final bill to the CR period. Therefore, during a long-term CR, NASA must generally reserve funding to accommodate potential new starts and differing funding levels in the final FY 2011 appropriations bill.

It should be noted that NASA is also working to complete reporting requirements outlined in the NASA Authorization Act of 2010 as soon as possible. However, due to the lack of a final FY 2011 appropriations act, NASA's ability to complete some of those reports may be hampered and, as such, interim reports may become necessary. NASA will continue to keep this Committee apprised about our status on these reports, particularly if interim reports are required.

**The FY 2011 CR and NASA's Exploration Programs**

As noted earlier, the FY 2011 CR is especially challenging for NASA's human spaceflight programs, particularly those currently managed by the Exploration Systems Mission Directorate (ESMD), as well as those that will be stood up once a final FY 2011 appropriation is received. A low-level planning effort is underway for robotic precursor and flagship missions, and commercial crew development efforts have been limited. Further complicating the matter is that the planning teams are working multiple planning scenarios for FY 2011, in anticipation of final appropriations outcomes.

On August 6, 2010, initial CR guidance was provided to ESMD programs. At that time, the most complete programmatic and funding information available for FY 2011 was contained in the pending Senate Appropriations Report. For that reason, NASA looked to the report to determine priorities and funding allocations at the program/project levels, while capping the total budget at the $3.746B FY 2010 enacted level, consistent with the terms of the CR.

For the period of the FY 2011 CR, the Agency determined that the monthly funding distribution during the CR period through December 3, 2010 should support spend rates consistent with fourth quarter FY 2010 estimated cost levels. The Constellation Program was directed to place the additional funding on the prime contracts. (To date, all funds have been or are in the process of being placed on contracts.) Note that this monthly funding distribution during the CR will require significant adjustments post-CR to meet annual marks for FY 2011.

When the NASA Authorization Act of 2010 became law, the Agency adjusted CR guidance to reflect authorized priorities and funding distribution, while continuing to use the FY 2010 enacted appropriations level to set the overall spending rate for exploration. Also at this time, ESMD performed a reassessment of labor allocations across the portfolio of authorized programs, resulting in a shift between "Large Developments" (*i.e.,* current Constellation and authorized Space Launch System and Multi-Purpose Crew Vehicle development) and "Other Exploration" (*i.e.,* current and authorized technology, research and commercial capability development), resulting in a revised labor allocation for Constellation, and an increase in the program's annual mark from $2.265B to $2.308B (without labor).

On October 18, 2010, ESMD issued the following guidance to the Constellation Program:

- The Constellation Program should not exceed a monthly rate of $243M a month through the period of the FY 2011 CR for procurement and travel. However, Constellation should plan to an annual control of $2.308 billion (the authorized level, less labor) for procurement and travel.
- In FY 2011 execution during the CR, the following priorities that have been in place since the June re-plan are being used:
  - Avoid termination of prime contracts and sustain current operations (and avoid workforce dislocations) to the maximum extent practicable;
  - Continue development of critical capabilities, technologies, and commercial services; and,
  - Prioritize investments that support the initiatives under FY 2011 President's budget request and the NASA Authorization Act of 2010.

Since the $243M monthly funding level (without labor) for the current CR period was established, actual Constellation/Large Development spending during September and October has been ~$40M lower than planned. This means that the program faces no funding shortfall as the end of the initial CR period approaches.

Under a full year CR scenario, to meet the total authorized level, monthly funding for Constellation/Large Developments would need to average ~$182M (without labor) for the remaining 10 months of the fiscal year.

Work on the heavy lift launch vehicle and multi-purpose crew vehicle was authorized by the NASA Authorization Act of 2010, and can proceed without a FY 2011 appropriations bill because it is associated with NASA's current Constellation Program. For example, on November 8, 2010, NASA announced the results of a Broad Agency Announcement issued in May with regard to Heavy Lift and Propulsion. As part of this competitive solicitation, utilizing approximately $7.5M in FY 2010 dollars, NASA selected 13 companies to conduct studies examining the trade space of potential heavy-lift launch and space transfer vehicle concepts. The BAA is focused on achieving affordability, operability, reliability and commonality at the system and subsystem levels with multiple users, including other government, commercial, science and international partners.

Additionally, work on NASA's successful Commercial Crew Development (CCDev) initiative, which was begun in FY 2010, continues. On October 25, 2010, NASA released a solicitation for CCDev2, seeking proposals to further advance commercial crew space transportation system concepts and mature the design and development of elements of the system such as launch vehicles and spacecraft. Proposals are due December 13, 2010, and award of multiple Space Act Agreements is planned for March 2011 for terms of 12–14 months. However, the awards are contingent on FY 2011 appropriations.

Together, the CCDev1 and CCDev2 efforts will stimulate efforts within the industry to develop and demonstrate human spaceflight capabilities, which could lead to the development of commercial crew transportation systems—one of the highest priorities in the President's FY 2011 budget request. NASA is cognizant of the restrictions included in the NASA Authorization Act of 2010 before we are authorized to proceed with a full-up commercial crew development competition, and we are developing our commercial crew plans based on those directives. We also are working in an expeditious manner to meet the associated reporting requirements outlined in the NASA Authorization Act of 2010.

**Other FY 2011 CR Implications**

The following is a summary of how other NASA programs are operating under the restrictions imposed by the FY 2011 CR:

- *Space Operations:*
  - *Space Shuttle*: Because the Shuttle continues to operate based on the FY 2010 rate under the FY 2011 CR, the program is able to meet all of its funding requirements during the first half of the fiscal year.
  - *STS–135*: If NASA is provided the funding, it would be able to support the flight of the STS–135 logistics mission to the International Space Station (ISS) as authorized under the NASA Authorization Act of 2010. To best manage workforce impacts, the Shuttle program needs to confirm approval to add the STS–135 mission by December 2010.
  - *NASA Launch Support and Infrastructure Modernization Program*: Although the NASA Authorization Act of 2010 authorizes upgrades of the launch complex at Kennedy Space Center (KSC), NASA is waiting for the enactment of an FY 2011 appropriations bill to fund this activity. A team at KSC is preparing to startup this program upon receipt of funding. They will select and initiate a set of projects consistent with the Authorization Act direction to support the Space Launch System. A report outlining the implementation plan for this modernization program is due to Congress no later than February 2011.
  - *ISS*: Both the President's FY 2011 budget request and the Authorization Act extended the ISS until at least 2020. Required activities to support ISS life extension will be performed under the FY 2011 CR and ISS research based on the FY 2010 budget also will continue during the CR. However, activities to increase ISS functionality will be delayed until FY 2011 funding is received. During the CR, SOMD will continue to plan to ramp up ISS user operations and to complete assembly of the ISS. Additionally, the Directorate will restructure the existing ISS utilization program into three primary components: (1) international partner uses; (2) NASA uses to enable future exploration; and, (3) U.S. uses by organizations other than NASA. This restructuring does not represent new research program content given that NASA has been pursuing ISS utilization in all three of these domains throughout the assembly period. Finally, SOMD plans to conduct a competitive acquisition for

a cooperative agreement to manage a portion of the research on ISS. This initiative is a continuation of the existing research program under an alternate management structure that includes a "single Point Of Contact" for ISS research, consistent with specific Administration and Congressional guidance. The schedule for this initiative would lead to award of a cooperative agreement in the May 2011 time-frame pending the availability of funds within the FY 2011 appropriation.

- *Science*: Plutonium–238 (Pu–238) has provided power for 26 different NASA missions that have flown over the years, missions that have been enabled with radioisotope power systems that require this particular fuel. The NASA mission to explore the solar system depends upon spacecraft that rely on Pu–238 to fuel their energy needs because solar power is not a practical option for many missions. NASA's access to secure and reliable sources of Pu–238 is endangered. Russia has suspended implementation of its contract with the Department of Energy (DOE) for purchase of Russia's remaining supplies of Pu–238. Our existing domestic stockpile of Pu–238 is not being replenished and is expected to be depleted before the end of the decade. NASA and DOE have submitted to the Congress a plan for restarting domestic production to provide a reliable and secure supply of Pu–238. Specifically, the President's FY 2011 budget request proposes $30M for this purpose, $15M in the request for DOE and $15M in the request for NASA. The NASA Authorization Act of 2010 authorizes NASA to pursue a joint approach with DOE beginning in FY 2011 toward restarting and sustaining the domestic production of Pu238. However, the FY 2011 CR does not fund NASA or DOE to initiate the authorized restart of domestic Pu–238 production. NASA and DOE will require appropriation of funds for FY 2011 and beyond in order to keep the supply of Pu–238, and with it the nation's Planetary Science program, on track.
- *Space Technology*: While Space Technology planning continues during the FY 2011 CR, the Office of the Chief Technologist cannot fund this work until FY 2011 appropriations are enacted. This may have an impact on schedule given the time required to make awards once a final appropriation is received. NASA recently completed an analysis of the content of six Space Technology initiatives in the FY 2011 budget request: Space Technology Research Grants; NASA Institute for Advanced Concepts; Game-Changing Development; Franklin Small Satellite Subsystem Technology; Technology Demonstration Missions; and, Edison Small Satellite Missions. The NASA Office of the General Counsel concluded that they are continuations of existing initiatives from prior budget requests and program descriptions, with management consolidated in the Office of the Chief Technologist rather than managed across other Mission Directorates as was the prior practice. As such, continuation of these initiatives is not subject to the current CR restriction on "new starts," and NASA could issue solicitations for these efforts, subject to final FY 2011 appropriations.

  Per direction contained in the NASA Authorization Act of 2010, the Office of the Chief Technologist has initiated a technology roadmapping activity to guide the agency's long-term technology needs and inform the National Space Technology policy called for in this Act. NASA will complete development of this strategic guidance through a national dialogue with industry, academia and other government agencies facilitated through the National Research Council. The Office of the Chief Technologist anticipates the release of 14 draft technology area roadmaps to the NRC and the public in December 2010.
- *Aeronautics*: The Aeronautics Research Mission Directorate (ARMD) has two new activities planned for FY 2011 that we are eager to move forward with: the Unmanned Aerial System (UAS) Integration in the National Airspace System (NAS) Project and the Verification and Validation (V&V) of Flight-Critical Systems sub-project, which is under the Aviation Safety Program's System-Wide Safety and Assurance Technologies Project. Since these activities are new, ARMD can only engage in low-level planning activities until there is an enacted FY 2011 appropriation. These programs will benefit two segments of the aviation community: the segment involved with UAS access to the NAS, and the Joint Planning & Development Office. Although there is stakeholder interest in both of these research activities, lasting detrimental effects are not expected as a result of a FY 2011 CR due to the long-term nature of the work. To address near-term issues, ARMD remediation options include delaying the start of these activities, which will in turn delay the benefits of research results. Additionally, ARMD may have to re-scope activities for FY 2011, depending on how long NASA must operate under a CR.

**Human Exploration Planning Efforts**

As noted earlier, the agency is reading the NASA Authorization Act of 2010 and the CR in concert, and we are continuing to observe any restrictions on new starts. However, NASA is also continuing prudent planning efforts to integrate new Exploration work across the Agency so that we are ready to move out once FY 2011 appropriations are received. In particular, NASA is continuing the efforts of the Human Exploration Framework Team (HEFT).

HEFT was chartered in April 2010 for the purpose of establishing a framework for human space exploration that defines the knowledge, capabilities and infrastructure that NASA needs to send people to explore multiple destinations in the Solar System in an efficient, sustainable way. HEFT is not a decisionmaking body; it is intended to provide *decision support* to NASA senior leaders as they plan the spaceflight activities for human exploration beyond LEO. HEFT will inform NASA senior leadership by providing credible, consistent, coherent, and transparent analyses of all aspects of potential human spaceflight architectures. In addition to its Steering Council, HEFT includes an Integration Team and domain experts drawn from across NASA.

The near-term objective for HEFT is to provide analysis to NASA leadership for consideration; this analysis will integrate the options, related priorities, and architecture implications of potential decisions. Per the Administrator's direction, HEFT is following three important principles in developing and analyzing architecture options; architectures must be:

(1) *Affordable* during development and operations;

(2) *Sustainable* over multiple years; and,

(3) *Feasible* so that, in consultation with its international partners and our contractors, NASA knows that it can be achieved.

HEFT is seeking one or more human spaceflight architectures that "close" by satisfying key stakeholder expectations, including fitting within projected human spaceflight budget limits. This will enable NASA to proceed with developments that enable human exploration beyond LEO as soon as affordable, open up the inner solar system to human presence, and preserve planning flexibility deep into the future. The realization of any architecture option is, of course, subject to the availability of appropriated funds.

The first phase of HEFT concluded in early September 2010, and the second phase will conclude in December 2010. A smaller HEFT effort may continue indefinitely since the human spaceflight technical and programmatic environment will continue to evolve. Ultimately, the goal for HEFT is to generate a process that evolves into a long-term, permanent NASA activity to support human spaceflight strategic planning.

**Conclusion**

Chairman Nelson and members of the Committee, thank you for the opportunity to appear before you today to discuss the NASA Authorization Act of 2010 and how NASA plans to implement that direction. NASA appreciates all the hard work and effort that has gone into enacting this legislation.

In the end, one thing is clear; even with the tremendous accomplishments of our past, NASA's best days are still ahead. NASA is at the beginning of a great adventure that will create opportunities and discoveries for generations and so, like you, NASA is eager to get started on that journey of exploration, both on our home planet and in the stars above.

I would be pleased to respond to any questions that you or the other Members of the Committee may have.

ATTACHMENT

*December 1, 2010*

**NASA General Counsel Assessment**

*Implementation of P.L. 111–267, the NASA Authorization Act of 2010 During the Current Continuing Resolution*

**Summary**

Under the current Continuing Resolution, the government is generally prohibited from commencing new projects or activities. NASA is therefore continuing work that was already underway on programs and projects across the agency, many of which were highlighted in the NASA Authorization Act of 2010 (P.L. 111–267). However, full implementation of the direction provided by that Act will be challenging if the

restrictive language in the FY 2010 Appropriations Act (P.L. 111–117) and FY 2011 Continuing Resolution (P.L. 111–242) remains in effect throughout FY 2011. In the Exploration account under these authorities, NASA is strictly limited to continuing projects or activities for which funds were available in FY 2010. In addition, NASA is further prohibited from terminating Constellation program elements, or even contracts, meaning that NASA must, for example, continue the Orion program. These provisions are carried forward into FY 2011 by the Continuing Resolution.

NASA is currently assessing the status of specific programs case-by-case, and has concluded that existing authorities are sufficient to allow several to be funded under the CR. NASA will continue to conduct these assessments for purposes of implementing Authorization Act direction, but the outcomes will depend on the specific provisions of appropriations legislation enacted and in effect after the expiration of the current P.L. 111–242 on December 3, 2010.

**Implementation of P.L. 111–267, the NASA Authorization Act of 2010**

The NASA Authorization Act provides significant new authority and direction for the Agency. However, as the Comptroller General has long maintained:

> The mere authorization of an appropriation does not authorize expenditures on the faith thereof or the making of contracts obligating the money authorized to be appropriated. 16 Comp. Gen. 1007, 1008 (1937).

No regular Appropriations Act has been passed, and the government is operating under a Continuing Resolution, P.L. 111–242. As a general rule, agencies are constrained from undertaking new programs, projects, and activities under Continuing Resolutions. Thus, NASA may not currently implement "new starts" under the Authorization Act in most cases.

*A. Statutory Framework*

There are several relevant provisions. The Continuing Resolution itself provides restrictions on new starts, as well as carrying forward substantive provisions from the prior year's appropriations. For example, Section 101 provides:

> Such amounts as may be necessary, at a rate for operations as provided in the applicable appropriations Acts for Fiscal Year 2010 and under the authority and conditions provided in such Acts, for continuing projects or activities (including the costs of direct loans and loan guarantees) that are not otherwise specifically provided for in this Act, that were conducted in Fiscal Year 2010, and for which appropriations, funds, or other authority were made available in the following appropriations Acts: [List omitted].

Thus, funds provided under the Continuing Resolution are to be used for "continuing projects or activities . . . for which . . . funds . . . were made available" by FY 2010 appropriations. The Continuing Resolution does not provide funding for new projects, since the purpose of the CR is to be a stop-gap measure enacted to keep existing federal programs functioning after the expiration of previous budget authority and until regular appropriation acts can be enacted. This principle is reinforced by Section 104, which states:

> Except as otherwise provided in section 102, no appropriation or funds made available or authority granted pursuant to section 101 shall be used to initiate or resume any project or activity for which appropriations, funds, or other authority were not available during Fiscal Year 2010.

Further, the Continuing Resolution amounts are provided "under the authority and conditions provided in such Acts," P.L. 111–242 Section 101, meaning that the provisions of the listed Acts continue to apply. The Commerce, Justice, Science, and Related Agencies Appropriations Act, 2010, Pub. L. No. 111–117, is one of the Acts listed in Section 101 of the Continuing Resolution. It contained the following general provision applicable to NASA:

> SEC. 505. (a) None of the funds provided under this Act, or provided under previous appropriations Acts to the agencies funded by this Act that remain available for obligation or expenditure in Fiscal Year 2010, or provided from any accounts in the Treasury of the United States derived by the collection of fees available to the agencies funded by this Act, shall be available for obligation or expenditure through the reprogramming of funds that——
>
> (1) creates or initiates a new program, project or activity. . . .

It also contained an appropriation for Exploration, which appropriated about $3.7 billion for "exploration research and development activities." The appropriation made the funds available until September 30, 2011, with the following limitation:

> "Provided, That notwithstanding section 505 of this Act, none of the funds provided herein and from prior years that remain available for obligation during Fiscal Year 2010 shall be available for the termination or elimination of any program, project or activity of the architecture for the Constellation program nor shall such funds be available to create or initiate a new program, project or activity, unless such program termination, elimination, creation, or initiation is provided in subsequent appropriations Acts."

This provision was amended by P.L. 111–212 to read:

> The matter contained in title III of division B of Public Law 111–117 regarding "National Aeronautics and Space Administration Exploration" is amended by inserting at the end of the last proviso "*Provided further*, That notwithstanding any other provision of law or regulation, funds made available for Constellation in Fiscal Year 2010 for 'National Aeronautics and Space Administration Exploration' and from previous appropriations for 'National Aeronautics and Space Administration Exploration' shall be available to fund continued performance of Constellation contracts, and performance of such Constellation contracts may not be terminated for convenience by the National Aeronautics and Space Administration in Fiscal Year 2010."

Thus, the general limitation on new starts has been recently emphasized by Congress with respect to Exploration funding; NASA is further prohibited from terminating Constellation program elements, or from terminating contracts for convenience. These provisions are carried forward into FY 2011 by the Continuing Resolution.

*B. GAO Report B–319488*

Earlier this year, numerous Members of Congress requested that GAO assess NASA's planning activities to determine whether NASA had violated the new starts prohibition contained in P.L. 111–117. Specifically, NASA had set up several teams to study aspects of the President's Budget Request. On May 21, 2010, GAO released a report finding that NASA's activities were in full compliance with the new start prohibition, primarily because NASA only engaged in planning activities, and did not take steps to implement any new programs, projects, or activities. In reaching that conclusion, GAO set forth the analytical framework to be used when assessing this and other similar provisions. Comparing the NASA activities with a prior case, GAO stated:

> NASA's actions thus far are in contrast to those of the Department of Energy (DOE) when it began to implement a loan guarantee program. B–308715, Apr. 20, 2007. GAO was asked whether DOE had violated an appropriations prohibition against implementing or financing a new loan guarantee program. *Id.* There, DOE had staffed and operated a program office, drafted regulations, and solicited and evaluated "pre-applications." *Id.* We found that DOE had taken concrete measures to implement the loan guarantee program and, therefore, that DOE's action violated a statutory provision that barred DOE from using funds to "implement or finance" the loan guarantee program. *Id.*
>
> DOE's activities went beyond those of NASA's study teams. At this time, NASA has not created or initiated a new program, project, or activity. Unlike DOE, NASA has not created a new office or drafted any regulations. In addition, NASA has not initiated any procurement actions. *B–319488,* p. 6.

GAO also found that NASA's action in releasing certain Exploration-related solicitations did not violate the restriction, since those solicitations related to existing, authorized programs. *Id.,* fn. 7. GAO concluded with the following cautionary note:

> However, going forward, NASA should be mindful of the appropriations provision and ensure that its preliminary planning activities do not evolve into activities that would create or initiate a new program, project, or activity.

NASA has been and will continue to be mindful of the new starts restrictions. Following the logic of footnote 7, NASA will also continue to undertake activities for which funding was available in FY 2010. As noted above, this provision is carried forward by the Continuing Resolution, and the analysis is applicable to the other relevant new starts prohibitions as well.

*C. Existing Authority*

Because of the numerous and binding restrictions on NASA's ability to initiate new programs, projects, or activities, NASA is strictly limited to continuing activities for which funds were available in FY 2010. Thus implementation of Authoriza-

tion Act provisions during the period of the current Continuing Resolution must, as a general rule, rely on existing authority. Each of these must be assessed on a case-by-case basis, and must be individually and specifically tied to prior authorization and appropriations acts, legislative history, and budget requests. For example, NASA recently concluded that it could issue a follow-on to the agency's Commercial Crew Development (CCDev) activity, called CCDev2. This was permissible because NASA had the authority for CCDev in FY 2010, not because P.L. 111–267 authorizes an expansion of CCDev.

Senator NELSON. Ms. Chaplain?

**STATEMENT OF CRISTINA T. CHAPLAIN, DIRECTOR, ACQUISITION AND SOURCING MANAGEMENT; AND SUSAN A. POLING, MANAGING ASSOCIATE GENERAL COUNSEL, U.S. GOVERNMENT ACCOUNTABILITY OFFICE (GAO)**

Ms. CHAPLAIN. Mr. Chairman, Senator Hutchison, and members of the Committee, thank you for inviting us here today to discuss issues NASA faces as it implements the direction outlined in the Authorization Act of 2010.

Today we will be briefly discussing how the continuing resolution continues restrictions on NASA's Fiscal Year 2010 appropriations and what steps NASA should take to increase the likelihood of success as it implements its new direction.

As you know, I am accompanied by Susan Poling, Managing Associate General Counsel at GAO, who can answer questions related to the appropriations restrictions.

As you know, NASA's Fiscal Year 2010 appropriations contain a restriction prohibiting NASA from terminating any program, project, or activity—that is, PPAs—of the Constellation program or creating new ones until provided for in a subsequent appropriations act. These restrictions remain in place today because NASA is operating under a continuing resolution. Continuing resolutions are temporary appropriations acts that Congress enacts to keep existing programs functioning after the expiration of previous budget authority. What this means for NASA's implementation of the Authorization Act is that NASA must carry out the Authorization Act but without terminating or eliminating any PPA of the Constellation program and without creating or initiating new ones.

Our opinions from earlier this year may offer NASA some guidance as it moves forward. We found that NASA did not violate the prohibition when it convened study teams to conduct planning activities. Agencies may conduct planning activities as part of the budget process, and NASA's planning activities earlier this year did not create a new PPA.

NASA also continued to obligate funds to all the existing PPAs of the Constellation program. As long as NASA did not improperly create or terminate a PPA, NASA has discretion in how it carries out the Constellation program consistent with the Congress' statutory direction. Shifts in priority do not, in and of themselves, constitute the termination or elimination of a PPA.

With regard to our perspectives on steps NASA needs to take to increase the likelihood of success as it implements the authorization, I would like to highlight recommendations related to how NASA manages its largest investments. Recently it has been reported that the James Webb Telescope may now cost $6.5 billion or more while its baseline estimate set just 2 years ago was about

$5 billion. Our studies have highlighted similar cases of large costs and schedule overruns in recent years, for example, with Mars Science Lab, the Glory Mission, and the National Preparatory Project.

Further, more than a decade of studies have consistently pointed to weaknesses and cost estimating contractor oversight, funding stability, management reserves, as well as technology and design problems that manifest late in the acquisition process. Thus, we would like to see NASA commit to the following key practices.

First, base decisions to move programs forward on tangible knowledge about requirements and resources. NASA's policies have incorporated many of the best practices GAO has advocated, but we still do not always see these policies translated into decisions. Some of the most expensive efforts are allowed to proceed in the more complex phases of development while there are still considerable unknowns about requirements, time needed to execute programs, cost, available funding, and available technology.

Second, NASA needs to prioritize investments so projects can be fully funded and it is clear where projects stand in relation to the overall portfolio. When funding profiles do not match up with the real needs of projects like James Webb or Constellation, higher risk development paths often become the only way to keep projects alive. Moreover, projects within NASA are often not prioritized until a large cost overrun is discovered and good programs are left to pay for poor performers.

Third, NASA still needs to instill greater accountability. The recent study on James Webb found that lines of authority and accountability are not clear and that ongoing, regular independent assessment and oversight processes at the agency are missing. Our view is that until accountability is instilled, NASA will struggle in its implementation of the good practices it has embraced in recent years.

I would like to note that aspects of the practices detailed in our written statement are reflected in the authorization for the new space launch system. We would like to see such measures extend across the acquisition portfolio. At the same time, it is important that Congress enable NASA to be realistic about what it can do and cannot do under the direction of the authorization and to support and assist the agency as it makes difficult trade-off decisions between resources, that is time and money, and requirements.

This concludes our opening statement, and Susan and I are happy to answer any questions you have.

[The prepared statement of Ms. Chaplain follows:]

PREPARED STATEMENT OF CRISTINA T. CHAPLAIN, DIRECTOR, ACQUISITION AND SOURCING MANAGEMENT; AND SUSAN A. POLING, MANAGING ASSOCIATE GENERAL COUNSEL, U.S. GOVERNMENT ACCOUNTABILITY OFFICE (GAO)

Mr. Chairman and members of the Committee:

Thank you for inviting us here today to discuss issues NASA faces as it transitions to and implements the direction outlined by the NASA Authorization Act of 2010.[1] The steps that NASA takes to implement the direction in the Authorization Act will set the stage for whether it can accomplish the goals of the authorization within the timeframes and resources as directed. NASA projects have produced

[1] Pub. L. No. 111–267, 124 Stat. 2805 (Oct. 11, 2010).

ground-breaking research and advanced our understanding of the universe. However, our work shows that another common theme binds most of the projects—they cost more and take longer to develop than planned. Frequently they are approved without evidence of a sound business case that ensures a match between requirements and reasonably expected resources. In today's fiscal environment, it is clear that this condition cannot be sustained.

In March, several members of the House of Representatives asked us for information and our views on, among other things, whether NASA complied with restrictions in the 2010 Exploration appropriation when it took certain actions pertaining to the Constellation program. Based on that request, we issued two legal opinions this summer.[2] The NASA Authorization Act of 2010, as signed into law by the President in October 2010, challenges NASA to develop new human spaceflight systems and use the commercial space industry and international partnerships to develop new technologies for space exploration, but NASA must still comply with the restrictions in the Fiscal Year 2010 Exploration appropriation. Regardless of the changes resulting from the Authorization Act, one thing that will remain constant is NASA's need to efficiently and effectively manage programs and projects. Against this backdrop, our testimony today will focus on: (1) how the Continuing Appropriations Act of 2011[3] continues the restrictions in the Fiscal Year 2010 Commerce, Justice, Science, and Related Agencies Appropriations Act,[4] and how they relate to the recently enacted NASA Authorization Act and (2) steps NASA should take to reduce its acquisition risk and increase the likelihood of success as it implements its new direction outlined in the NASA Authorization Act.

In preparing this statement, we relied on completed and ongoing work. Our audit work examining best practices for system development and assessing NASA's major projects was performed in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives.

**Appropriation Restrictions Remain in Effect**

In October 2009, the Review of U.S. Human Spaceflight Plans Committee issued a report which concluded that the human spaceflight program is on an "unsustainable trajectory."[5] The conference report accompanying the Consolidated Appropriations Act, 2010 stated that "the Committee's work raises issues requiring thoughtful consideration by the Administration and the Congress" but that "it is premature for the conferees to advocate or initiate significant changes to the current program absent a bona fide proposal from the Administration and subsequent assessment, consideration and enactment by Congress."[6] Accordingly, Congress appropriated about $3.7 billion for "exploration research and development activities," but provided that none of the funds from 2010 or prior years

> "shall be available for the termination or elimination of any program, project or activity of the architecture for the Constellation program nor shall such funds be available to create or initiate a new program, project or activity, unless such program termination, elimination, creation, or initiation is provided in subsequent appropriations Acts."[7]

These are the restrictions that we addressed in our recent legal opinions. Currently, NASA is operating under the Continuing Appropriations Act, 2011 (Continuing Resolution), which Congress enacted on September 30. Continuing resolutions are temporary appropriations acts that Congress enacts to keep existing programs functioning after the expiration of previous budget authority. Most continuing resolutions, including the one under which NASA is currently operating, incorporate by reference the conditions and restrictions contained in prior years' appropriations acts or the appropriations bills currently under consideration. In this case, the Continuing Resolution provided amounts to NASA

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[2] B–320091, July 23, 2010; B–319488, May 21, 2010.
[3] Pub. L. No. 111–242, 124 Stat. 2607 (Sept. 30, 2010).
[4] Pub. L. No. 111–117, div. B, tit. III, 123 Stat. 3034, 3113 (Dec. 16, 2009).
[5] Review of U.S. Human Spaceflight Plans Committee, *Seeking a Human Spaceflight Program Worthy of a Great Nation*, available at *www.nasa.gov/offices/hsf/home/index.html* (last visited Nov. 12, 2010). The Committee is commonly known as the Augustine Commission, after its Chairman, Norman R. Augustine.
[6] H.R. Rep. No. 111–366, at 755 (2009).
[7] Commerce, Justice, Science, and Related Agencies Appropriations Act, 2010, Pub. L. No. 111–117, div. B, title III, 123 Stat. 3034, 3113, 3143 (Dec. 16, 2009).

> "at a rate for operations as provided in the applicable appropriations Acts for Fiscal Year 2010 and *under the authority and conditions provided in such Acts, for continuing projects or activities* . . . that are not otherwise specifically provided for in this Act."[8]

(Emphasis added.) Like most continuing resolutions, the current Continuing Resolution also prohibits new activities and projects for which funds were not available in the prior fiscal year.[9]

About a month ago, Congress enacted the NASA Authorization Act of 2010 (Authorization Act),[10] which provided specific direction on a number of issues related to human space flight and space technology. The Authorization Act requires that NASA undertake a number of initiatives, but NASA still needs appropriations to carry out these activities. As you know, under the Constitution, "no Money shall be drawn from the Treasury, but in Consequence of Appropriations made by Law."[11] The Continuing Resolution provides funds for NASA, but only "under the authority and conditions provided" in the Fiscal Year 2010 Exploration appropriation.[12]

One of the conditions in the Fiscal Year 2010 NASA appropriation is the limitation discussed in our recent opinions that funds are not available "for the termination or elimination of any program, project or activity of the architecture for the Constellation program" nor are they available to "create or initiate a new program, project or activity, *unless* such program termination, elimination, creation, or initiation is provided in subsequent appropriations Acts" (emphasis added). Thus NASA must still comply with the restrictions contained in the Fiscal Year 2010 Exploration appropriation. What this means for NASA's implementation of the Authorization Act is that NASA must carry out the Authorization Act[13] but without terminating, eliminating any program, project, or activity of the Constellation program and without creating or initiating a new program, project, or activity.[14]

Because the continuing resolution subjects NASA's current appropriation to the Fiscal Year 2010 restriction, our two opinions this year may offer NASA some guidance as it goes forward since we analyzed various actions related to the Constellation program to determine if NASA was complying with the restriction. In both opinions, we concluded that NASA did not violate the restrictions in the Fiscal Year 2010 Exploration appropriation. In May,[15] we noted that Congress prohibited NASA from using Exploration funds to bring into being a new program, project, or activity.[16] We concluded that NASA did not violate this restriction when it convened study teams to conduct planning activities. Agencies must conduct planning activities as part of the budget process, and the prohibition in the Exploration appropriation did not preclude the use of funds for planning purposes. Further, NASA's planning activities did not result in the use of funds to create or initiate a new program, project, or activity.[17]

In July,[18] we considered whether NASA improperly terminated or eliminated any program, project, or activity of the Constellation program. We determined that

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[8] Pub. L. No. 111–242, § 101.
[9] Pub. L. No. 111–242, § 104.
[10] Pub. L. No. 111–267.
[11] U.S. Const. art. I, § 9, cl. 7.
[12] Pub. L. No. 111–242, § 101.
[13] "[W]hen two statutes are capable of co-existence, it is the duty of the courts, absent a clearly expressed congressional intention to the contrary, to regard each as effective." *Andrus* v. *Glover Construction Co.*, 446 U.S. 608, 618–619 (1980).
[14] In addition to the restriction pertaining specifically to the Constellation program, the Continuing Resolution also bars the use of funds "to initiate or resume any project or activity for which appropriations, funds, or other authority were not available during Fiscal Year 2010." Pub. L. No. 111–242, § 104.
[15] B–319488, May 21, 2010.
[16] A "program, project, or activity" is "[a]n element within a budget account. For annually appropriated accounts, the Office of Management and Budget (OMB) and agencies identify [programs, projects, or activities] by reference to committee reports and budget justifications." GAO, *A Glossary of Terms Used in the Federal Budget Process*, GAO–05–734SP (Washington, D.C.: September 2005).
[17] NASA's actions differed from those of the Department of Energy (DOE) when it began to implement a loan guarantee program. B–308715, Apr. 20, 2007. There we found that DOE had staffed and operated a program office, drafted regulations, and solicited and evaluated "pre-applications." Therefore, we concluded that DOE violated a statutory provision that barred it from using funds to "implement or finance" the loan guarantee program. In contrast, NASA had not created a new office or drafted any regulations; instead, NASA staff developed preliminary plans.
[18] B–320091, July 23, 2010.

NASA had five programs, projects, or activities within the "Constellation Systems" category:

- Program Integration and Operations,
- Orion Crew Exploration Vehicle,
- Ares I Crew Launch Vehicle,
- Ares V Cargo Launch Vehicle, and
- Commercial Crew and Cargo.[19]

We concluded that NASA did not terminate or eliminate any program, project, or activity of the Constellation program because NASA continued to obligate Exploration appropriations to all five of the Constellation programs, projects, and activities. NASA diverted no Exploration funds to create a new program, project, or activity. We also noted that as long as NASA does not improperly create or terminate a program, project, or activity, the agency has discretion in how it carries out the Constellation program consistent with Congress's statutory direction. Shifts in priority do not in themselves constitute the termination or elimination of a program, project, or activity.

**Steps NASA Should Take to Reduce Acquisition Risk and Increase the Likelihood of Success as it Implements the Authorization Act**

Regardless of its current restrictions, once NASA begins to implement the new direction outlined in the Authorization Act, it will need to adopt new ways of doing business—particularly with respect to matching requirements to resources, managing costs, increasing transparency into the most critical phases of development, and strengthening accountability—to reduce acquisition risk and increase likelihood of success. Our work has consistently shown that NASA's projects cost more and take longer to develop than planned. This year, for example, we reported that 10 NASA projects that had their cost and schedule baselines set within the last 3 years experienced cost growth averaging $121 million, or 18.7 percent, and schedule growth averaging 15 months.[20] Many of the projects we reviewed experienced challenges developing new or retrofitting older technologies, stabilizing engineering designs, and managing the performance of contractors and development partners. These challenges, and the significant cost growth experienced by NASA projects after they were baselined, occurred as a result of projects being approved with considerable unknowns about requirements, technologies, costs, or other resources. Our reports have highlighted the risk that the Constellation Program was headed in this same direction. For example, in 2009 we reported that Constellation program had significant technical and design challenges that until resolved would hinder NASA's ability to reliably estimate the time and funding needed to execute the program. In addition, the Constellation program's poorly phased funding plan has affected the program's ability to deal with technical challenges.[21] Similarly, the Review of U.S. Human Spaceflight Plans Committee reported that "the U.S. human spaceflight program appears to be on an unsustainable trajectory. It is perpetuating the perilous practice of pursuing goals that do not match allocated resources." [22]

While space development projects are complex and difficult by nature, and most are one-time efforts, the nature of the work should not preclude NASA from being accountable for achieving what it promises when requesting and receiving funds. Moreover, measures can be taken to better position programs for success, which we believe should be emphasized as the Authorization Act is implemented. Specifically, our past work has shown that developing a sound business case, based on matching requirements to available and reasonably expected resources—including time, dollars, technology, and people—before committing to a new development effort, reduces risk and increases the likelihood of success.[23] GAO's work has shown that

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[19] NASA, *Fiscal Year 2010 Budget Estimates*, at EXP–2, available at *www.nasa.gov/news/budget/FY2010.html* (last visited Nov. 10, 2010).

[20] GAO, *NASA: Assessments of Selected Large-Scale Projects*, GAO–10–227SP (Washington, D.C.: Feb. 1, 2010).

[21] GAO, *NASA: Constellation Program Cost and Schedule Will Remain Uncertain Until a Sound Business Case Is Established*, GAO–09–844 (Washington, D.C.: Aug. 26, 2009).

[22] Review of U.S. Human Spaceflight Plans Committee, *Seeking a Human Spaceflight Program Worthy of a Great Nation*, available at *www.nasa.gov/offices/hsf/home/index.html*.

[23] GAO, *Defense Acquisitions: Key Decisions to Be Made on Future Combat System*, GAO–07–376 (Washington, D.C.: Mar. 15, 2007); *Defense Acquisitions: Improved Business Case Key for Future Combat System's Success*, GAO–06–564T (Washington, D.C.: Apr. 4, 2006); *NASA: Implementing a Knowledge-Based Acquisition Framework Could Lead to Better Investment Decisions and Project Outcomes*, GAO–06–218 (Washington, D.C.: Dec. 21, 2005); *NASA's Space Vision:*

Continued

how well an agency matches resources with requirements sets the stage for the eventual outcome—desirable or problematic—of the project. The match is ultimately achieved in every development project, but in successful development projects, it occurs before significant commitments and investments are made.

We have reported that steps agencies should take prior to undertaking new projects include:

- Prioritizing investments so projects can be fully funded and it is clear where projects stand in relation to the overall portfolio.
- Following an evolutionary path toward meeting needs rather than attempting to satisfy all needs in a single step.
- Matching requirements to resources—that is, time, money, technology, and people—before undertaking a new development effort.
- Researching and defining requirements before projects start and limiting changes after they start.
- Ensuring cost estimates are complete, accurate, and updated regularly.
- Committing to fully fund projects before they begin.
- Ensuring critical technologies are proven to work as intended before projects start.
- Assigning more ambitious technology development efforts to research departments until they are ready to be added to future generations (increments) of a project.
- Using systems engineering to close gaps between resources and requirements before launching the development process.[24]

Our work has shown that projects that have not attained the level of knowledge needed to support a sound business case that proceed to development have been plagued by cost overruns, schedule delays, decreased capability, and overall poor performance. This phenomenon is not unique to NASA—the Department of Defense and the Department of Homeland Security experience the same outcomes with many of their acquisition programs. If the knowledge the project has attained does not confirm the business case on which the acquisition was originally justified, the best practice organizations we have studied do not allow the project to proceed.

Critical to success is performance and requirements flexibility in early phases of development. NASA needs to be open to reducing expectations, deferring them to future projects, or to investing more resources up front to eliminate gaps between resources and expectations. In successful projects we have studied, requirements were flexible until a decision was made to commit to development given the desire to obtain the capability as soon as possible. This makes it acceptable to reduce, eliminate, or defer some capabilities so the project's requirements could be matched with the resources available to deliver it within the desired time frame.

In addition to ensuring projects establish a business case before they are approved for long-term financial commitments, both program officials and senior leaders need to be held accountable for executing the project by the most efficient and effective means. To that end, the NASA projects need to be structured to ensure that decisionmakers, including NASA and Congress, have the insight necessary to make informed, knowledge-based decisions and hold project managers accountable for managing projects effectively and efficiently. We have reported that during development, NASA should ensure its decisionmakers do the following:

- Use quantitative data and demonstrable knowledge to make go/no-go decisions, covering critical facets of the project such as cost, schedule, technology readiness, design readiness, production readiness, and relationships with suppliers.
- Establish consistent metrics to measure design readiness and ensure they are met before development proceeds.
- Empower project managers to make decisions about the direction of the project and to resolve problems and implement solutions and hold them accountable for their choices.
- Ensure contractors are holding suppliers accountable to deliver high-quality parts for their products through such activities as regular supplier audits and performance evaluations of quality and delivery, among other things.

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*Business Case for Prometheus 1 Needed to Ensure Requirements Match Available Resources*, GAO–05–242 (Washington, D.C.: Feb. 28, 2005).

[24] GAO, *Space Acquisitions: Major Space Programs Still at Risk for Cost and Schedule Increases*, GAO–08–552T (Washington, D.C.: Mar. 4, 2008).

- Encourage project managers to share bad news, and promote collaboration and communication.

Over the past several years NASA has moved to incorporate a more knowledge-based approach to managing its development projects and instill a stronger focus on managing costs. For example, NASA has taken steps to enhance cost-estimating methodologies and ensure that independent estimates are used to provide decision-makers with an objective representation of likely project cost and schedule. As a result, NASA has begun to budget its projects at a higher degree of confidence. Broader steps NASA is taking focus on strengthening program and project management, facilitating monitoring of contractor cost performance, improving agency-wide business processes, and improving financial management.[25]

While NASA has laid out a broad plan for reducing acquisition risk, more needs to be done as the Authorization Act is implemented. For example,

- NASA does not use a common measure to assess design stability before allowing programs to move from the design phase to the test and integration phases of the development process. At the same time, our studies and others have found that significant cost growth occurs in these phases and, in some instances, has tied these problems to issues related to design. Moreover, a recent study by the National Research Council found that the critical design review milestone for many missions may be held prematurely—driven by schedule rather than driven by design maturity. GAO reports and this study have found that critical design review approval of an immature design can cause downstream problems for complex acquisitions such as integration difficulties and late changes.
- NASA does not provide enough transparency in the early, critical phases of development to help Congress identify risks and inefficiencies and ensure earlier accountability. Currently, NASA only begins to publicly share cost and schedule information for projects that have been formally approved to enter development. To add some perspective to this timing, neither the Ares nor Orion projects have reached this point, despite having spent over $9 billion dollars combined; and the James Webb Space Telescope (JWST) just reached this point in 2008, despite having spent nearly $2 billion prior to that time. While there is a need to allow projects a period of time for discovery and to pursue different concepts—particularly highly complex efforts such as JWST—inadequate transparency into their progress for what sometimes amounts to 5 or more years can preclude effective oversight and accountability and make it even more difficult to stop projects that are not on track to meet the agency's goals with available resources.
- An independent study released just last week of problems affecting the James Webb Telescope program concluded that significant changes are still needed in NASA's oversight and accountability functions to ensure that programs base their decisions on sound knowledge, noting that NASA's governance policy is not consistent with accountability for project execution. In particular, the study found that lack of clear lines of authority and accountability contributed to a lack of executive leadership in resolving the broken JWST life-cycle cost baseline. The study found that JWST's flawed budget should have been discovered as part of the Goddard Spaceflight Center's execution responsibility, but the interpretation of the agency's governance policy on the role of the center in this regard is ambiguous and not uniformly interpreted within NASA. The study also noted that ongoing, regular independent assessment and oversight processes at the agency are missing.

Because NASA is pushing the exploratory envelope, it is reasonable for unexpected problems and discoveries to occur. Not all projects will go as planned. On the other hand, it is clear from recent findings from the JWST Independent Review, the National Research Council (NRC), and GAO's continued assessments of major projects that inherent risks to spacecraft development are being exacerbated by poor management and oversight practices. While NASA still needs to make fundamental changes to how it plans, manages, and oversees its major investments, it will be a challenging endeavor as the agency is faced with implementing a new direction for its human spaceflight programs, retiring the space shuttle, and balancing investments among its science portfolios. Our reports, as well as recent studies by the NRC and the JWST Independent Review Team, however, provide a map that can help NASA adopt best practices and more effectively manage investments. As stressed in our 2009 high-risk report, to maximize NASA's investment dollars, im-

[25] GAO, *High-Risk Series: An Update*, GAO–09–271 (Washington, D.C.: January 2009).

plementation of these steps needs to be complemented by vigorous executive leadership to foster the expansion of a business-oriented culture and a sustained commitment to identify and take action on projects that are not achieving cost, schedule, or performance goals upon which they were based when they were initiated.[26]

Mr. Chairman, this concludes our prepared statement. We would be glad to answer any questions that you or members of the Committee have at this time.

Senator NELSON. I thank all of you for your testimony and thank all of you for your public service.

Dr. Holdren, do you intend to follow the law in the NASA authorization bill?

Dr. HOLDREN. Absolutely, we are committed to following the law. The President signed it. The Congress passed it. We will follow it, and we will execute it and implement it to the best of our ability.

Senator NELSON. Dr. Robinson, as the Chief Financial Office, are you intending to follow the law?

Dr. ROBINSON. Most definitely.

Senator NELSON. I want to ask you about a statement that you made on page 4 of your testimony that would indicate otherwise. In speaking about the implementation, the following guidance to the Constellation program at the top of page 4, you note in the execution under the existing appropriations of the law that the following priorities have been in place since the June replan. And you go on to list avoid termination of prime contracts and continue development of critical capabilities. And then you list prioritize investments that support the initiatives under the 2011 President's budget request and the NASA Authorization Act of 2010.

The President's budget request is history. The law is now the authorization bill. So are you suggesting in this testimony that you intend to follow the President's budget request instead of the law?

Dr. ROBINSON. No, not at all. To us the end is very important. What we were trying to convey there is there are some elements in the Authorization Act which were discussed and presented in the budget. And so to the extent that there was guidance there and parameters, we wanted to make sure that the program was looking at those because that is the basics of budgeting. Right? We present a proposal and if you say yes, then you expect us to follow our proposal, and that is all we are saying there.

Senator NELSON. The reason I bring this up is exactly what Senator Vitter had raised in his comments, that there have been plenty of messages that have been sent to the overseers—which is this committee—that certain elements of NASA and other parts of the Administration intend to follow their own directions instead of the law. And as a matter of fact, you would lend to that by this statement. So I am glad that you clarified that for the record.

Dr. Holdren, how would you characterize the Administration's support for the entire Authorization Act?

Dr. HOLDREN. We support it wholly, sir. Again, you passed it. The President signed it. It is the law of the land. We intend to implement it. We support it. We are looking forward to working with this committee and the rest of the Congress in getting that done. We are looking forward to the additional guidance and the resources that will come with appropriations that will make it easier

[26] GAO–09–271.

to move forward rapidly with all of the elements of the Authorization Act. But we support it fully.

Senator NELSON. What direction have you as the Science Advisor to the President given to the agency to assure what you just said: the full, faithful, and timely implementation?

Dr. HOLDREN. I have spoken with Administrator Bolden, with Deputy Administrator Garver, with the CFO, the Honorable Beth Robinson, who is here with me, and we have had no trouble coming to complete agreement, that NASA is in full support of the law that has been passed and signed. And we will implement it. We are in complete agreement on that. I did not need to offer any particular further guidance because that was already NASA's position, but I have been very clear it is the President's position. I have been assured that it is NASA's position.

Senator NELSON. As you know, the President's initial proposal, as referenced by Dr. Robinson in her statement on page 4, as Senator Hutchison had said, was met with a great deal of resistance to some of its elements. I think part of it was in some cases a poor choice of words: the President's budget request, for example, utilizing the word "cancel" the Constellation program instead of using the word "redirect" the Constellation program. And it gave perceptions and impressions that did not reflect the President's true intention about a manned space program.

And yet, since then we have seen that some people, whether it be that or it be the question of the appropriations on the commercial crew program, whatever it was, feel strongly that the President's proposal was the only way to go. I think you have sufficiently given the authority as the President's Science Advisor what this committee needs now in stating that the President's signature on the law is now the President's proposal. And that is what we are going to proceed with.

Dr. Robinson, do you concur with what Dr. Holdren said?

Dr. ROBINSON. Definitely. We are very committed to moving forward on all aspects of the law. From our perspective, we are doing that. I regret if there have been any messages to the contrary because we are very excited at NASA about this new path and implementing as fast as we can.

Senator NELSON. Last June, a national space policy was articulated. It is broader. It has goals and objectives.

What do you think about—Dr. Holdren, is the Authorization Act that is now signed into law the new national space policy?

Dr. HOLDREN. Well, Senator, it is the authorization for NASA. It is the law, and we will follow it. As far as I can see, it is consistent with the national space policy which also, however, addresses some additional issues related, for example, to national security and homeland security and the role of space in that domain, issues that are not specifically addressed in the Authorization Act. I think these two documents coexist nicely.

Senator NELSON. Senator Hutchison?

Senator HUTCHISON. Thank you.

Let me say I am very pleased to hear both of you being very clear and very supportive, and that is what we all are looking for to go forward.

Let me ask Dr. Robinson. There is a specific part of the law which I will read. Section 101 of the law that passed this year states, after providing an authorized funding level for the space operations line: ". . . of which $1,609,700,000 shall be for the Space Shuttle to support Space Shuttle flight operations and related activities."

Further, in section 503 of the same law, it states: "The Administrator shall fly the launch-on-need shuttle mission currently designated in the shuttle flight manifest, dated February 28, 2010."

Finally, in section 503, it says: "Amounts authorized to be appropriated by section 101 shall be available for the mission authorized by paragraph 1."

So given that precise language, is it your understanding, Dr. Robinson, that the law requires NASA to conduct that mission subject, obviously, to safety certifications and that type of requirement?

Dr. ROBINSON. The law definitely does. The only caveat that I would put forth is that we still do not have the final appropriations. So we do not know if we have the money to carry it out. But it is NASA's complete intention to fly the third flight.

Senator HUTCHISON. But if we pass a long-term CR—we are not sure yet if it will be a short-term/long-term CR. But if there is the long-term CR and it would provide, as the Chairman has stated earlier, $18.7 billion at least, it would cover, given the priorities of the bill, that capability to go forward, which we will know in the next few weeks? I mean, time is running out.

Dr. ROBINSON. Right. Definitely. If we were operating on a long-term CR, we would have enough funding to fly the third flight.

Senator HUTCHISON. Thank you. Of course, the reason that we were so specific is that we are looking for the reports now on the needs of the station and trying to forecast any equipment, any kind of emergency capability that we might need to keep the station operative to fulfill the investment that we have made in it for research. So it is essential that we have that report so that we are able to know what is needed in the last shuttles because that will be our last chance.

Now, I would ask Dr. Holdren, as well as you, Dr. Robinson. If we are all on the same wavelength here, that we have got to get the report—and what we are hearing is that there might be an interim report, with the President's 2012 budget request. But we need a full-steam-ahead effort to determine what is going to be needed for the Space Station because we are moving up on the last two shuttles next year. So could I hear from both of you on your view of that priority and on the reports?

Dr. ROBINSON. We fully agree with you, and the reports are on track. I do know this is also an issue of the manifest that Space Operations Mission Directorate works consistently. And so we fully expect to have those reports up on time.

Dr. HOLDREN. Yes. I would just add I completely agree with what the CFO has just said. Certainly the future of the Space Station and how we manage that and how we provide for it is one of those areas where the President's initial proposal and the bill that is now law, the Authorization Act, are in complete agreement. We are completely with you.

Senator HUTCHISON. Well, I am pleased that the President does focus on the need to use the station for this purpose and has extended its capability or, hopefully, the use of it beyond the original end date that we had because, of course, there has been such a lag time in the development of the next crew launch vehicle and so we have to deal with that. But I think that going forward on a quicker timeline than was in the President's for the next vehicle so that we know we have that capability, hopefully, quicker is something that we have got to all work together to do.

Let me ask this. The holding back of funds that might be made available to begin the development for the space launch system and the multipurpose crew vehicle—obviously in our bill the highest priority is in the Exploration Systems Mission Directorate, ahead of things like space technology initiatives which the law clearly states are activities expected to be undertaken in later years.

Can you give our committee assurances that the Congressional intent to aggressively pursue immediate initiation of the space launch system and crew exploration vehicle development activities will be followed? Both of you—Dr. Holdren?

Dr. HOLDREN. Senator, we are going to follow the law. I cannot emphasize that enough. It is the law. We are going to follow it.

Dr. ROBINSON. I would further say we have already begun those efforts, the planning and design efforts.

Senator HUTCHISON. Thank you.

Thank you, Mr. Chairman.

Senator NELSON. Senator Vitter?

Senator VITTER. Thank you, Mr. Chairman.

I want to go back to this issue of the restrictive language in the continuing resolution from the 2010 Appropriations Act because I think if we really want to solve that problem, it is easily, easily solved. I think the almost certain next step, in terms of funding, is going to be another CR for some length of time. As the Chairman indicated, that would put NASA funding extremely close to what is outlined in our new Authorization Act, less than a 2 percent difference. In the grand scheme of things, that difference is trivial. So, therefore, for that next step, it seems to me it should be easy to all agree on clarifying language saying that anything from that 2010 Appropriations Act inconsistent with the new 2010 Authorization Act will have no force and effect, except the overall funding level which should not be a big deal to come down $300 million out of however many billion.

Given that the Authorization Act passed unanimously in the Senate and by a three-fourths vote in the House, it should not be a big hurdle to insert that language in a new CR. Maybe I am missing something, but if we are really trying to accomplish that, it should be a no-brainer.

Have you developed language to accomplish that for the new CR, and have you told Congressional leaders that the President absolutely wants that language included?

Dr. ROBINSON. We have developed that language. We have been working with staff on the authorization committees and appropriations committees. As you point out, it is a relatively simple matter in terms of legislative language, and we do fully support it at NASA.

Senator VITTER. As Administration policy, have you said the President absolutely wants this language included so that we can fully, without any restriction, accomplish the new Authorization Act?

Dr. HOLDREN. I cannot say for sure to whom that message has been communicated up until now because legislative affairs is not something I can keep track of to that detail. But certainly that message will be communicated if it has not already been communicated to the key folks.

Senator VITTER. Can you put that message in writing, and can I get a copy?

Dr. HOLDREN. Sure.

Senator VITTER. And can I get a copy of your drafted language that you think will do the trick?

Dr. ROBINSON. Sure.

Senator VITTER. OK, great.

I am a recovering lawyer. So that is dangerous. It seems to me it should be pretty simple, something like no language in the Fiscal Year 2010 NASA Appropriations Act inconsistent with the NASA Authorization Act of 2010, except the overall NASA funding level, shall continue to have force and effect. Something like that. Maybe that is not the perfect language, but something like that. Do you have any reaction to the general notion?

Dr. ROBINSON. That sounds like it would work. I think the draft that we have is more forward-looking, basically saying anything that is in the Authorization Act NASA is allowed to do, and we also remove the specific restrictions. It is a different approach. Same idea.

Senator VITTER. OK. Well, again, if you all could send me—and I am sure the others would like to see it—both the draft language and the letter to appropriate leadership, committee chairmen, stating that it is the Administration's position that this really needs to be included. Thank you.

And I would like to ask the folks from GAO if they have a reaction to that solution to the problem that your report highlights.

Ms. POLING. I think it is important that there be an anomaly in any continuing resolution so that there is no question that NASA can move forward, and the form that that takes—as you just discussed, there are probably many forms that it could take. You might also want to include in it that the no new starts provision of the continuing resolution also would not apply.

Senator VITTER. I mean, you can do it different ways, but my language would clearly cancel that out because that is inconsistent with the Authorization Act.

Ms. POLING. Perhaps, but you referenced it back to the 2010 appropriations which has its own set of restrictions. The continuing resolution has a different set of restrictions.

Senator VITTER. OK, good point. So we would have to include any language in the CR——

Ms. POLING. I think so, yes.

Senator VITTER.—that is inconsistent would not have force and effect.

Ms. POLING. Yes. You want to relate it back to both Acts and to the amendment that was passed in late July that also had to do with termination of contracts.

Senator VITTER. OK. Well, I just wanted to focus on this.

But let me underscore quickly I think we are going to have another CR. As the Chairman said, that funding level for the next Fiscal Year will be right about at where it is in the authorization bill. So this should be a simple task if we really all want to accomplish it. And so the proof will be in the pudding if it gets done. And so I look forward to getting that done in the next CR.

Thank you, Mr. Chairman.

Senator NELSON. And Senator Vitter, it is actually even closer. I was rounding it, the $300 million difference. It is actually a difference of $276 million. The funding level in last year's 2010 appropriations was $18.724 billion.

Senator Warner?

**STATEMENT OF HON. MARK WARNER,**
**U.S. SENATOR FROM VIRGINIA**

Senator WARNER. Thank you, Mr. Chairman. Let me start by thanking you for working with me and others on another, I think, critical piece of NASA's program, the commercial development side and the private sector side. And I was happy to hear in Dr. Holdren's comments a recommitment to that part of the program.

I wanted to make a couple of quick comments and then ask reflection from Dr. Holdren and Ms. Robinson.

It appears the commercial spacecraft side of the house seems to have accomplished quite a few milestones for basically small—less than $50 million so far in the commercial crew development. I was pleased to see today, for example, on a related—but something I think will dominate, I hope, all of our efforts going forward—that the President's Deficit Commission final report which in the preliminary report had said perhaps this investment in the commercial side of the house from the public dollars should not be included—that part was actually dropped out. So I think the Deficit Commission concurred with those of us who believe that the commercial side, both in terms of a viable, new worldwide industry for America to take a lead in and for more public/private partnerships with NASA—I think it is going to be a critical part of our space future. And I just want to—again, in recognizing that the Chairman helped build this into the 2010 authorization, I would like to get a couple of quick comments from Dr. Holdren or Ms. Robinson on that subject.

Dr. HOLDREN. Well, first of all, let me join you, Senator Warner, in welcoming the fact that the Deficit Commission dropped from their report that was just released, the proposition that this would not have been a good investment. We think it is a terrific investment. We think we are going to get great value for the money invested in terms of the future of a commercial space industry and the jobs and opportunities that will provide and, as I noted in my testimony, meeting at the same time a critical national need. So we are grateful that this element is in the authorization bill. We are grateful that the Deficit Commission did not put a bull's eye on it, and we are very optimistic about progress in that domain.

As you probably know, the SpaceX launch of Falcon 9 with the Dragon spacecraft is now scheduled for December 7. This will be the first time that a commercial craft has actually reentered, and we are very excited about it. We think that the industry has terrific prospects, and I agree with you that it has made a substantial amount of progress so far with rather modest resources. We are going to see a lot more progress.

Dr. ROBINSON. You also pointed to the commercial crew development effort that was begun last year, and I also just wanted to point out that the Authorization Act encouraged us to continue that effort in 2001, and we have done that. We are going out with another round of—to seek another round of proposals because we do think tremendous things came of that effort, and we hope it will continue in this year.

Senator WARNER. Let me raise one other issue with my remaining time which is a little off subject and candidly not an area that is a huge piece of the NASA budget, but that is the NASA aeronautics program. I am blessed to have a large piece of that in my state at NASA Langley.

But I would like a comment from you all, that it seems to me that one of the real growth areas again from an industry-wide standpoint is the development of a more fuel-efficient aeronautics program worldwide. I think no one sees a diminishment of the amount of air traffic. Obviously, in other parts of this committee, we have looked at the enormous needs we have to upgrade our aviation control system with NextGen, but actually redesigning 21st century airplanes in a more fuel-efficient way to my mind is one of the great next frontiers.

I would like, again, either one of you to make a brief comment on how you see the NASA aeronautics program. We saw a small increase in the authorization in Fiscal Year 2010. What kind of potential do you see for growth in that field?

Dr. HOLDREN. Well, first of all, I can only agree that there is tremendous potential in the domain of more fuel-efficient aircraft and the development of those. And there is also tremendous potential, as you have noted, in upgrading our national air traffic control system to a 21st century standard. NASA's role in advancing these goals is an important one, and we intend to pursue it vigorously.

Senator WARNER. And Mr. Chairman, I would just add that this is an area in which I think there has yet to be a hub. Whether this will be America leading the way or Europe or elsewhere on the development of next generation aeronautics and aviation I think is an open question. And I hope in this coming year we will get a chance to look at this issue more deeply and make sure that America takes an appropriate leadership role in this field.

Senator NELSON. And Senator Warner, you might note that there was a huge plus-up in the aeronautics part of this budget, some $422 million, which was a substantial percentage increase for the aeronautics. And of course, it all plays into the skies of the future, all the needs on upgrades that we are seeing there in the FAA.

Senator WARNER. Great leadership by the Chairman.

Senator NELSON. And Senator Hutchison.

Senator WARNER. And Ranking Member.

Senator NELSON. My colleague, Senator LeMieux.

**STATEMENT OF HON. GEORGE S. LEMIEUX,**
**U.S. SENATOR FROM FLORIDA**

Senator LEMIEUX. Thank you, Mr. Chairman. Thank you for holding this hearing. Thank you all for being here. Thank you for your public service.

As I know you know from my colleague from Florida, these issues of NASA are very important to our state, and it is a very emotional issue because where America first reached for the stars was from Florida. And we have this huge investment in our communities in the space coast, and we have a lot of folks now who are worried about losing their jobs and who will be losing their jobs in an area that is already economically depressed.

When I first came to the U.S. Senate and learned sort of the process, it gave me a lot of consternation about where we are with manned space travel. And it was described that the Constellation program was vision without funding. And it occurred to me that the Administration's original proposal was funding without vision. But we came to a consensus on this committee, and with the good work of the people on this committee, we came to this authorization bill. It is not my first choice. I would have liked more, but it was a good consensus-building product I think.

Now, I have read—Madam CFO—I have been reading your statement, and I am concerned that Congress has gotten in the way of you implementing this bill. You have made very positive statements today, all of you, about you are going forward, it is the law of the land, and you support it. But in your testimony on page 2, specifically in points 4 and 5—5 goes over to page 3—you talk about the fact that because an appropriations bill has not been passed, that you are continuing to apply the previous appropriations bill. Now, I want you to tell us, because of the failure of Congress to act, what have you not been able to do to move forward on the authorization bill that was passed and signed by the President.

Dr. ROBINSON. There are a number of ways to look at it. One is that there is a tremendous amount of uncertainty, and there is uncertainty about what our legal basis is to move forward with specific authorized efforts, and we are working through that. And without clarity, it is a long task to be able to buttress that, the argument that we can move forward.

Also, the funding levels. In the various acts, we have seen different funding levels, and so there is uncertainty around that and then also, of course, whether or not there will be reductions taken further from those bills or even further in a full-year CR.

And so in that kind of environment, it is just very difficult to put your foot firmly on the path and start walking because you are still trying to make sure that you are going in the right—that you will have the resources to get there. And so it is mainly that, that just puts a damper on the system from being able to move forward quickly.

Senator LEMIEUX. Can you give us some examples of things that you cannot do because the funding is in question?

Dr. ROBINSON. We have moved forward in select areas. The real issue is not whether or not a specific activity is one we can pursue. It is how much we can pursue it. For example, will we get funding

at a specific level for heavy lift? What will that funding level be? You will have a different program if you start out at a different funding level in the first year and thereabouts. And so it is not a specific activity. It is more you just cannot finalize your plans until you have the overall funding and other terms and conditions set so that you can move forward.

Senator LEMIEUX. Dr. Holdren, can you speak to this topic?

Dr. HOLDREN. Well, I guess I cannot speak to it as accurately or with as much information as CFO Robinson can do. I am the Science and Technology Advisor. I cannot really speak to the details of the constraints of existing legislation and lack of appropriations on exactly what NASA does. I think that expertise resides both to my right and to my left.

Senator LEMIEUX. Well, it is my hope that this will get resolved and the language that Senator Vitter proposed or others have suggested can get done. It seems time and time again this Congress' dysfunctionality and failure to move on things is causing paralysis out in the world. And for my colleague from Florida and I, this is a big issue because this is not just an abstract issue and it is not just manned space flight which is an essential part of being exceptional in this country, all important things, but it is people's lives. There is an article today from the *Orlando Sentinel* about NASA's human space flight program, that it is adrift. You know, there is all this uncertainty. What is it going to mean for the people of our state?

So working with Senator Vitter, with the Chairman, with our Ranking Member, and others to get this done, helping us get this done I think is very important. So I appreciate your statements today that you will do that.

Thank you very much, Mr. Chairman.

Senator NELSON. Senator Cantwell?

**STATEMENT OF HON. MARIA CANTWELL,**
**U.S. SENATOR FROM WASHINGTON**

Senator CANTWELL. Thank you, Mr. Chairman, and thank you for holding the hearing and the witnesses for being here and their input on these important issues.

I want to bring up the issue of solar electronic propulsion demonstration with you, Ms. Robinson, if you could. The NASA Reauthorization Act calls for a balance between human spaceflight using and building upon existing capabilities and then investing in new capabilities. One such technology is solar electronic propulsion.

So what is the current status of the research on that, and how much is NASA budgeting for that demonstration in the next 5-year time window, 2011 to 2015?

Dr. ROBINSON. Well, I will have to get back to you on the specifics of how much we are spending now and how much we have carved out in the future lines. Again, given the uncertainty that we have, some of the lines that would support solar electric propulsion are the ones that are most in question.

But NASA is very excited about that technology and is pursuing it in a number of laboratories and certainly in a concerted research effort. That was one of the technologies that we want to bring for-

ward and bring to a higher technology readiness level so that we can start demonstrating its effects.

Senator CANTWELL. Well, it obviously factors into the human exploration framework team for space missions.

Dr. ROBINSON. Right.

Senator CANTWELL. I guess a budget number is what we are really after for Fiscal Year 2011 to Fiscal Year 2015.

Dr. ROBINSON. We will do that for the record.

Senator CANTWELL. Great.

Another thing that is of lots of interest, I think, across the country is the site selection process for the retired shuttles. Obviously, the NASA Authorization Act of 2010 stated that these space orbiters shall be available and located for display and maintenance through a competitive process. Could you describe for the Committee what that competitive procedure or process is and what is being undertaken?

Dr. ROBINSON. Well, the process that we have at NASA—it will be the Administrator's decision where the orbiters go. We have put out several requests for information. We have been contacted. It has been wonderful. We have been contacted by hundreds of potential applicants, and we have been looking—the team, which I am not on, but the team has been looking through and evaluating those proposals from potential museums and sites as to some of the key factors that the authorization bill and other places have stressed for us in terms of how many students can see it, do people around the country have access to them. And so that evaluation is ongoing.

Senator CANTWELL. When you say a team, is that a site selection committee?

Dr. ROBINSON. No. It is just a team that is looking at the information and advising the Administrator.

Senator CANTWELL. And so what will the Administrator make his decision on?

Dr. ROBINSON. He will make his decision based on several criteria that have been set forth and talked about in the request for information. I will have to get those for you for the record. I cannot list them all.

Senator CANTWELL. And is there going to be geographic diversity as part of the consideration?

Dr. ROBINSON. That is part of the consideration, yes.

Senator CANTWELL. Will the White House be involved?

Dr. ROBINSON. We will have to get back to you for the record. I am not involved in the process. I do not believe they are. It is the Administrator's decision.

Senator CANTWELL. Well, I think there are a lot of different people who are very interested in this, and I think the RFI has stipulated that $28 million was required to be interested. Anyway, I think there are lots of different changing things here, and I think what people are looking for is a process that people really understand, that it is transparent, that people know what the requirements are, and if the Administrator is going to make the decision and on what basis is the Administrator going to make the decision. So if it is not an official RFP with a site selection process and it is just advice, a little more framework—obviously, communities like

ours have already built an entire infrastructure around the public access to our space and flying history and obviously would like to build on that further, but certainly want to understand that the western part of the United States is not going to be overlooked in the assets that it has brought as part of this history.

So anyway, I mean, is NASA considering the Smithsonian for one of these sites?

Dr. ROBINSON. As regards to the Smithsonian, the Smithsonian has the right of first refusal.

Senator CANTWELL. Why do they have the——

Dr. ROBINSON. Why? Because they are the—I do not actually know the term of art, but they are the nation's—it is an MOU. It is a Memorandum of Understanding with them. The orbiters are one class of NASA artifacts that we have interacted with the Smithsonian. If you go to the Air and Space Museum, you see lots of NASA hardware, and so we have an ongoing MOU with them.

Senator CANTWELL. Are they required to pay the $28 million?

Dr. ROBINSON. Yes. At this point, yes. NASA does not have the funds to cover transportation and making the orbiters ready for using them in public exposure.

Senator CANTWELL. OK. Well, I will look forward to more specifics about how the Administrator is going to make the decision. Thank you.

Thank you, Mr. Chairman.

Senator NELSON. Thank you, Senator Cantwell.

Dr. Robinson, you say in your testimony that, "to best manage workforce impacts, the shuttle program needs to confirm approval to add the third shuttle flight, STS–135 mission, by December 2010." Well, we are at December the 1st today, and given the Administration's emphasis that we want to supply and equip the International Space Station, can you tell me where NASA is in the approval process for that third shuttle flight?

Dr. ROBINSON. As I said, we have every intention of flying that flight. With the continuing Continuing Resolutions, we still have some uncertainty about the ultimate funding level, and we are trying to quantify what it means to hedge our bets, in other words, in case there is a drastic change in funding level. But we have every intention of moving forward on that.

Senator NELSON. Do you concur, Dr. Holdren?

Dr. HOLDREN. I do. The only challenge would be is, as Ms. Robinson just indicated, if there were a funding level drastically different than the one we have been talking about here. That would clearly pose challenges. But as we have stated here already, we are committed to fly it and with the funding levels that have been discussed here, we will certainly be able to do so.

Senator NELSON. Back to the issue of implementing the law, you all in NASA already have a general counsel opinion on implementing two parts of the authorization law: one, space technology; and two, commercial crew. And you have a legal opinion that says that you can pursue that. The question is, why do we not have a legal opinion on pursuing the part of the new authorization law on the Space Launch System, which is the heavy lift vehicle, and the multipurpose vehicle, which is the crew capsule?

Dr. ROBINSON. Well, as I referred several times here, it is a lengthy thing to generate these opinions. We actually have a third now. We have a third for the ISS NGO, the nongovernmental organization, that will be doing the research which was authorized in the act. So they have cleared that too.

I think the issue of priority was which program needed clarity first, and space technology was driven primarily by the cycle for graduate students, that they wanted to be able to tell potential graduate students that there would be funding available for that graduate program. I already know that they are working on the one for heavy lift and the Orion Multi-Purpose Crew Vehicle.

The other thing about those activities is that they have been able to go forward with a whole host of things that are just in line with setting priorities among the Constellation activities and have not really needed any buttressing to be able to make progress, and that is the only reason that they were further down in the list.

Senator NELSON. Do you know when we might expect those legal opinions to be produced on those two items?

Dr. ROBINSON. I do not know exactly when, but I know they are working them as we speak.

Senator NELSON. Dr. Holdren, I want to come back to this theme of consensus building. The perception of the President's position did not, in this Senator's opinion, do justice to the President in the way that the budget was rolled out on the President's budget for NASA. And in order to avoid the disaster of that perception in that budget rollout, can you express to this committee the intent of collaboration between the Congress and the Administration and the Agency to be improved as we are now looking to next February in the rollout of the next President's budget which is the 2012 budget request?

Dr. HOLDREN. The short answer, Senator, is yes. The slightly longer answer in support of that is that I think we are in a much better position now with the Authorization Act passed and signed by the President giving direction. This provides a basis for our consultations and collaboration going forward, which I think will be very beneficial, and it is certainly our intention to collaborate and cooperate with this committee and others in the Congress as we move toward a Fiscal Year 2012 budget proposal.

Senator NELSON. So, is the new law being incorporated into the Fiscal Year 2012 planning process of the budget?

Dr. HOLDREN. Of course, it is. It has to be. There is no way that we could meaningfully think about the 2012 budget without taking into account the guidance of that legislation which is now law.

Senator NELSON. And in the spirit of collaboration, of which there has been some paucity in the past—and I refer back to specifically the previous budget—are you going to seek—and by the way, the paucity is not directed at you personally, but you are the Science Advisor. And so my question is, will you seek Congressional input before the rollout of that budget in February?

Dr. HOLDREN. Well, sir, again the answer is yes. And as you will recall, even in the circumstance of the 2011 budget, you and I met on a number of occasions to discuss the priorities and the issues there. I met with Senator Vitter on one occasion to discuss issues around the space program and the budgets going forward. So I

would not quite agree that there was—there may have been a paucity in the sense that it was not sufficient, but there was consultation before and there will be more consultation going forward.

Senator NELSON. Well, it was certainly insufficient in the rollout of the budget with the use of the words "cancel the Constellation program" because that was not the intent that the President was trying to convey. And that is why I keep harping on the issue of collaboration.

Dr. HOLDREN. We will do better this time.

Senator NELSON. Senator Hutchison?

Senator HUTCHISON. Could I be added to your list of people with whom you consulted?

Dr. HOLDREN. Yes. I did also consult with Senator Hutchison. That is true. I apologize for omitting that.

Senator HUTCHISON. All right.

I think the point is that we would like to all be on the same page because it will just be more expedited if we are. I think you all have been forthcoming and I appreciate it very much. Just know that if we can all agree on language and all put our collective weight behind getting it into the CR so that we can move forward—we need the design to be done so that we can fully fund that because it is our highest priority in order to shorten the gap that we would have to depend on Russia to get our people into the Space Station and, second, to fully utilize the Space Station. So I think that going forward, we just have to collaborate right away on the CR language that would satisfy all of the potential legal hurdles to going full force toward the design of the next launch vehicle with the crew capsule.

Dr. HOLDREN. I agree.

Senator HUTCHISON. Thank you.

Senator NELSON. Senator Vitter?

Senator VITTER. Yes. Just as a quick follow-up to something the Chairman mentioned, Ms. Robinson, the three opinions that you have—were those three activities all activities included in the President's budget proposal and submission plan?

Dr. ROBINSON. Two of them definitely were. The commercial crew one—they were cleared to do a different activity than what was proposed in the President's budget. It was not the full-up crew activity that was proposed there.

Senator VITTER. But he certainly had a lot of commercial activity in the budget that was similar or consistent.

Dr. ROBINSON. Yes.

Senator VITTER. Well, my point is simply this. You have three opinions. They are all basically about activity that the President wanted as reflected by his budget submission. You have no opinions yet about the changes Congress made. That is sort of a perfect example of the sort of thing to date that has us skeptical and concerned, and that is what really needs to change so that we come together around what is law and move forward aggressively around every aspect, not just certain favored aspects about what is law.

And I think this CR language discussion is very useful. First of all, it is the next step in terms of what we all need to accomplish. Second, I think it will be a very useful test. I mean, if the Administration wants that to happen, it will happen. If the Administration

is not committed to really coming together and aggressively implementing the new authorization language, it will not happen. So I consider it an immediate and useful test because it should not be difficult, particularly considering the President's leverage of—in any CR discussion it should not be difficult to accomplish. So I am certainly hopeful it will happen and we will see.

Thank you.

Senator NELSON. Do not worry, Ms. Chaplain. We are going to get to you.

Dr. Robinson, if we are under a CR at the 2010 funding level which was the $18.724 billion level, what recommendations would you provide to the Administrator of NASA for the necessary $276 million funding reduction from what was authorized in the NASA bill, which is $19 billion?

Dr. ROBINSON. Well, the Administrator has already considered that, and he decided that the best place to take that money would be the 21st Century Launch Complex Initiative for 2011. The fact that we are already a quarter in—the fact that the bulk of that money is being spent on things like construction and things like that, we thought that it would be difficult at this point, once we get clearance, to actually obligate all that money. And so he wanted to take the reduction there with the thought that we would make it up later.

Senator NELSON. Even though some of those projects are already underway?

Dr. ROBINSON. No. Some of the projects are definitely underway, but for the full $429 million program, all of that is not planned and underway.

Senator NELSON. By that, is the implication of your answer that you would pick up that full funding for the 21st century launch center in fiscal year—it would be 2012, starting in October of 2011?

Dr. ROBINSON. Right. The commitment to that initiative is, I believe, $1.9 billion over 4—5 years. And so we would rephase it. We would look and see when we needed to obligate money for the various projects, but that would be our intent if NASA is blessed with having the funding levels continue in the out-years.

Senator NELSON. Well, if you would pass on to the Administrator that I would like to know the specifics of that. One of the President's major goals that he stated in the speech down at the Kennedy Space Center is that in order to be able to have the NASA of the future, you have got to modernize the facilities that in fact are used to launch the space vehicles. And that we cannot lose any time on. So I want to see the implementation of what the Administrator would be proposing there.

Dr. Robinson, how would the agency prioritize the funding cuts if they are more dramatic?

Dr. ROBINSON. Well, I have agreed we will look to the Congress to provide us guidance on how to do that. For example, one level that is talked about is the 2008 funding level which for NASA was about $17.4 billion, a $1.6 billion cut from the numbers that we have talked about. We are already a quarter into the fiscal year basically, and so it is even more of a magnitude cut for the remainder of the year. And we would have to look very hard at places where we could instigate those kinds of savings on that kind of timetable.

It would be a truly drastic situation at that point and we would be looking to be able to share the expenses wherever we could. But most of our programs are long-term. Most of them have long-term contracts, and so we would be limited in many different areas to implementing a cut that quickly.

Senator NELSON. You have heard this recent Casani report, and Dr. Holdren, I will ask this to you as well. It documents the major financial problems with the James Webb Space Telescope. It is going to cost more money, and it is going to add another year to the development on a schedule for a launch somewhere around 2014. So how is NASA responding to the reports, and will the funds from other programs have to be shifted to allow the telescope to move forward in a timely manner? Dr. Holdren?

Dr. HOLDREN. Well, I would start by saying that I was certainly very disappointed to read the findings of the Casani report indicating the dimension of the problems with the James Webb. We think the James Webb is a very important component of our ability to understand the universe going forward. It is a very important successor to the Hubble. And given its importance and given the difficulty that we now understand that program is in, I can assure you that a very hard look is being taken in NASA at how those challenges are going to be addressed and ameliorated. It is possible that CFO Robinson can add something about that process that is going on, but I know from my own direct interactions with Administrator Bolden that this is now a very serious focus of his attention.

Dr. ROBINSON. I wanted to add to that too that when we all read the Casani report, we were heartened to see that the program is making its technical milestones, but from a budgeting and planning perspective and a lot of the work that we have done with GAO, it simply had not followed those. It was somewhat shocking actually that it had just not followed the normal NASA procedures. And so we are taking a look at that.

The Casani report gave us a parametric look, a broad scale look at the money that was going to be needed. Also, they were looking at the quickest route to get there which would involve changes this year. Of course, we are already a quarter into this year and we are unlikely to be able to implement increased funding this year to the level that Casani was recommending earlier. And so we are doing a bottoms-up analysis trying to get a more detailed cost estimate, looking at the phasing in the budget for that program, and we will be presenting more details in the 2012 budget.

Senator NELSON. If the newspaper accounts are accurate that I have read, this could be a hit of something like $200 million in 1 year in order to make up for the deficiencies in the telescope project. Is it the position of the CFO to recommend to the Administrator a place to take that $200 million if that is the Administrator's decision?

Dr. ROBINSON. The way we do this at NASA is a very collaborative effort. The Science Mission Directorate, which owns JW and a whole host of other programs, will be looking hard at that funding profile. The Casani report was about $200 million a year. So that is in line with what they said. And we will just have to do an

analysis throughout the entire budget of where to make those kinds of changes.

Senator NELSON. Ms. Chaplain, could you comment on behalf of GAO on this Casani report?

Ms. CHAPLAIN. We were very disappointed to see the findings of the report. In my own mind, it kind of has to re-baseline my thinking about the improvements NASA has been making because we have been hearing for several years now that we have a plan, we are trying to incorporate those practices, we are trying to reflect them where we can. And James Webb was actually one program where you did see those practices reflected in the technology development portion of it. But then to have this kind of news come out so late in the game after so much has been spent is very disconcerting and disappointing. I think NASA really needs to pay attention to the report and really examine the accountability processes it has, the oversight processes it has to make sure they are the most effective as possible.

Senator NELSON. And this was at the same time that NASA got some good news that it achieved a qualified opinion from the auditors for the first time since 2002. So, Ms. Chaplain, what issues does NASA need to address in order to continue this forward progress?

Ms. CHAPLAIN. I think NASA is making good progress on the financial statement side of things and the accounting side of things. I think where progress really needs to be made is translating the good practices that are embedded in their policies and procedures into real decisions and getting more insight into programs early in their development. In the case of James Webb, we will not have official cost estimates or a lot of information until they have been in development for quite a long time, years maybe. So the more we could have some insight up front to see if programs are really being set up for success and we have more indicators about whether management reserves are sufficient or not and have more insight into things like cost estimates, the better off everybody will be because we can see what kind of path a program is headed down. So it is a matter of gaining more insight up front and also getting more accountability and attention to actually implementing the policies that are on paper.

Senator NELSON. Your written statement, Ms. Chaplain, puts emphasis on the design stability prior to proceeding. The new law adopts a proven heritage approach to development of the new launch system which requires maximum use of design elements with a large body of experience and knowledge behind them. Do you think that if the law is implemented by NASA in this way, that it is going to contribute to an increased chance for a successful space launch system development?

Ms. CHAPLAIN. I think there were a lot of good practices reflected in the authorization, including an emphasis on evolutionary development. That way you are putting off some of the more challenging and costly aspects to later on, relying on heritage, as you said, encouraging earlier design knowledge than would normally be attained, and also scaling requirements to a minimum and being flexible.

That said, I still have concerns when I see any effort like this. There is a tendency across NASA and, as you know, the Air Force, to consistently underestimate—or overestimate—how much heritage technology you can actually use in your next project. So while it seems like we can use a lot of the stuff that is already around, we do not always have realistic estimates of the engineering and integration needed to make that happen.

Also, when we have dates set out in a bill or anywhere else that are kind of set out there in stone, you have to be careful because sometimes it can encourage an agency to take higher risk development paths. They may do more concurrent development. They may skip testing and things like that if their progress is not going well. And that is why it is just very important to have a lot of insight into the progress NASA is making. Do not just accept what they tell you up front about what can be done and not done. You really have to have checks along the way to see what is that progress, is what they are saying really happening, and get back the knowledge that you need about technology design, production, and all those other issues.

Senator NELSON. We were pressing for a focus on transparency and accountability, and that has certainly been the theme of a lot of your recommendations. And that is what we were looking for in section 309 of the law. It is a reporting requirement on launch vehicle design and development, both for the initial launch system design and the subsequent annual reporting requirement. We anticipate an initial 90-day report to result in what they call a baseline program.

What else do you believe that we as the oversight committee should be looking for to ensure the transparency and accountability?

Ms. CHAPLAIN. I think as the program proceeds, you probably want to get knowledge indicators, things like technology maturity readiness levels, design stability readiness levels. It is one thing to have an architecture kind of laid out in the beginning, but as the program proceeds, you actually want to see the number of design drawings that are releasable so you can see the progress the program is making on that.

Also, you need to look at things like management reserves, the funding that is available to the program, and things just like how is the contract working. In the Constellation program, the contract was undefinitized for a very, very long period of time, meaning a lot of things were still in flux and you could not set baselines down early on to manage contractor progress. So there are a lot of just key knowledge indicators that I think are typical in any type of review of a program that you want to keep following as the program proceeds.

Senator NELSON. Senator Hutchison?

Senator HUTCHISON. Thank you all very much.

Senator NELSON. Yes.

Senator HUTCHISON. This has clarified a lot and I think we can all go forward now very productively. Thank you.

Senator NELSON. To put it in the vernacular, we can all get hitched up in a harness all pulling in the same direction. What is at stake is very, very important, and that is the future of our

American space program. And we are at a critical juncture here for everybody that has helped us get to this point, which I believe the President is—this is his vision for a vigorous space program, both human and robotic. So, I hope we have brought to light some clarity on the future direction as a result of this hearing.

And with that, the hearing is adjourned, and thank you.

[Whereupon, at 12:14 p.m., the hearing was adjourned.]

# A P P E N D I X

## PREPARED STATEMENT OF HON. JOHN D. ROCKEFELLER IV, U.S. SENATOR FROM WEST VIRGINIA

The NASA Authorization Act of 2010 was signed into law nearly two months ago. The bill was the culmination of a spirited year-long debate between members of Congress, the Administration, the space community, and the American public on the future of America's space agency. We were able to find a sensible center, and the resulting bill signed into law will help refocus and reinvigorate NASA, while making key investments in aeronautics, science and human space flight missions.

For this achievement, I again want to thank my Committee colleagues—the Committee's Ranking Member, Senator Kay Bailey Hutchison, and the Science and Space Subcommittee Chairman, Senator Bill Nelson—who worked day-in and day-out to get this bill passed and sent to the President's desk.

Passing the NASA Authorization Act of 2010 into law was the first step. We're now in the implementation process. This transition is an opportunity to chart a clear course forward for NASA, but we must remain vigilant to ensure implementation throughout the authorization period. Objectives must be achieved in a fiscally responsible manner. I intend to fully exercise this committee's oversight role throughout the transition and implementation of the NASA Authorization Act.

With proper implementation of the law, I believe NASA can continue to lead the world in innovation and discovery, and inspire future generations of scientists. Dr. Holdren, the Director of the Office of Science and Technology Policy, joins us today to discuss these opportunities, as well as the Administration's plans for implementing the NASA Authorization Act. Also joining us is Dr. Beth Robinson, NASA'S Chief Financial Officer. This is Dr. Robinson's first time testifying before the Committee since her confirmation hearing.

I have made my concerns about NASA's fiscal and program management clear. At the first hearing we conducted on NASA this year, I stated that I wanted strong financial accountability from NASA's Chief Financial Officer. Dr. Robinson, you have been on the job now for just over a year. I look forward to hearing what advice and options you have provided to the NASA Administrator, and what actions you have taken to strengthen the agency's financial management.

Finally, we have two experts from the Government Accountability Office here today. Ms. Cristina Chaplain, Director of Acquisition and Sourcing Management, and Ms. Susan Poling, the Managing Associate General Counsel, will provide guidance on how NASA can improve its financial and acquisition management to ensure effective implementation of the NASA Authorization Act.

I want to thank all of our witnesses for being here today. I look forward to your testimony.

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## RESPONSE TO WRITTEN QUESTIONS SUBMITTED BY HON. KAY BAILEY HUTCHISON TO HON. JOHN P. HOLDREN, PH.D.

*Question 1.* I have long believed that in the operations of the government, the national policy should serve to drive the allocation of resources. The Budget should *not* drive the policy. Certainly, there are times of limited resources—I am one who believes the government should always be the consumer of limited resources—but that is one of the considerations that policymakers must take into account in defining the policy. All too often, it seems, we have seen the Office of Management and Budget drive the policy for the U.S. Space Program. As the Director of a White House Policy office, how do you view the distinction between policy and budget?

Answer. As you indicate, budgetary issues must be considered in a careful and realistic way by policymakers, and the same is also true in reverse. One cannot take a linear approach to these considerations, that is to say, considering policy before budget or budget before policy. Instead they must be addressed concurrently, in an integrated manner, in order to identify a stable and achievable plan.

*Question 1a.* Did OMB, for example, have to review and approve your testimony before this Committee today?

Answer. As you are aware, the Office of Management and Budget (OMB) Circular A–11 requires all budget-related materials to be reviewed by OMB. This guidance applies to testimony before Congress as well.

*Question 2.* As you know, the past 9 months has seen a vigorous debate regarding the correct "policy" for moving forward with human space flight programs in this country, whether government, commercial, or some blending of both. The NASA Authorization Act of 2010, agreed to in principle by the President, as communicated to the Chairman of this Committee and others before we marked up and reported that bill, established what was clearly a compromise among the many diverse views on that subject. The President signed that Act into law. In your view, does that unqualified signature represent, in effect, the President's agreement with—even his adoption of—the policy embodied in that law as the new policy of his Administration?

Answer. I believe the President's signature demonstrates the Administration's strong support for the NASA Authorization Act, which will help put the nation on track for an ambitious and sustainable future space program.

*Question 3.* What have you done to ensure that your relevant deputies, chief of staff and supporting staff have a clear understanding of the President's acceptance of the direction provided by the NASA Authorization Act of 2010?

Answer. I have communicated clearly to my staff, and also with NASA's senior leadership, that the Administration is committed to following the law in pursuing these and all other programs, as I have previously stated.

*Question 4.* What would your response be to information that any member of your staff were acting in a manner contradictory to that direction?

Answer. I would work with my staff to address such a situation and correct any misunderstandings or errors.

*Question 5.* There appears to be a focus only on implementing those portions of the law that were a part of the President's request. That was not the expectation of this Committee in accepting those portions of the request as part of the authorization bill. In fact, the Committee—and the Congress—placed a higher priority through numerous expressions in the act of moving forward quickly on the development of a new replacement set of vehicles for the Shuttle. What steps will you take to ensure the full intent and purposes of the Act are carried out?

Answer. I believe the Administration and Congress share the goals both to assure timely U.S. access to the International Space Station after the retirement of the Space Shuttle, and to swiftly assure a worthwhile beyond-Earth-orbit human spaceflight and exploration program that initiates a new era of discovery for the next generation in a cost-effective and timely manner. I am confident that NASA will implement its programs consistent with these goals, and both I and my staff intend to continue coordinating with NASA regarding these activities going forward.

*Question 6.* Timing is one of our significant enemies in the situation in which we find ourselves. The Administration is already pulling together the content of the FY 2012 Budget Request. We expect it will be rolled out—this time with a markedly improved pre-briefing to the Hill—in early February. Yet we are being told we may expect to see only an interim report on the design for the Space Launch System by the middle of January—and that, in fact, the target date for completion of three studies currently underway is mid-February—*after* the FY 2012 Budget submission. The Congress has made it clear we need to begin immediate development of the Space Launch System. . . . . As a reference point, I note that the Administration indicated it would offer an amended budget request for Exploration Systems when you released the FY 2010 Budget Request with the requirement for the Augustine Report. In the end, you did not do that, and chose to come back, instead, with the FY 2011 request which ultimately was unacceptable to the Congress. Can you commit to us today that the Administration will be willing to offer an amended budget request for this portion of NASA to reflect the needed funding levels for expeditious development of the Space Launch System?

Answer. The President's budget will be released on February 14, and we look forward to working with you throughout the budget process. Any amended budget request for NASA, or any other agency for that matter, would be transmitted by the President.

RESPONSE TO WRITTEN QUESTIONS SUBMITTED BY HON. DAVID VITTER TO HON. JOHN P. HOLDREN, PH.D.

*Question 1.* During the hearing, I requested copies of two items to be provided to myself and to the other members of the Committee:

> a. A copy of a letter from the President or a senior official within the White House to the appropriate Senate and House leadership, stating the Administration's support for clarifying language in any FY 2011 appropriations legislation to remove any constraint from initiating full and active development of the Space Launch System and Multi-Purpose Crew Vehicle, as provided in P.L. 111–267, and
>
> b. A copy of the draft language that would accomplish the above objective, which Dr. Robinson said had been prepared.

I received a letter from you dated December 7,* addressed to me, stating the support of the Administration for clarifying language, and noting that such language had been forwarded to the Congress requesting government-wide permissive language to initiate new programs. That letter will be included for the record. However, to date, I have seen neither the language referred to by Dr. Robinson in that conversation, nor the language mentioned in your referenced letter as having been sent subsequent to the hearing. Nor have I received a copy of any communication to the appropriate Senate and House leadership requesting consideration of either set of language. Can you please provide these materials for the hearing record?

Answer. I was pleased to send you the referenced letter regarding the Administration's support for clarifying language on new FY 2011 programs under a CR. Further, as I indicated in that letter, quickly advancing the new initiatives reflected in the Act is a goal we share. As is custom, the Administration provided informal technical assistance to the Appropriations Committees to assist them in drafting the CR. There is no official public list. With respect to your request of Dr. Robinson, I must refer you to her and to NASA Administrator Bolden.

*Question 2.* As you know, in the end, following the hearing, neither the proposed omnibus appropriations or the "instructional" Continuing Resolution were adopted, both of which did include the necessary clarifying language, and a relatively "clean" CR was adopted to fund the government through March 4, 2011. There will then be another opportunity to address this issue with a request for clarifying language as the Congress considers a successor to the current CR prior to March 4, 2011. Please provide both the assurance that the Administration will pursue the required language change, if still deemed necessary, as well as supporting correspondence and documentation.

Answer. As I noted to you in my letter of December 7, and as you quote immediately below, making immediate progress in advancing the goals and requirements contained in the 2010 NASA Authorization Act is a goal we all share. That is and will remain a fundamental priority of the Administration.

*Question 3.* In the letter referenced above, there appears to be a discrepancy between part of the content and statements made by Dr. Robinson during the hearing. Specifically, the letter states:

> "Making immediate progress in advancing the goals and requirements contained in the 2010 NASA Authorization Act is a goal I believe we both share. However, as both you and the U.S. Government Accountability Office noted at the hearing, the FY 2010 NASA appropriations contains limitations on the transfer of funds from certain programs, and also contains limitations on using funds to 'create or initiate a new program, project or activity, unless such program termination, elimination, creation, or initiation is provided in subsequent appropriations Acts.'"

During her oral statement, Dr. Robinson stated, with respect to the appropriations restrictions and limitations noted in your letter:

> ". . . we have not yet found anything in the Authorization Act on which we cannot proceed, but we are not done with our analysis, this unfortunately lengthy analysis, and we are working the issue daily. However, there are some areas in which we can clearly proceed. For example, planning efforts for the heavy lift and multipurpose crew vehicle activities, both authorized in the act, are proceeding and are assessing the transition from the Constellation efforts to the new programs."

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*The letter referred to is printed at the end of the appendix of this hearing.

There appears to be a difference in interpretation between these two statements and their representation of whether the FY 2010 appropriations language is, in fact, an impediment to moving forward with the "redirected" program. Note my use of that term, or the term "modified" which would be equally applicable; neither of which were included in the restrictions put in place by the appropriators before the Congress had completed its consideration of the FY 2011 Budget Request. Could you explain the precise situation as you see it, and whether or not NASA is in any way being hampered in moving forward with implementation of the Act in the current appropriations situation?

Answer. My letter to you accurately reflected the views expressed by both Members of the Committee and the U.S. Government Accountability Office on this subject, *i.e.,* that some restrictions were in fact in place and that these restrictions could be an impediment to significant progress for various programs. I was pleased, as I am sure you were, to hear Dr. Robinson describe what is apparently a deliberate, case-by-case approach to assessing how or if one of those limitations—that on "new starts"—applies to the initiatives of the 2010 NASA Authorization Act, and that perhaps the actual impacts of that restriction will be more limited than initially feared in many cases. In this context, it appears that NASA is able to move forward productively in several efforts, but I must defer to Administrator Bolden and his legal experts on the specifics.

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RESPONSE TO WRITTEN QUESTIONS SUBMITTED BY HON. ORRIN G. HATCH TO HON. JOHN P. HOLDREN, PH.D.

*Question 1.* Dr. Holdren, in your testimony before the Commerce Committee you stated "We are committed to following the law [the 2010 NASA Authorization Act]. The President signed it. The Congress passed it. We will follow it and we will execute it and implement it to the best of our ability."

a. Will the Administration and NASA fully, faithfully and timely implement the provisions of the 2010 NASA Authorization Act, including Sections 302 and 304 which, in part, direct the agency to build a new heavy-lift Space Launch System with the following minimum capabilities?

- "The Space Launch System shall be designed from inception as a fully-integrated vehicle capable of carrying a total payload of 130 tons or more into low-Earth orbit in preparation for transit for missions beyond low-Earth orbit."
- "Priority should be placed on the core elements with the goal for operational capability for the core elements not later than December 31, 2016."
- In developing the Space Launch System, NASA "to the extent practicable, [will] utilize existing contracts, investments, work force, industrial base, and the capabilities for the Space Station . . . *Ares 1* projects, including . . . Space Shuttle-derived components and *Ares 1* components that use existing United States propulsion systems including . . . solid rocket motors . . ."

b. If not, under what legal authorities does the Administration and NASA cite and argue justify violating the law?

c. Will the Administration and NASA fully, faithfully and timely implement the intent of Congress, which was written by the Senate Commerce Committee and included in the legislation's report, including the following section?

The Committee anticipates that in order to meet the specified vehicle capabilities and requirements, the most cost-effective and "evolvable" design concept is likely to follow what is known as an "in-line" vehicle design, with a large center tank structure with attached multiple liquid propulsion engines and, at a minimum, two solid rocket motors composed of at least four segments being attached to the tank structure to form the core, initial stage of the propulsion vehicle. The Committee will closely monitor NASA's early planning and design efforts to ensure compliance with the intent of this section.

Answer. NASA has recently transmitted to Congress its interim 90-day report describing its progress in assessing designs and acquisition approaches for the Space Launch System (SLS) and the Multi-Purpose Crew Vehicle (MPCV). In that report NASA clearly indicated that its baseline, reference design for the SLS is consistent with the technical requirements spelled out in the 2010 NASA Authorization Act (*i.e.,* the Act). Specifically, this reference design reflects a launch vehicle with an "in-line" configuration that uses the Space Shuttle main engine, the Shuttle/Ares solid rocket boosters, and the Space Shuttle external tank and that can ultimately be capable of lifting 130 tons or more to low-Earth orbit. As you know, that report indi-

cated that there are challenges associated with meeting the combined cost and schedule restraints in the Act for this reference design. Therefore, NASA has indicated that it will continue to study affordability initiatives and approaches for addressing these challenges in an effort to achieve the goals of the Act in an affordable and sustainable manner. We believe that this is an appropriate and prudent exercise and look forward to NASA's conclusions.

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RESPONSE TO WRITTEN QUESTIONS SUBMITTED BY HON. KAY BAILEY HUTCHISON TO HON. ELIZABETH M. ROBINSON

*Question 1.* Can you describe a summary of your role and responsibility as the National Aeronautics and Space Administration (NASA) Chief Financial Officer (CFO)? Who do you work for? What is your reporting chain?

Answer. The CFO reports to the Administrator and Deputy Administrator of NASA, and is an employee of NASA. NASA's CFO is also appointed by the President and is confirmed by the Senate; and she reports to the Administrator of NASA. The role as CFO is summarized in NASA Policy Directive 1000.3D which states, in part, that the NASA CFO "a. Oversees all financial management, budget, strategic planning, and performance activities relating to the programs and operations of the Agency[; and] m. Leads the Agency's effort in financial reporting under the CFO Act and coordinates on the Annual Performance Plan and Performance Report in accordance with the Government Performance and Results Act (GPRA) of 1993 (Public Law 103–62), as amended, and other relevant legislation."

*Question 2.* I assume you believe it is your sworn duty to uphold the laws of the United States, so I won't ask that direct question. But do you see it as your role, in upholding those laws, to seek every means possible to ensure the resources available to the Agency are effectively marshaled to enable the fulfillment of the requirements of the law?

Answer. Yes. In carrying out duties under the CFO Act, part of the CFOs responsibilities includes oversight and effective financial management of Agency resources and their strategic alignment with Agency mission—in collaboration with the Administrator, NASA leadership, and the applicable programs—consistent with all applicable laws, regulations and national policies.

*Question 3.* Would you agree that it is not your role to second-guess, or impose your own judgment on the wisdom of the applicable laws governing NASA programs and policies?

Answer. Yes. The CFO, like any other NASA employee, always attempts to faithfully carry out the law. Without questioning the wisdom of any particular law, part of that role as CFO includes working closely with the Administrator, NASA leadership, other Agencies, and Congressional Committees on proposals for new statutory provisions, which may include improvements or clarifications to existing laws.

*Question 4.* Your statement notes the constraints against moving forward with some of the requirements of the new NASA authorization law (P.L. 111–267) that result from restrictive language contained in prior Appropriations Acts in 2009 and 2010 and continued in effect by blanket restrictive language carried over into the current Continuing Resolution making appropriations through December 3, 2010. Can you provide the Committee with a *specific list of those activities authorized and directed by the law and which you believe continue to be constrained by that restrictive language? Include in your accounting, the specific legal analysis which supports your belief of the continuing restrictions.*

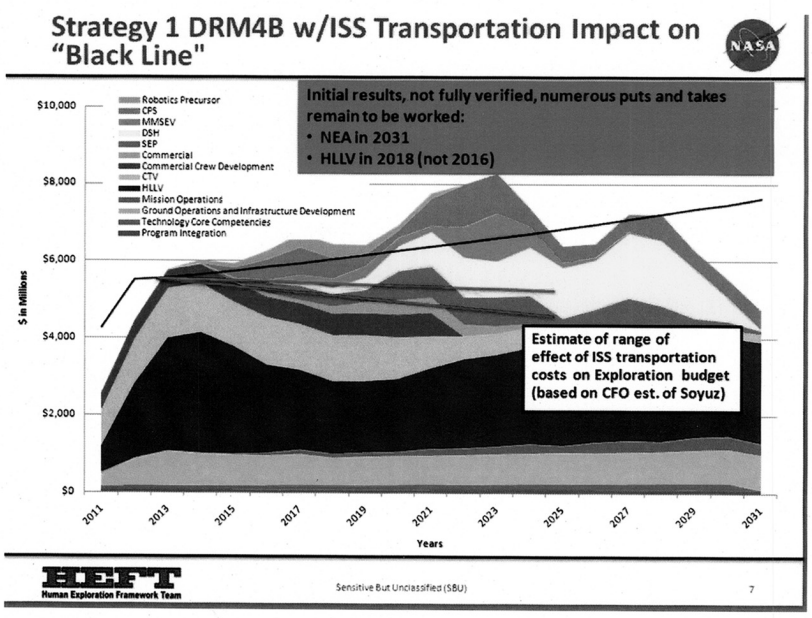
Answer. The FY 2010 Appropriations Act states: "none of the funds provided herein and from prior years that remain available for obligation during Fiscal Year 2010 shall be available for the termination or elimination of any program, project or activity of the architecture for the Constellation program." In addition, the 2010 Supplemental Appropriations Act inserted additional restrictions. These provisions continue to apply, despite the fact that the 2010 Authorization Act makes no reference to the Constellation Program. While many aspects of the Constellation Program have applicability to the MPCV and SLS authorized in the Authorization Act, resources cannot be fully brought to bear on these new programs without the flexibility to terminate Constellation projects and contracts when necessary.

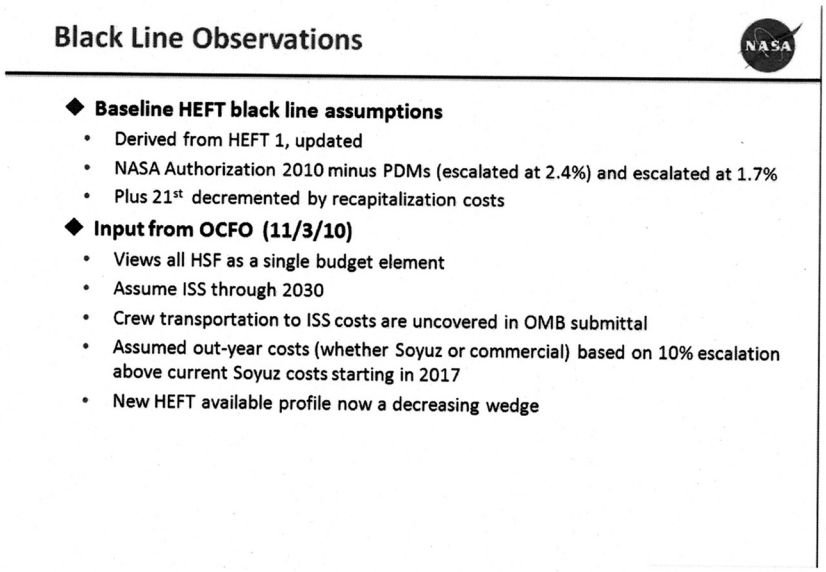
Regarding programs authorized in the NASA Authorization Act of 2010, NASA has found no program to date on which we cannot proceed with required activities during the remainder of FY 2011. However, until the NASA FY 2011 appropriation is finalized, many of these authorized activities are not proceeding, due to lack of funding certainty. For example, the Act authorized $580M in FY 2011 for Aeronautics activities, including several program initiatives. However, the annualized

CR amount at the FY 2010 level is approximately $501M. At this time Aeronautics is not beginning its new initiatives, except for prudent preparatory activities.

In addition, the FY 2011 President's Budget request for Space Technology programs is $572M (including Innovative Partnerships Program) and the authorized level is $350M; programs have been formulated and stand ready for implementation. While not considered "new starts," without a final FY 2011 appropriation key authorized NASA Space Technology (non-IPP) activities will not be awarded.

*Question 5.* Below are two charts I understand to be related to the HEFT exercise—the Human Exploration Framework Team—so I recognize they are *not* charts that relate directly to the development of plans for a Space Launch System, per se. What they seem to reflect, though, is a mind-set within the Agency—and particularly within your organization—regarding the priority for Human Space Flight programs within NASA—a priority that would appear *less* than that given to those areas of activity by the new law. The charts include a number of items that would be part of a broader "Exploration Architecture"—items which the law places as downstream initiatives to be undertaken at a point subsequent to the development of a new heavy-lift launch capability. I want to illustrate the kinds of questions raised by these charts to underscore why we are holding this hearing—and why we will undoubtedly be holding many more of these kinds of oversight hearings in the next Congress.






First is what is called a "sand chart" showing relative funding levels across a number of program activities within a given category of funding—in this case, it appears, the NASA human spaceflight programs.

The second chart was provided as partial interpretation of the sand chart, in that it describes guidance and budget assumptions—including some specifically from your office, the OCFO, or Office of the Chief Financial Officer—as of November 3—provided to the Human Exploration Framework Team (HEFT).

Separate information we have been provided along with these charts raise a number of questions:

*Question 5a.* All categories on the sand chart show declining numbers starting in FY 2014—after the period covered by the NASA Authorization Act of 2010. What is the basis for that projection?

Answer. The sand chart does not represent the position of NASA or the Administration regarding NASA's budget. It is one early estimate from an internal study team of the costs of a specific Design Reference Mission (DRM) for a complete exploration architecture, including the additional elements required for a deep-space mission. This estimate shows numerous elements of the program expanding after 2014. The decline for SLS and MPCV starting about 2015 was based on an estimate that costs for SLS and MPCV would peak about 2014 during development, and then fall off as development completes and the programs shift to operations. As SLS and MPCV costs fall off, development of the additional elements required for a deep-space mission begins. (Without those additional elements, a deep-space mission cannot be performed, and MPCV and SLS will have limited utility.)

*Question 5b.* NASA Authorization items outside of human spaceflight (Science, Cross Agency Support, etc.) are projected to escalate at 2.4 percent for inflation. Human Spaceflight is escalated only at 1.7 percent. (This would result in a net reduction in spending power in this account of almost a billion dollars per year by 2030.) Can you explain why a different escalation projection is used?

Answer. In past budgets, an escalation projection of 2.4 percent was used per A76 guidance for the NASA top-line budget. However, the guidance for the HEFT study was to initially use a rate of 1.7 percent budget escalation, although this was later changed to 1.4 percent, based on the Authorization Act increase from 2012 to 2013 for the combined ESMD and SOMD budget projections. Budget escalation is how the real year dollars of succeeding budgets change. Thus, when budget-escalation is less than cost-inflation, which is the case assumed in these estimates based upon input guidance, the associated "buying power" is reduced.

*Question 5c.* The 21st Century Launch Complex has to pay for its own facility recapitalization costs, rather than be included in the Cross-Agency Support line item. Assumption of sustaining ISS through 2030 removes about $30–35B of funds that might otherwise be available to Exploration post 2020, if no increase in top line is available through that period (which is assumed). Using a 2030 assumption for sustaining ISS (while in principal I would not oppose that notion) seems an artificial means of constraining our-year funding to force near-term design concessions. Can you explain the basis for this?

Answer. ISS to 2030 was a budget planning assumption for HEFT. Based on technical estimates of ISS lifetime and the program of maintenance and in-place spares, NASA anticipates that ISS can be operated well beyond 2020, and possibly to 2030. The estimate of funding available for HEFT prudently assumes that ISS will operate through 2030, rather than build a HEFT case that requires arbitrary early ISS termination to close financially. If ISS were terminated before 2030 but after 2020, the primary effect on this DRM would be to advance the schedule of the additional elements required for a Near-Earth Asteroid (NEA) mission.

*Question 5d.* Commercial Crew Transport to ISS was not submitted as a costed-effort in the summer to OMB, meaning funding comes from within the Exploration line, at an amount estimated at $400–$500M per year after 2017. That seems to pose a potential negative impact to Space Launch System (Upper Stage) development and Multi-Purpose Crew Vehicle operations. Can you explain the reason for not submitting anticipated Commercial Crew development as a separate, costed-element within the Exploration line? Does that in effect reduce funds otherwise planned for Space Launch System and Multi-Purpose Crew Vehicle development?

Answer. Commercial Crew Development is included in the Exploration budget requests for both FY 2011 and FY 2012. Operational support to the ISS program, including crew transportation through spring 2016 and cargo delivery, is included in the Space Operations budget. Costs for ISS crew transportation after spring 2016 are not included in the ISS budget request, pending better cost estimates. However, an estimate to purchase crew transportation after spring 2016 is included in the HEFT analysis. The estimate is based on the projected cost of purchasing transportation services from the Russians beyond spring 2016. Although commercial transportation services likely will be available in that timeframe, NASA at this time does not have high fidelity estimates for the cost of those services, so estimates are based on an extrapolation of Russian charges for these services.

*Question 5e.* Combined result is a decreasing Real Year Budget wedge which makes every optional Exploration Plan undoable. Last planning exercise to the Black line on the chart reflected an HLV available in 2018 and a Near-Earth Object mission in 2031. These planning assumptions obviously do *not* reflect what is contemplated by the requirements of the Act. Can you explain the basis and justification for these planning assumptions being made by your office?

Answer. The Act authorizes NASA to develop an SLS and an MPCV and provides performance, cost and schedule instructions. Beyond the time-frame of the Authorization Act, NASA presumes the intention of the Act is to continue ISS operation and utilization, and to conduct missions of exploration. Conducting such missions requires that NASA develop the mission payloads that justify the heavy lift and crew vehicles.

NASA is actively determining the details of programs that comply with this direction and assessing the architecture options to meet the cost, schedule, safety, and performance requirements as outlined in the Act. NASA's planning assumptions are based on what it believes will be the funding available from future appropriations in consonance with the amounts authorized for the FY 2011 through FY 2013 by the Act. NASA has endeavored to properly budget for mandatory and projected expenses such as a continuation of ISS. The development of the MPCV and the SLS would realistically be funded with the remainder of the total Human Space Flight future appropriation. NASA believes that its approach including funding assumptions for complying with the Authorization Act is fiscally sound and prudent.

*Question 5f.* Did you coordinate with Mission Directorates in establishing these guidelines, taking into account the requirements of the law?

Answer. Yes, the guidelines were coordinated among Agency leadership, including the Mission Directorate elements, taking into account the strictures contained in the Act.

*Question 6.* Your statement, on pages 2 and 3, describes the need to reserve funding under a long-term CR to accommodate potential new starts and differing funding levels in the final 2011 appropriations bill. What criteria are you planning to apply to the determination of those reserves?

Answer. The FY 2011 funding posture is still unknown. There is a likely and potentially substantial risk of further FY 2011 reductions. Section 109 of the Continuing Resolution instructs all agencies to spend the minimum amount necessary so as to avoid "imping[ing] on final funding prerogatives." With the possibility of reductions below current CR (FY 2010) levels being considered by the new Congress, care should be given to limit spending before the resolution of FY 2011 appropriations.

The Agency has been prudent in setting the appropriate rate of spending in its accounts within the totals allowed by the FY11 Continuing resolution. As programs go forth under CRs, NASA is cognizant of what the House and Senate have included in their bills for the agency. When the final bills are adopted, they will retroactively apply constraints and funding levels covering the CR period. Thus, as with other Agencies, NASA must generally reserve funding to accommodate potential new starts and differing funding levels in the final bill.

Aggressive pursuit of SLS/MPCV development activities means that NASA must start out with credible plans and budgets that will assure development efforts will be affordable and sustainable. Much work remains to be accomplished over the next few months in terms of the SLS and MPCV development effort, such as in-depth planning to synchronize the schedules and budgets for both vehicles and supporting capabilities such as Ground Operations such that each capability is successfully delivered during the right timeframe. Since an integrated schedule for the SLS and MPCV vehicles is an essential product of our planning efforts, NASA must gain reliable information from on-going SLS trade studies, obtain a better understanding of budget requirements and constraints, and develop acquisition strategies that can put development on an affordable and sustainable path.

NASA recognizes it has a responsibility to be clear with the Congress and the American taxpayers about our true estimated costs and schedules for developing the SLS and MPCV. NASA is committed to keep Congress informed about our planning efforts. To this end, NASA will acquire independent (outside of the Agency) cost and schedule assessments for SLS and MPCV design options as part of its decision process this Spring or Summer. Furthermore, NASA will make these assessments public.

*Question 7.* I am concerned that you will use that protect strategy to hold back funds that might otherwise be made available to begin development activities for the Space Launch System and the Multi-Purpose Crew Vehicle ongoing development. It should be clear to you from even a cursory reading of the law that those activities have the highest priority in the Exploration Systems Mission Directorate—ahead of things like Space Technology initiatives, which the law clearly states are activities expected to be undertaken in later years, when better definition is obtained from the required Decadal Survey of Human Space Flight programs. What assurances can you give the Committee that its intent to aggressively pursue immediate initiation of SLS/MPCV development activities will be followed?

Answer. NASA is spending all the money allowed to us under the CR. Work is continuing on Ares and Orion contracts and hardware, software, & tooling that enables SLS and MPCV scenarios at a pace of approximately $200M per month.

It is important to emphasize that NASA currently has the flexibility to concentrate its spending on those aspects of the Constellation Program that may have applicability to the new SLS and MPCV programs, and is doing so, thus maximizing the effective use of taxpayer dollars.

The NASA Authorization Act calls for development of specific systems for the SLS and MPCV, including associated program and other necessary support. NASA has taken steps to concentrate its spending on those aspects of the Constellation Program that may have applicability to the new SLS and MPCV programs. In fact, NASA has already scaled back funding for some elements of the Ares program that are unlikely to be applicable to the SLS Program. At the same time, NASA senior management have also deemed it necessary to allow other Ares work that may have a higher applicability to the SLS program to continue, albeit at a lower level, while NASA works to finalize a development and acquisition strategy for the SLS.

NASA expects to finalize an acquisition strategy and other key development decisions as early as the spring 2011. In the meantime, NASA has initiated several industry study contracts to help inform decisions on the final detailed design concept and acquisition details for the SLS. In parallel, NASA will conduct studies on concepts that were competitive in our internal trade studies to validate, support, or challenge our current thinking in an effort to ensure an affordable design that meets Authorization Act requirements.

Additionally, NASA is assessing requirements in the NASA Authorization Act for SLS against contract language for each element of Ares (first stage, upper stage, upper stage engine, and avionics) to determine whether the new SLS requirements

are within scope of the current contract. That determination is expected to be completed within the next few months.

*Question 7a.* In your statement, you refer to the reporting requirements outlined in the new law, and indicate that the lack of a final resolution of FY 2011 appropriations may hamper NASA's ability to meet those reporting requirements. Yet you state—and GAO has stipulated—that planning activities are not hampered by the restrictive language in prior appropriations. What, then, is the basis for delaying the required reports? In addition, you state that interim reports may be required in lieu of the final reports. The law does not provide for "interim reports." By what assumption or authority do you state that "interim reports" may be needed, when that is not what the law requires? Do you believe the law must be followed only if it is convenient for you to do so?

Answer. On January 10, 2011, NASA provided to Congress an interim report on our SLS and MPCV efforts to date, with a commitment to provide more extensive details in the FY 2012 Presidential Budget Request and in a follow-on report to Congress as early as spring 2011. We recognize that Congress wanted more information than we were able to provide in the 90-day report. Unfortunately, such a deadline did not afford NASA sufficient time to make significant acquisition and development decisions for a major programmatic evolution of the kind authorized by Congress, especially given the challenge of not having final FY 2011 appropriations by the time the report was due to Congress. Therefore, in an effort to be as responsive to Congress as possible, NASA developed an interim report which noted the progress we had made—in particular the definition of two reference vehicle designs—with a commitment to provide a follow-on report with more extensive details, once finalized, as early as next spring.

To be clear, much work remains to be accomplished over the next few months in terms of the SLS development effort, such as in-depth planning to synchronize the schedules and budgets for SLS, MPCV and Ground Operations efforts such that each delivers its capability during the right timeframe. Since an integrated schedule for the SLS and MPCV vehicles is an essential product of our planning efforts, NASA requires additional time to gain reliable information from on-going SLS trade studies, obtain a better understanding of budget requirements and constraints, and develop acquisition strategies that can put development on an affordable and sustainable path. NASA feels that these activities are essential to provide a responsible response to the final report and is pursuing these activities as expeditiously as possible.

NASA recognizes it has a responsibility to be clear with the Congress and the American taxpayers about our true estimated costs and schedules for developing the SLS and MPCV. NASA is committed to keep Congress informed about our planning efforts. To this end, NASA will acquire independent (outside of the Agency) cost and schedule assessments for SLS and MPCV design options as part of its decision process this Spring or Summer. Furthermore, NASA will make these assessments public.

*Question 8.* On page 3 of your statement, you describe the development of monthly funding allocations, and state that "to date, all funds have been or are in the process of being placed on contracts" in the Constellation Program. Yet we continue to hear reports of funds being held back from certain contracts. Please provide for the record a complete and detailed accounting of the allocations made to date, or pending, under the current CR and its replacement legislation, expected within the 2 or 3 weeks following this hearing. I am especially interested in a complete accounting of any funds being held back from active work directly applicable to the major project activities, the amounts involved, and the rationale and justification for holding or redirecting the funds, in each particular instance.

Answer. The only Exploration funds held back from distribution to the Constellation Program are those for two Boeing contracts comprising the $81M in potential termination liability for the Upper Stage Production and Upper Stage Instrumentation Avionics contracts. In response to recurring inquiries by Boeing, a Special Termination Cost (STC) clause was inserted into the Boeing Avionics and Upper Stage contracts on January 21, 2010, and January 25, 2010, respectively. These STC clauses delineated that potential termination liability costs would not be funded on the contract; identified the funding process to cover potential termination costs; and set forth the maximum amount of termination liability under the contract. In this case, the maximum amount of termination liability under the Avionics and Upper Stage contracts was set at $29M and $52M, respectively, based upon estimates provided by Boeing.

Under the Continuing Resolutions for FY 2011, NASA has received $1,149M for the Constellation Program. Of that amount, $116.8M covers civil service costs

through March 4, 2011, and $3.1M covers civil service travel costs, also through March 4. The remaining $1,029.1M is available for use on contracts.

Of the $1,029.1M available for use on contracts, $144.3M has not been issued to projects as of the end of January—$81.0M of that $144.3M is withheld to be in compliance with a Special Termination Clause (STC) for the two Boeing contracts discussed above. The remaining $63.3M of the $144.3M is being held as a prudent contingency for late-arising requirements in the current Continuing Resolution through March 4.

As of the end of January, $745.2M of the Constellation CR funding has been obligated on contracts and is available to the contractors to perform work. Setting aside the legally-required hold-back of $81M for in compliance with a Special Termination Clause in two contracts, but including the $63.3M contingency, there is $203M available but not yet obligated onto contracts.

However, the $203M not yet on contracts is not preventing contractors from performing work. As of the end of January, contractors had sufficient funds to both cover their potential termination liabilities (and similar items) and to perform new work. Obligating the $203M at this time would only add to funds on contract and extend the forward funding even further beyond March 4, which is not necessary at this time.

*Question 9.* On page 4 of your statement, you describe the recent Broad Area Announcement and award of Space Act agreements for 13 companies to conduct studies examining the trade-space of potential heavy-lift launch and space transfer vehicle concepts. We understand these contracts are subject to available appropriations, and that they include completion dates in the six-month range. Yet you are required under the law to provide a heavy-lift launch concept definition by the middle of January. How do you explain the relationship between that near-term requirement and these extended studies which would not be available to provide input to the near-term definition? It sounds like a further effort to delay a decision on a heavy-lift vehicle design, which is in direct conflict with the requirements of the law.

Answer. NASA is actively developing and executing plans for implementing the Space Launch System (SLS) and Multi-Purpose Crew Vehicle (MPCV), programs, including efforts to transition the design and development efforts of the Constellation Program. We have selected a Reference Vehicle Design. We also have a multi-layered approach we are using to conduct systems trades and analysis to meet the objectives of the Authorization Act.

In FY 2011, the SLS formulation phase will pursue multiple parallel activities to help drive down the development and operations costs for the SLS. NASA plans to transition relevant work from the Space Shuttle Program and Ares Project to the new SLS Program, while also continuing to define the requirements for the new SLS system.

NASA is performing its analyses using a government Requirements Analysis Cycle (RAC), in which ESMD, with support from the SLS Center Planning Team at Marshall Space Flight Center, will develop a set of SLS requirements by early Spring 2011. These requirements will be informed by NASA analysis of the direction in the Authorization Act, needed SLS safety, performance, existing national capabilities, and Administration priorities. The RAC study team results will be used to develop and refine the vehicle design concepts and to determine whether the NASA Reference Vehicle Design meets the SLS mission requirements as well as the Administrator's goals that the design be affordable, sustainable, and realistic. To this end, NASA commits to obtaining independent (outside of the Agency) assessments of cost and schedule for SLS and MPCV design options as part of its decision process this Spring or Summer.

In parallel with the RAC teams, on November 8, 2010, NASA announced the results of the heavy lift and propulsion study contracts that were awarded as part of a Broad Agency Announcement (BAA) issued in May 2010. As part of this competitive solicitation, utilizing approximately $7.5M in FY 2010 dollars, NASA selected 13 companies to conduct six-month studies examining the trade space of potential heavy-lift launch and space transfer vehicle concepts.

While the Broad Agency Announcement (BAA) solicitation was issued before the Authorization Act was enacted into law, inputs from the BAA study contracts will apply directly to our SLS efforts. For example, NASA will use the BAA study contracts to continue to study affordability initiatives and approaches for addressing these challenges in an effort to achieve the goals of the Act in an affordable and sustainable manner. These trade studies will provide a "fresh look" at innovative launch vehicle concepts, propulsion technologies and processes that can be infused into the development of the new human exploration missions—information that will be used to help inform the overall selection and development of the final SLS vehicle detailed design.

In summary, together, these internal and external study efforts will be used to conduct systems trades and analysis to meet the objectives of the Authorization Act, and information from these efforts will be contained in our follow-on report to Congress as early as Spring 2011.

*Question 10.* On page 5 of your statement, you note the extension of the ISS until at least 2020. You indicate that "activities to increase the ISS functionality" will be delayed until FY 2011 funding is received." What exactly does that term "increase the ISS functionality" include, and what is the basis—and impact—of delaying those activities?

Answer. The FY 2011 President's budget request provided additional funding to increase ISS functionality and enable utilization of the International Space Station (ISS) as a National Laboratory. This is an investment to improve the efficiency and effectiveness of the Space Station facility itself. It will support ISS upgrade efforts while supporting the development of, and proving, new technologies. Projects selected will meet one or more of the following objectives:

- Reducing demands on crew time;
- Lowering ground-based costs;
- Mitigating capabilities lost when the Shuttle retires;
- Improving ISS software capabilities;
- Improving ISS safety;
- Benefiting future human spaceflight programs; and/or
- Increasing ISS payload throughput capacity.

Candidate projects under evaluation fall into the following major themes:

- Upgraded environment systems (air and water)
- Upgraded communications (data, audio, and video)
- Pressurized volume improvements (space-savers)
- Flight and ground crew time optimization tools (automated locaters and links)
- Payload operations upgrades and scope expansions (control centers, apparatus and non-profit organization participation)
- EVA and robotics enhancements (productivity improvements)
- International standards (interface complexity reductions)

This initiative is contingent upon the availability of appropriated funds. Delaying these activities would result in less efficient ISS operations than could be achieved through the implementation of the efforts noted above.

*Question 11.* I also note that nowhere in your statement, when referring to the ISS, do you refer to the designation of the U.S. Segment as a National Laboratory; nor do you specifically acknowledge the legal requirement for allocation of half of that U.S. research capability to the independent management entity you refer to, in passing, on page 5. Are you fully aware of what the congressional intent—and requirements of the law—are regarding that designation of a National Laboratory?

Answer. NASA continues to support the use of the ISS as a National Laboratory, as reflected by the Agency's ongoing efforts to expand its partnerships with organizations interested in conducting microgravity research aboard the Station. Currently, NASA has five Memoranda of Understanding (MOUs) with other federal agencies for the use of ISS as a National Laboratory, two Space Act Agreements with universities, and seven Space Act Agreements with private firms.

In addition, NASA is moving ahead with a Cooperative Agreement Notice (CAN) to implement the use of a Non-Profit Organization (NPO) to manage the National Laboratory aspect of ISS, including the allocation of 50 percent of Station's U.S. research capability to the National Lab partners. The Agency released the CAN on February 14, 2011, and anticipates an award in late Spring.

*Question 12.* On pages 6 and 7 of your statement, you describe the HEFT studies . . . the Human Exploration Framework Team. The function of the HEFT studies—as we highlighted in the other questions about that effort previously—appears to be rather misunderstood. It also appears to ignore the requirement in the law for a Decadal Survey of the Human Exploration of Space as outlined in Section 204 of the law—a study for which HEFT is specifically called out in the law as one of several *inputs* to that study. Is it clear to you that HEFT is *not* a definitive study effort; that it reaches beyond the scope of the activities authorized by the law at the present time? Given the kinds of budget assumptions and guidance you have provided to the current HEFT activities, it seems that the role of HEFT is being overstated in the internal planning at NASA and is, in effect, under the terms of the

law enacted since its initiation, a premature activity which is having an unwarranted influence in determining the planning assumptions for definition of Space Launch System development. Can you provide an explanation or assurances that this characterization is not correct?

Answer. HEFT studies and analyses are part on an on-going and continual human exploration architectural analysis effort that are vital for prudent planning and responsive execution of the requirements outlined in the law. As such, they were initiated prior to the current NASA Authorization Act of 2010 and remain on-going cross-Agency activity led by the Exploration Systems Mission Directorate, with the information intended to objectively inform agency decisionmaking and serve as input to any future national studies or assessments. The planning assumptions for the definition of the SLS are part of a larger system of systems architecture assessment, and important program planning and implementation preparatory work is being guided by the current law and informed by the technical analysis conducted in several on-going Heavy Lift Launch Vehicle assessment efforts. The study effort is important because it integrates the essential analysis necessary to consider and plan for the direction outlined in the law.

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RESPONSE TO WRITTEN QUESTIONS SUBMITTED BY HON. MARIA CANTWELL TO HON. ELIZABETH M. ROBINSON

*Question 1a.* Section 603 of the NASA Authorization Act of 2010 states that the retiring space orbiters "shall be made available and located for display and maintenance through a competitive procedure" established pursuant to the disposition plan outlined in the 2008 NASA Authorization Act. The 2010 law also specifies that certain conditions must be met by eligible applicants. Could you describe the competitive procedure NASA is undertaking to make the site selections?

Answer. The NASA Authorization Act of 2008 (P.L. 110–422, Section 613(a)) directed the Agency to "submit to Congress a plan describing the process for the disposition of the remaining Orbiters and other Space Shuttle program-related hardware after the retirement of the Space Shuttle fleet." NASA submitted the *Space Shuttle Program Transition and Retirement Personal Property Disposition Plan* to Congress in November 2008. The NASA Authorization Act of 2010 (P.L. 111–267, Section 603) restated the direction that Orbiter vehicles shall be made available and located for display and maintenance through procedures established pursuant to that plan. The Agency's efforts to appropriately place the Orbiters remain consistent with that plan.

The Agency has conducted two Request for Information (RFI) inquiries to obtain market research from educational institutions, science museums, and other appropriate organizations regarding the community's ability to acquire, maintain and display a Space Shuttle Orbiter. The first was issued on December 17, 2008, and closed on March 17, 2009. NASA subsequently updated requirements, detailed tasks to safe each Orbiter following its final mission, and determined that NASA will no longer ask recipients to provide the Agency the funds for Orbiter safing. NASA's estimate of the total cost of receiving an Orbiter to a recipient is now $28.8M. In an effort to ensure that: (1) all interested parties were made aware of the opportunity to obtain an Orbiter for display, and (2) respondents to the previous RFI were aware of the revised cost projections and schedule changes, NASA issued a follow-on RFI on January 15, 2010, which included cost and delivery schedule changes, as well as revised financial milestones. The RFI closed on February 19, 2010.

The Administrator has broad authority to determine the best way to meet the Agency's outreach and educational objectives, consistent with the priority considerations listed in the NASA Authorization Act of 2010. Some factors considered include: financial aspects of transfer process; quality and availability of facilities; options for transporting Orbiters; attendance levels at prospective recipient organizations; size of regional population; access to domestic and international transportation; and, other factors. However, there is no one criterion or combination of criteria that will be used to determine the ultimate selection of recipients. The Administrator's decisions will be informed by responses to the two RFIs and additional research.

*Question 1b.* While I am aware that NASA has released two Requests for Information to assist the agency in identifying interested sites, has the agency released a Request for Proposal? Does the agency intend to release a Request for Proposal? What is the reasoning behind the decision?

Answer. NASA has not released a Request for Proposal (RFP), and has no plans to do so. The Administrator has the authority to determine the disposition of the

Space Shuttle Orbiters. Data gathered from interested parties through the RFIs, as well as additional research and analysis, will inform the Administrator's decisions.

*Question 1c.* Will the Administrator establish a formal site selection committee? If there is a selection committee, what will be the process by which members are chosen? What is the time-frame for this committee member selection to occur?

Answer. Please see response to *Question 1b*, above. A formal selection review committee was not established. NASA's Office of Strategic Infrastructure's (OSI), which is charged with addressing Space Shuttle Program property disposition, did market research, developed two RFIs, coordinated with museum consortia, and evaluated responses from all interested organizations. A proposal was made to the Assistant Administrator for OSI that was fully vetted with NASA offices including: the Space Operations Mission Directorate, Office of the Chief Financial Officer, Office of the General Counsel, Office of Communications, and Office of Legislative and Intergovernmental Affairs. A coordinated staff recommendation was made to the Administrator. The Administrator's announcement is pending, currently scheduled for April 12, 2011.

*Question 1d.* Will geographic diversity be a consideration in the site selection process?

Answer. Yes, geographic diversity is a consideration in the site selection process, especially those factors pertaining to attendance at a prospective recipient organization, the size of the regional population and access to domestic and international transportation. There is no single criterion that will determine the placement of the Space Shuttle Orbiters.

*Question 1e.* Will the White House be involved in making the final decisions?

Answer. No, the White House is not involved in making the final decisions on Orbiter placement; that authority rests with the NASA Administrator.

*Question 1f.* What is the time line for the final decisions to be made?

Answer. NASA is currently targeting April 12, 2011 for announcing the selection of Orbiter recipient organizations.

*Question 2a.* Section 603 of the Act authorizes federal funds to cover the costs of decommissioning the shuttles. Congress's rationale behind this provision was to enable NASA to choose the best site candidates rather than those with the deepest pockets.

However, I understand that in the Request for Information that the agency provided to museums and interested locations subsequent to the NASA Authorization Act of 2008 but prior to the NASA Authorization Act of 2010, it was stipulated that $28.8M was required by any interested site to cover NASA expenses for decommissioning a shuttle. Could you please comment on the $28.8M price tag and NASA's basis for that figure? As you may recall, the initial estimate was $42M.

Answer. In the initial 2008 RFI, it was assumed that the recipient organization would pay for the safing of the Orbiter, as well as for display preparation tasks and ferry costs, and NASA projected the cost to the recipient at $42M. One reason for the release of the second RFI in 2010 was to inform interested parties that NASA would be paying the costs to safe the Orbiters (safing tasks remove from Orbiters systems and materials that would present hazards for long-term storage or disposition of the vehicles).

In addition to NASA paying for the cost of safing the vehicles, the Agency also generated a new estimate for display preparation and ferry costs. The revised estimate for total cost to the recipient organizations was $28.8M. The $28.8M cost is the sum of two component costs: $20.5M for "Display Preparation" and $8.3M for "Ferry." NASA defines these two tasks as mandatory work to provide an Orbiter to a recipient.

$20.5M is required for Display Preparation which includes the reinstallation of safed orbiter vehicle systems or substitutes for orbiter vehicle systems; provision of new special hazard notices and controls; and configuration of the vehicle to allow it to be transported to and reside in its final destination. Tasks include set up of the Crew Module in flight configuration, installation of structural shells and skins for the previously removed Orbital Maneuvering System pods, Forward Reaction Control System, and internal cabin structural panels, as well as final closeout of the payload bay, wings and the aft compartment. Display preparation also includes costs for NASA to configure the orbiter for ferry flight per existing Space Shuttle Program ferry flight requirements; preparation and sign-off of the Ferry Flight Readiness Statement, as well as preparation and delivery of the NASA display site "kit."

The $8.3M "Ferry" cost is the work to fly the orbiter to an airport near the display site. The airport must meet specific criteria that allow landing the Shuttle Carrier Aircraft (SCA) with attached orbiter. The orbiter will remain in Ferry Flight Con-

figuration. The major tasks include: actual ferry of orbiter, offload & tow to final location; positioning the orbiter on jack stands and deservicing Hydraulic System #1; renting two NASA approved mobile cranes, on-loading/off-loading the orbiter to/from the SCA; shipment of Ground Support Equipment (GSE) required from and to NASA KSC; travel cost and rentals of hi-lifts, access stands, etc.; and Shuttle Carrier Aircraft and Shuttle Landing Facility costs to conduct the ferry operation.

Also included is the ground support equipment (GSE) required to support final NASA public display site requirements, including "Data" packs (MSDS equivalent for remaining passive hazards; orbiter system configuration summary).

*Question 2b.* Is NASA still requiring applicants to cover this expense when doing so appears to contradict language in the NASA Authorization Act? Won't NASA have to decommission the shuttles for safety reasons, regardless of where the shuttles are ultimately stored or displayed?

Answer. The large majority of the $28.8M to be paid by recipients supports work that NASA would not do in order to place the Orbiters in storage. Requiring the recipient organizations to pay display preparation and ferry costs does not contradict language in the NASA Authorization Act of 2010 (P.L. 111–267). Having the recipient organizations provide funding for display preparation and ferry costs of their Orbiter is an appropriate way to defray the cost to the taxpayer of retiring and displaying the Orbiters to ensure that these historic vehicles are retained in facilities properly equipped to maintain and display them.

*Question 2c.* Will the "safing" work be performed by NASA personnel or by NASA contractors? Does NASA envision the work to be performed in parallel or in series? If the work is performed serially, should NASA expect savings through gains made from the learning curve?

Answer. Activities associated with safing the Orbiters are conducted after each Shuttle mission, and are carried out primarily by contractor personnel, with NASA personnel providing safety and assurance oversight.

Activities associated with display preparation and ferrying the Orbiters to the recipient organizations will be paid for by the recipients, and will be carried out primarily by NASA contractor personnel with NASA personnel providing safety and assurance oversight. Display preparation tasks will be performed in parallel, for the most part, and NASA does not expect savings to accrue based on experience gained from processing the Orbiters.

*Question 3a.* NASA has publicly indicated an interest in placing one of the retiring shuttles at the Smithsonian. Section 603 of the Act provides the Smithsonian with the authority to "determine any new location for the *Enterprise*," the orbiter test vehicle currently housed at the National Air and Space Museum. It would be my assumption that if the Smithsonian were chosen as the recipient of a retiring shuttle, the Smithsonian would then determine a new location for the *Enterprise.* Has the Smithsonian responded to the Requests for Information issued by the agency?

Answer. NASM was not required to respond to the RFIs as addressed in the NASA *Space Shuttle Program Transition and Retirement Personal Property Disposition (T&R) Plan* as submitted to Congress in November 2008. The T&R plan suggested that one flight Orbiter would be transferred to NASM and that an RFI would be issued to inform decisions on subsequent Orbiter placement. The RFI additionally addressed a joint effort by NASA and NASM to subsequently place the Orbiter Enterprise.

*Question 3b.* Is NASA requiring the Smithsonian to pay $28M for a shuttle—an amount that equals the National Air and Space Museum's total annual budget?

Answer. NASA intends to fund the cost of providing Discovery to NASM. NASM has the unique responsibility of being the curator of the national collection. Given this unique responsibility, the NASA Administrator decided it is in the best interests of the Nation to ensure NASM received a flight orbiter, and that NASA assume the costs for ensuring that this happened so as not to detract from NASM overall responsibilities in safeguarding its historic collection.

NASM and NASA have agreed to discuss the appropriate placement of *Enterprise.* The costs to prep and ferry the *Enterprise* will be paid by the recipient of the *Enterprise*.

*Question 4a.* The Act calls for "a balance between human space flight using and building upon existing capabilities and investing in and enabling new capabilities" What is the current status of solar electric propulsion research at NASA?

Answer. During FY 2011, ESMD has accelerated their solar electric propulsion (SEP) investment strategy because of its potential performance benefits as an in-space transportation option to a variety of deep space destinations. The Human Exploration Framework Team (HEFT) identified SEP as a necessary and enabling

technology for future deep space missions due to its ability to significantly reduce the mass and cost of such missions. The underlying technologies including, solar power arrays, hall thrusters and power management, have completed ground testing to the extent that the next logical step is an in-space technology-focused flight demonstration. Current plans call for initiation of a 30 kW class SEP technology demonstration mission as a precursor to an operational human exploration vehicle in the 300 kW class. With the movement of a large portion of the Exploration Technology development effort to Space Technology in FY 2012 and beyond, the Office of the Chief Technologist (OCT) plans to pursue an in-space SEP Technology Demonstration Mission as one of the first two Exploration-specific projects in this line.

*Question 4b.* How much is NASA budgeting for the solar electric propulsion demonstration in FY 2011—FY 2015 time-frame since it factors strongly into the Human Exploration Framework Team architecture for future space missions?

Answer. In FY 2011 (under ESMD), NASA plans to invest approximately $8M in planning for the SEP flight demonstration. In FY 2012 through FY 2015 (under OCT), NASA plans to invest an additional $75–200M subject to the results of an FY 2011 Phase A (Conceptual Design) study, and the conclusion of technology partnership discussions initiated with other government agencies.

*Question 5.* Last month, it was reported that China has efforts underway to develop a 1M pound force liquid hydrocarbon engine. For purposes of comparison, the current Russian built engine used on the Atlas 5 rocket has 860 thousand pounds of thrust at sea level.

I am told that these types of high performance hydrocarbon engines essentially burn kerosene and are more environmentally friendly than shuttle derived technology. My understanding is that the U.S. Air Force has a small program to look into these types of engines to meet its needs, but NASA has chosen not to invest in advanced liquid hydrocarbon engines.

(a) Is it the case that NASA is not investing in the technology? If so, why not?

(b) Does NASA see any potential benefits in this technology in comparison to shuttle derived technologies?

(c) Are there potential downsides if the U.S. is not actively engaged in this specific area of advanced rocket engine design and development?

Answer. The rocket propulsion industry in all phases (production, testing and launching) involve the use of hazardous and/or toxic chemicals therefore all systems have environmental impacts. However, during the design phase of the rocket, engineers consider the potential environmental impact and design the system to meet the regulatory requirements, thus mitigating or minimizing the environmental impact to an acceptable risk level.

(a) The FY 2011 NASA Budget proposed the development of a large liquid hydrocarbon rocket engine as part of the Heavy Lift and Propulsion Technology efforts. However, in the NASA Authorization Act of 2010 enacted on October 11, 2010, NASA has been directed to develop a SLS that "to the extent practicable utilize existing contracts, investments, workforce, industrial base, and capabilities from the Space Shuttle, and Orion and Ares projects." The liquid engines within these systems are based on a liquid hydrogen and liquid oxygen and do not use liquid hydrocarbon (typically kerosene).

(b) There are positive attributes to both the large hydrocarbon (kerosene) engine development as well as using Shuttle-derived systems. Kerosene systems tend to be less expensive to operate however the upfront development costs for a new engine may be large. The Shuttle-derived systems, although likely more costly to operate, would allow the Agency to take advantage of previous investments and leverage the heritage workforce knowledge and assets at a reduced development cost upfront.

(c) Currently there are only two domestic vendors that are actively developing kerosene engines but nowhere near the thrust levels that China is reportedly pursuing. Engine development of a large (1M pounds thrust or greater) kerosene engine is not considered advanced development, but there are challenges that need to be overcome such as combustion stability issues, material compatibility as well as low-cost produce-ability challenges. The U.S. liquid propulsion system industrial sector is under significant stress due primarily to the low demand of launch services, hence the decrease in the need for liquid propulsion skills and manufacturing capabilities. Development of a domestically manufactured large hydrocarbon engine would provide the liquid propulsion industrial base with additional work, relieving some of the stress on the sector.

RESPONSE TO WRITTEN QUESTION SUBMITTED BY HON. MARK BEGICH TO HON. ELIZABETH M. ROBINSON

*Question.* The Kodiak Launch Complex in Alaska is a state-of-the-art facility that provides a flexible, efficient and economical launch capability to its customers. On November 19, 2010, the Kodiak Launch Complex successfully launched STP–S26, which contained two NASA satellites as part of its payload. Are you familiar with Kodiak Launch Complex facility? How do you see commercial facilities like Kodiak Launch Complex playing a role in space access especially as NASA retools its mission under the recently passed NASA Authorization Act of 2010?

Answer. NASA is very familiar with the Kodiak Launch Complex. Moreover, the Agency had responsibility for the first orbital launch utilizing the Complex. NASA's Launch Services Program purchased and assured the launch service for the Kodiak Star Mission, which launched in September 2001 carrying four satellites into Earth orbit: the NASA-sponsored Starshine 3, and three satellites sponsored by the Department of Defense Space Test Program (STP): PICOSat, Prototype Communications Satellite (PCSat), and Sapphire. This was the last launch of the heritage Athena launch vehicle. The Kodiak Star and STP–S26 campaigns utilized the Wallops Flight Facility's Mobile Range.

NASA encourages the development of commercial launch ranges for increased space access for an array of mission types for their potential to reduce costs and increase our nation's launch capability. In the case of uncrewed science missions, NASA procures commercial launch services from launch providers under the NASA Launch Services (NLS) contracts. Each provider offers services from one or more launch sites. The specific vehicle type and launch location is selected through a best-value determination depending upon mission requirements. Lockheed Martin, with its yet-to-be-flown Athena IC and IIC, is the only current NLS provider who offers NASA launches from Kodiak. From this launch site, Athena is suited to meet performance requirements for smaller spacecraft missions recommended in the National Research Council's Earth Science Decadal Survey.

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RESPONSE TO WRITTEN QUESTION SUBMITTED BY HON. ROGER F. WICKER TO HON. ELIZABETH M. ROBINSON

*Question.* Can you provide the construction timeline of the A–3 test stand NASA will adhere to in order to comply with section 304(b)(3) of the NASA Authorization Act of 2010, and provide quarterly updates on progress through completion?

Answer. The A–3 Test Stand currently being constructed at Stennis Space Center was approximately 70 percent complete at the end of January 2011. NASA is committed to completing the A–3 Test stand, contingent on available funding.

The 2010 NASA Authorization Act sets a goal for the A–3 completion by September 30, 2013. However, NASA does not anticipate being able to meet that goal. Funding available in the current Continuing Resolution (CR), which expires March 4, will likely delay the completion and acceptance of the test stand by as much as 8 months. Additional delays are likely if NASA were to operate under a full-year CR.

The table below identifies the major construction milestones and their estimated completion dates, contingent on available funding. *The estimated completion dates do not account for delays in funding due to a CR.*

| Major Construction Milestone | Estimated Date of Completion |
|---|---|
| Construct Upper level Signal Conditioning Bldg | 08/31/2011 |
| Construct Tool Crib | 07/29/2011 |
| Installation and Calibration of Run Tank and Gauge Float | 07/29/2011 |
| Fabrication and Installation of the Cooling Elbow Water Piping | 03/20/2012 |
| Fabricating and Installation of High Pressure Industrial Water Filters and Isolation Valves | 03/20/2012 |
| Procurement and Installation of Monitoring, Measuring Control System (MMCS) | 09/03/2012 |
| Installation of Isolation Valve, Thrust Measurement System and Chemical Steam Generator (CSG) System Skids | 07/06/2011 |
| Activation of MMCS | 09/06/2013 |
| Activation of CSG System | 09/30/2013 |
| Site Work and Paving | 01/17/2013 |

NASA would be willing to provide the Senator with a current status briefing about the A–3 test stand, at his convenience, and we will, of course, keep our committees apprised of future major developments regarding the A–3.

RESPONSE TO WRITTEN QUESTIONS SUBMITTED BY HON. ORRIN G. HATCH TO HON. ELIZABETH M. ROBINSON

*Question 1.* Dr. Holdren and Dr. Robinson, senior NASA officials have recently stated "solid [rocket motors] are too expensive." However, pre-*Columbia* accident production costs for all the elements associated with Space Shuttle liquid propulsion systems, including engines, external tank, fuel, and pre-flight testing is approximately $800M per year. By comparison, the costs for a solid propulsion system, including motor and booster elements is approximately $550M per year. This less expensive cost is also reflected in the Fiscal Year 2010 development amount of $940M for the Ares I Upper Stage propulsion system; whereas the system's solid rocket motor First Stage cost only $460M.[1] Therefore, how does NASA's data substantiate the claim "solids are too expensive"? How recent is NASA's data on the cost of solid rocket motors?

Answer. NASA recently performed a study identifying attributes and characteristics of both solid and liquid propulsion systems and found that the data does not indicate that one system is inherently more cost effective than the other. Furthermore, the research found that there was no statistical difference between the nonrecurring costs of a liquid system versus a solid propulsion system. Not knowing the pedigree of the figures cited above in the question, NASA cannot respond or defend those figures. The current contract values (FY 2011 first quarter data) for the Design Development Test and Evaluation contracts for upper stage engine and first stage respectively are $1.3B and $2.0B for a period of performance of September 2014 and June 2015, respectively.

*Question 2.* Dr. Robinson, as defined by the Anti-Deficiency Act, how many "uncosted" funds does NASA currently have for Fiscal Year 2011? What is the amount of NASA termination liability if NASA canceled Project Constellation in Fiscal Year 2011?

Answer. The Anti-deficiency Act (ADA) greatly limits NASA's options for dealing with termination liability. NASA uses cost-reimbursement contracts for most of the Constellation program, which require a Limitation of Funds clause to comply with the ADA. The Limitation of Funds clause (Federal Acquisition Regulation 52.232–22), in paragraph (h), states, "the government is not obligated to reimburse the Contractor for any costs incurred in excess of the total amount allotted by the government to this contract, whether incurred in the course of the contract *or as a result of termination*" (emphasis added). Accordingly, it is the responsibility of the contractor, in the first instance, to manage all of its costs and obligations within the allotted funding under this Limitation of Funds clause. And, on July 26, 2010, the GAO issued the opinion, which found that NASA's actions are in full compliance with the Impoundment Control Act and the 2010 Appropriations Act. GAO further found that NASA's interpretation of the Anti-Deficiency Act is, in fact, correct. Both rulings can be found at *http://www.gao.gov*.

Potential term liability for Constellation prime contracts is approximately $920M. This includes $500M for ATK, who has stated to NASA that they are planning to cover their termination liabilities, if they occur, from amounts not dedicated to the contract. All other contractors over the past several months have reduced their level of activity to accommodate their potential termination liability. ESMD uncosted at the end of FY 2010 was approximately $900M for FY 2004–2010 funds.

At the end of FY 2010, NASA's total uncosted balance for Program Year 2004–2010 funds was $5.6B.

*Question 3.* Dr. Holdren and Dr. Robinson, Section 309 of the NASA Authorization Act requires NASA to provide a report to Congress which articulates the design of the new Space Launch System by mid January 2011. Will NASA fully complete a final version of such a report by that date? If not, will the report be sufficient to establish a program of record, or baseline program, to begin the development of the Space Launch System?

Answer. On January 10, 2011, NASA provided to Congress an interim report on the our SLS and MPCV efforts to date, with a commitment to provide more extensive details in the FY 2012 Presidential Budget Request and in a follow-on report to Congress as early as Spring 2011. We recognize that Congress wanted more information than we were able to provide in the 90-day report. Unfortunately, such a deadline did not afford NASA sufficient time to make significant acquisition and development decisions for a major programmatic evolution of the kind authorized by Congress, especially given the challenge of not having final FY 2011 appropriations

[1] However, it goes without saying an upper stage and a solid rocket motor first stage are essential to meeting the legal parameters articulated in the NASA Authorization Act of 2010.

by the time the report was due to Congress. Therefore, in an effort to be as responsive to Congress as possible, NASA developed an interim report which noted the progress we had made—in particular the definition of two reference vehicle designs—with a commitment to provide a follow-on report with more extensive details, once finalized, as early as next Spring.

As noted in the report, in choosing a Reference Vehicle Design for the SLS, NASA took a significant step forward in the SLS development process. Consistent with direction in the Act, the Agency has decided to use a Reference Vehicle Design for the SLS that is derived from Ares and Shuttle hardware. The current concept vehicles would utilize a liquid oxygen/liquid hydrogen core with five RS–25 Space Shuttle Main Engine-derived engines, five-segment solid rocket boosters, and a J–2X based Upper Stage for the SLS. This would allow for use of existing Shuttle and Ares hardware assets in the near term, with the opportunity for upgrades and/or competition downstream for eventual upgrades in designs needed for affordable production.

More specifically, NASA has developed a process to make progress on the Reference Vehicle Design for the SLS while the Agency determines whether the design is sufficiently affordable, sustainable, and realistic, and also while the Agency studies other options to solicit innovative ideas and ensure the best value for the American taxpayers.

By spring of 2011, NASA expects to have completed several key analytical steps—information that will be contained in our follow-on report to Congress:

- Analysis of the current Ares and Shuttle contracts for their applicability to the future development program;
- Analysis of the cost and benefits of the Reference Vehicle Design and other vehicle designs;
- Analysis of potential initial procurement approaches (in the case when procurements are required, NASA will follow applicable procurement regulations, including the March 4, 2009, Presidential Memorandum on Government Contracting).

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RESPONSE TO WRITTEN QUESTIONS SUBMITTED BY HON. KAY BAILEY HUTCHISON TO CRISTINA T. CHAPLAIN

*Question 1.* Has your office been contacted regarding its participation in, or oversight of, the ISS sustainability study required in Section 503(b) of P.L. 111–267?

*(NOTE: The pertinent language is at Section 503(c)(2) and states*:

"(2) GAO REPORT.——

(A) REPORT REQUIRED.—Not later than 90 days after the submittal to Congress under paragraph (1) of the assessment required by subsection (b), the Comptroller General of the United States shall submit to the appropriate committees of Congress a report on the assessment. The report shall set forth an evaluation of the assessment by the Comptroller General, including an evaluation of the accuracy and level of confidence in the findings of the assessment.

(B) COOPERATION WITH GAO.—The *Administrator shall provide for the monitoring and participation of the Comptroller General in the assessment* in a manner that permits the Comptroller General to prepare and submit the report required by subparagraph (A).

*(Emphasis added showing portion which directs NASA Administrator to provide for GAO to monitor and participate in the required NASA assessment of ISS sustainability requirements)*

Answer. Yes, my office has been coordinating with the ISS program office since December. The ISS Program office has shared the report and supporting information and has met extensively with my staff to discuss the data, methodology for analysis, and the findings of the study. We anticipate delivering a preliminary report on April 11, 2011.

*Question 2.* Your statement places emphasis on design stability prior to proceeding to implementation. The recent new law adopts a "proven-heritage" approach to SLS development, requiring maximum use of design elements with a large body of experience and knowledge behind them. Do you agree that, if implemented by NASA in his way, it will contribute to an increased chance for successful Space Launch System development?

Answer. Adopting a "proven heritage" approach to SLS development, in which the program is based on heritage elements, if done correctly, can reduce risk and build off of the hard work that has been done to date on the Constellation Program. However, our work has shown that NASA frequently employs heritage technologies that

have to be modified from their original form, fit, and function and frequently underestimates the time and money it will take to allow them to operate in a modified design. NASA's Systems Engineering Handbook states that particular attention must be given to heritage systems because they are often used in architectures and environments different from those in which they were designed to operate. Further, the Handbook states that modification of heritage systems is a frequently overlooked area in technology development and that there is a tendency by project management to overestimate the maturity and applicability of heritage technology to a new project. Likewise, our work has shown that NASA's cost estimates generally underestimate the cost of adopting heritage technologies. Thus, while building off the progress made on prior programs can benefit the new SLS program, Congress should take steps to ensure that NASA is realistic in how it is estimating the applicability of these heritage designs to the SLS program.

*Question 3.* The focus on early transparency and accountability in our recommendations is exactly what we are looking for in the Section 309 reporting requirement, both for the initial SLS conceptual design and the subsequent annual reporting requirement. We anticipate the near-term outcome of the initial 90-day report to result in a "baselined" program. What else do you believe we should be looking for in our oversight of NASA to ensure transparency and accountability?

Answer. The reporting requirement outlined in Section 309 of the NASA Authorization Act is a positive step for ensuring that NASA is held accountable for delivering what it promises and that the Congress is well informed of the status of the program. Additional information that could enhance oversight and help to ensure greater accountability could include requiring NASA to report information to the Congress on early planning cost baselines and how the agency is or is not maintaining those cost projections. As I mentioned in my written statement, currently NASA shares very little cost information prior to formally baselining a project. This puts Congress in the position of approving a long term effort with only the benefit of a five-year budget projection.

Of course NASA needs time for discovery and to pursue different options, but the Congress can be provided earlier indication to how the project is doing based upon how well the project is meeting its planning baselines. Deviations from these baselines should easily be explained by the information required by Section 309, for example information on trades, modifications, schedule changes, changes in assumptions, and justifications for deviations from requirements. Attaching a dollar figure to the information required to be reported will ensure that the reason behind any change is presented in a transparent way to Congress such that it can fully understand the basis behind any cost increases and make its funding decisions accordingly.

As I discussed in the hearing, there are other knowledge-based metrics that should be used to gauge NASA's progress in the earlier phases of SLS development. They include: requirements stability, technology readiness and design maturity, which assess the level of unknowns being carried forward into development. Based on experiences of prior programs, it is also important to assess: (1) the level and use of management reserves and (2) contract-related activities, specifically whether high risk approaches are being used—such as undefinitized contracts.

*Question 4.* Your statement makes a strong point about matching resources and requirements (see page 7) and also emphasizes the need for "performance and requirements flexibility in early phases of development," and the acceptability to "reduce, eliminate, or defer some capabilities so the project's requirements could be matched with the resources available to deliver it within the desired time fame." (page 8). We believe the "evolvable" nature of the SLS development approach required by the law, and the upper stage and advanced technology developments for beyond-Low Earth Orbit capabilities are tailored to be in line with what your are recommending. Do you believe that is an important "success-oriented" feature of the provisions and approach taken by the law?

Answer. The requirement for the SLS to be evolvable in nature is in line with our prior reviews of stable programs, where requirements are scaled to a minimum. Through this approach, projects are encouraged to incorporate known, proven technologies, while work is completed on more advanced technologies to meet future requirements. While the stable programs we studied pursued capabilities through evolutionary or incremental acquisition strategies a number of other things had to be in place, or in practice, for this approach to work. Specifically, the projects also had clear and well-defined requirements, received stable funding, leveraged mature technologies and production techniques, and established realistic cost and schedule estimates that accounted for risk. In addition, they executed their business plans in a disciplined manner and resisted pressures for new requirements. As I mentioned be-

fore, NASA has a history of not following through on some of these aspects or underestimating the risks associated with their approach. The reporting requirements from Section 309 will help the Congress ensure that these other aspects are in place. The bulk of the responsibility, however, will fall on NASA leadership to instill a disciplined management approach to the project that encourages a realistic identification of risks and progress and that holds managers accountable for project decisions.

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OFFICE OF SCIENCE AND TECHNOLOGY POLICY
EXECUTIVE OFFICE OF THE PRESIDENT
*Washington, DC, December 7, 2010*

Hon. DAVID VITTER,
Senate Committee on Commerce, Science, and Transportation,
U.S. Senate
Washington, DC.

Dear Senator Vitter:

I am writing to follow up on our discussions at the December 1 hearing regarding implementation of the 2010 National Aeronautics and Space Administration (NASA) Authorization Act and your specific request for a letter addressing the Administration's support for language in a Continuing Resolution (CR) that would enable NASA to move expeditiously forward.

Making immediate progress in advancing the goals and requirements contained in the 2010 NASA Authorization Act is a goal I believe we both share. However, as both you and the U.S. Government Accountability Office noted at the hearing, the FY 2010 NASA appropriation contains limitations on the transfer of funds from certain programs, and also contains limitations on using funds to "create or initiate a new program, project or activity, unless such program termination, elimination, creation, or initiation is provided in subsequent appropriations Acts."

At the hearing, you specifically asked whether the Administration would support the inclusion of language in an FY 2011 CR (or other appropriations vehicle as applicable) that would address these limitations and facilitate NASA's ability to proceed with full and timely implementation. I would like to take this opportunity to reiterate the Administration's support for language in either an FY 2011 CR or other relevant FY 2011 appropriations measure that would enable NASA to move forward in executing the full range of programs and initiatives described in the 2010 NASA Authorization Act, without the restrictive language contained in the FY 2010 appropriation or current FY 2011 CR. Enabling transfers and new starts, as required by the 2010 NASA Authorization Act, will enable NASA to more effectively implement the direction provided in this Act, which will in turn help us chart a new path forward in space and help to ensure that America's space program remains a shining beacon of American ingenuity and discovery.

Indeed, immediately following the hearing, the Administration sent a request to Congress for a broadly applicable, U.S. government-wide provision that would enable both the initiation of new projects and the transfer of funds from existing projects in the event of a FY 2011 CR, and this request would of course be applicable to NASA.

I appreciate the opportunity to appear before the Senate Commerce Committee and share with you and other members of the Committee the Administration's views on how we and the Congress can work together to make implementation of the 2010 NASA Authorization Act an unqualified success. As we continue our collective efforts to help NASA advance this bold new era of innovation, exploration; and discovery, I look forward to any future discussions with you or other members of the Committee on this important topic.

Sincerely,

JOHN P. HOLDREN,
*Director.*

Cc: The Honorable John D. Rockefeller IV
The Honorable Bill Nelson
The Honorable Kay Bailey Hutchison
The Honorable Barbara A. Mikulski
The Honorable Richard C. Shelby

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