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Chairman House Science Committee
U.S. Representative Sherwood L. Boehlert (R-NV)
House Committee On Science Holds A Hearing On Space Exploration
Washington, D.C.

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U.S. Representative Dennis Cardoza (D-CA)

Witnesses:
Sean O'Keefe, Administrator National Aeronautics And Space Administration
John Marburger, Director Office Of Science And Technology Policy

BOEHLERT: Good morning. I'd like to welcome everyone here for the first of what I am sure will be many hearings on the president's space exploration initiative. Our goal today is to get as many facts on the table as possible. Congress can only have a sensible and definitive debate on space policy if we are all working with the same understandings and assumptions. The policy questions before us are tough enough without a fight over the facts in the case. I think everyone concerned with this issue should expect a lengthy and spirited debate before Congress decides how to proceed, which could easily take us to the end of this calendar year.

So what do we hope to better understand at the end of today's session? We want a clear description of the goals of the proposed initiative, the ways it is expected to contribute to science, security and the economy. We need a clear understanding of the cost of the initiative, what's been assumed in developing cost estimates and how those estimates are most likely to change.

We need to get more operational details of the initiative. For example, how the space station will be serviced after 2010 and we need a fuller explanation of the impact of the policy. How will it affect both science and aeronautics and other NASA programs?

Right now we have far more questions than answers and I look forward to hearing from our witnesses today who are among the key architects of this new policy. We're going to need very direct and precise guidance from them. As you might have already gathered, I remain open minded about this proposal. The president and his top advisers are to be congratulated for having done what no one has been able to have been willing to do for more than 40 years -- lay out a well thought out space policy with a seemingly reasonable price tag.

The president has made hard choices. I know I agree with some of those choices. For example, I have been calling for the past year for a date certain to end the shuttle and space station programs. The president's proposal provides those dates, although we still have to examine whether the right end points were selected.

I still need much more information about the goals and costs before I can decide whether I support the particular choices the president has made in this proposal. I have to say that this is hardly the ideal year for this proposal to have come forward, although perhaps there would never be an ideal year.

But the increased proposed for NASA is especially conspicuous in a budget in which basic search increases by only half a percentage point. Indeed, non-defense, non-homeland discretionary spending as a whole increases only by that same slim amount. Is this initiative a high enough priority, a pressing enough priority to be funded in such a budget? I don't know.

And we have to remember that the percentage increases required in the years before fiscal 2009, if not before, will also turn out to be significant. So I am in a quandary, quite frankly, and the answers we get today will help me determine which way to turn. I imagine that will be true of others on the panel and certainly of others in the Congress.

The advance of human space flight is an engaging dream, but I want to know how we're going to feel when we wake up, when we have advanced human knowledge, when we have enabled our nation to be more respected, more secure and more prosperous. Will we have behaved responsibly in meeting the needs of the American people? Will we in short have helped this nation remain what Abraham Lincoln born this day called the last best hope of Earth . These are perhaps the toughest questions we'll confront at a hearing this year.

I look forward to hearing our witnesses provide the specifics that will help me figure out the answers.

Mr. Gordon?

GORDON: Thank you, Mr. Chairman. Good morning. I want to thank the chairman for welcoming the witnesses or join the chairman in welcoming the witnesses to today's hearing. I want to thank Chairman Boehlert for convening this hearing on the president's new space exploration initiative.

It's clear that the proposal has potential to result in significant changes to NASA's programs in the future direction as an agency. We need to hear more about it. First over I would like to state that I am pleased that the president has proposed some specific long-term goals for the nation's human space flight program. That is something that members on both sides of the aisle have been urging for some time.

I think it is appropriate for this nation to make a sustained commitment to human and robotic exploration of the solar system and also welcome the president's speech to that matter. And I think that an incremental approach, starting with a sustained presence on the moon makes a lot of sense for many reasons.

History has shown that past investments in our space program have resulted in new discoveries and technologies that have delivered significant benefits to our citizens. I have no doubt that we will learn much from future exploration missions and the American people will garner benefits both tangible and intangible from our expansion into the solar system.

Of course after further review, Congress and the American people may conclude that NASA's plans for implementing the president's goals are unrealistic or unaffordable or both. If so that doesn't mean that the nation should walk away from long term exploration goals. It just means that we have more work to do to craft a plan that is workable and sustainable. As we examine NASA's plan, I'll be looking for answers to a number of questions, including, one, what will the impact of the president's initiative on NASA and other important activities. I'm particularly concerned that NASA's other missions not be cannibalized, whether over the short term or the long term to cover the cost of this initiative.

Second, how confident should we be that NASA and the White House have a good understanding of the cost of the proposal and have a budget plan that truly reflects those costs? NASA has had a mixed record on the credibility of its budgeting and we need to be convinced that NASA is not being overly optimistic in its cost estimates.

In that regard, I would simply note that former president, George H.W. Bush proposed a similar program in 1989, his OMB director estimated its 30-year cost to be about $590 billion in 03 dollar terms. If that is what NASA is now estimating, I hope the budget plans reflect it.

If NASA thinks it can be done cheaper, then we need to understand why. Or what are the implications of some of the policy decisions embedded in the president's initiative and in particular, what will it mean to terminate the space shuttle program years before another American space craft is available to get U.S. astronauts into space.

It's clear that we will be dependent on the kindness of others, in this case, the Russians, to have any way of getting our astronauts to and from the space station. What if the Soyuz fleet is grounded or unavailable to us for whatever reason? What is plan B?

Well, there is much to cover and I hope that this hearing will mark the beginning of a thorough review of the initiative. I also hope that the president will choose to speak out on the space initiative. This will not be an easy year to start a major new initiative in the face of the growing deficit. The

president is going to have to make the case that this initiative is a high priority if it's going to survive for more than one or two sessions in Congress.

With that, I again want to welcome our witnesses. I look forward to your testimony.

BOEHLERT: Thank you very much, Mr. Gordon.

The chair recognizes the chairman of the Subcommittee on Science and Astronautics, Mr. Rohrabacher.

Now it is up to us to do our part of the job. It is the time for Congress to get on board and one thing that makes the strategy is that you are setting priorities. And while I respectfully disagree with my good friend, Mr. Gordon, I expect the president to cannibalize other programs in order to make this strategy work. That's called setting priorities .

But what we need to do, however, is make sure that those decisions, and this I would agree with Mr. Gordon, are clear decisions made that this priority is more important than another and thus we are taking funds intentionally in order to make sure the president succeeds in the goals that he has established.

Mr. O'Keefe, you can count on me and I know you can count on the other members of this committee to work with you if indeed the president is serious about the vision that he laid out and I am banking on the fact that he is serious and that we're going to do a job here and that we're going to start on the way back to the moon and then beyond. With your leadership and then perhaps 10 years, 20 years from now there will be a whole new set of characters, but we will have laid the foundation for the great success that they will accomplish.

Mr. Chairman, I commend your decision for holding this critical hearing today. As you know, I have been a staunch advocate of returning to the moon and establishing a permanent manned site there. Now the president has given NASA a vision that may help us realize that dream as a stepping-stone, of course, to even more further explorations of the universe.

Some day lunar settlements may be and will be thriving and growing, increasing our natural resources, the natural resources that are available to us, perhaps providing us abundant energy, but most certainly expanding our scientific knowledge and creating future industries that we can only now imagine.

In fact, citizen astronauts not only will contribute to our economic development, but also to our national standing and leadership in science and engineering as well. First and foremost, this outlook for the future must be built on a foundation of credible and affordable near and far term technologies and that's basically what we're going to be talking about -- the development of these technologies, how to

pay for it, when do we expect them to come on board, how that relates to the plan.

But experience has shown that the private sectors are innovating approaches are just as important as what government is doing, so let's, as we move forward, not look at this as simply a government enterprise. What the president laid out is a national vision not just a bureaucratic or governmental process.

Emerging space entrepreneurs have demonstrated that space activities are no longer limited to the government domain and that making a profit is critical to enabling the private sector to make investments in space. If we make it profitable, we have a vision of the moon includes something where the private sector is going to make a profit in helping us accomplish that mission, we can expect private sector investment to help the taxpayers.

The successful development of new space industries will undoubtedly hinge on expanding market opportunities and the new space exploration mandate calls for promoting commercial space and however let me just say that at this moment, I am uncertain exactly what NASA's plans are for the commercial part of this and how to attract private sector investment into the technologies and into the goals that we wish to achieve.

We can't expect to have it right now, but I know that's going to be an area of discussion for the next few months and perhaps the rest of this year. NASA must make clear how its long term investment in the future exploration activities with support and combination of focused man missions, robotic exploration and private sector initiatives.

Anything less threatens the credibility of the president's space vision and again, let me say you have our 100 percent support and I am looking forward to working with you, Mr. O'Keefe, in making this vision a reality.

Thank you.

BOEHLERT: Thank you very much, Mr. Rohrabacher and like you, as I indicated in my opening statement I want to applaud the president's vision, but I would like to add that before we get on board and to determine the extent of the ticket we're willing to purchase for the journey and that's why it's so critically important that we get very precise in addressing the timetables, the dollars and the impact on science overall and that's why I welcome Dr. Marburger here, because this is equally important that we hear from the president's science adviser on how this critical component on an overall package fits in with everything else.

With that, I recognize the subcommittee chairman, ranking member of space and aeronautics, Mr. Lampson.

LAMPSON: Thank you, Mr. Chairman. Good morning. I want to join my colleagues in welcoming Dr. Marburger and Administrator O'Keefe to this morning's hearing. It is indeed a very important one. I hope that it's just the first in a series of hearings that examines the president's proposed initiatives as well as to review the overall NASA budget request.

For me, the president's announcement of some long-term goals for the nation's human space flight program was both welcome and overdue. I've been pushing for a commitment for a sustained exploration agenda with a series of exciting and significant intermediate milestones on the way to Mars.

I introduced legislation to that effect in the last Congress and I reintroduced it again in this Congress. I welcomed the president's decision to put forth an exploration agenda and I look forward to working with him to advance its goals.

I think space exploration brings out the best of us, in us as a people. That said, I'm also going to need to be convinced that the implementation plan laid out by NASA is, in fact, both credible and sustainable before I can give it my unreserved support. I found it interesting that this morning's Washington Post had an article on the meeting yesterday, the commission -- the space exploration commission meeting where Norman Augustine, the retired chairman of Lockheed Martin, made comment that NASA doesn't have enough money or bright young stars to achieve President Bush's goal of returning astronauts to the moon and flying from there to Mars and It would be a grave mistake to undertake a major new space objective on the cheap, he said. To do so in my opinion would be an invitation to disaster .

In that same article, there was a quote from General Wester Lyles (ph) retired from the Air Force about the possibility that budgets and technologies from other government agencies could even be tapped. So it would be interesting to know, Dr. Marburger, if those were certainly plans or thoughts that you have.

We will do no favor to the dedicated men and women of NASA if we fail to ask the tough questions about the president's initiative. For example, what will be the impact of the president's plan on NASA's other programs? I agree with my colleague, Mr. Gordon. I am not prepared to do damage to NASA's other programs and other important activities in order to make this new plan fit within the president's budget.

Those who know me know that I am an unabashed supporter of NASA's human space flight program and of the good work done, particularly done at the Johnson Space Center. Human space flight is an important part of our nation's overall space effort and it has delivered significant technological and other benefits to our citizens over the years, but it is only one of NASA's missions. I don't know how many of you saw the news about the local law enforcement officials getting help from

NASA technology in identifying the suspect in the tragic abduction and murder of Carlie Brucia in Florida just recently.

What you may not know is that the technology was first developed by two NASA employees -- one a solar physicist and the other an atmospheric scientist to assist them in their research activity. It's a poignant, but important example of the ways in which our investments in all areas of the space program can serve the broader needs of our society.

As you know, the House recently passed NASA work force legislation to improve NASA's ability to attract and retain the best and the brightest. What message will we send if we now embrace an exploration plan that tells a range of dedicated NASA employees, thanks for your hard work, but we now need your budget for our new initiative. It seems to me that the president needs to propose funding adequate to do the job right or NASA regrettably will have to scale back its aspirations.

My own strong preferences is that the president provide the funding needed to do the job right. We in Congress will work to do it, but fundamentally, I don't want to put the NASA employees in the situation of once again trying to fit 10 pounds of new tasks into a five-pound budgetary pack.

Mr. Chairman, I have a great number of questions about the initiative that I hope we will address at this and subsequent hearings but I won't list them all right now. Instead I just will close by saying that we're being given the opportunity to construct an exciting and productive future for our nation's civil space program. We owe it to NASA and to the American taxpayers to take the time to get it right.

Thank you and I yield back my time.

BOEHLERT: Thank you very much, Mr. Lampson. I am particularly pleased that you mentioned the successful effort on the part of this committee to pass the NASA restructuring act, because that will enable Administrator O'Keefe and others associated with that very important agency to retain the existing stars in the horizon and to attract the new ones to that lexicon. So I am very pleased with that.

With that, let me say how pleased we are to have with us two very distinguished witnesses who have proven their service to the nation by their very capable administration of their duties.

First we have the Honorable John Marburger, director of the Office of Science and Technology Policy, affectionately referred to as the president's science adviser, Dr. Marburger. And secondly, our good friend -- and so are you, Dr. Marburger -- our good friend, Sean O'Keefe, the able administrator of the National Aeronautics and Space Administration.

Gentlemen, you know the drill. We try to condense the opening statements to allow us ample time for questioning and there are

more questions that can possibly be answered in this hearing. This is the first of several. I am not going to run a clock on you, but at some time, if you get a little bit too loquacious, I will suggest that maybe you stop and permit us to get a word or two in. With that, I open with Dr. Marburger.

MARBURGER: Thank you, Mr. Chairman and Committee Members, for inviting me to discuss the president's vision for space exploration. I believe the nation's space enterprise will be strengthened by this vision, which will continue a brilliant record of NASA discoveries that have literally changed the way we view the universe.

I prepared a written testimony that is too long for oral presentation, but it does contain detailed responses to the questions that you asked in your letter inviting me to testify. Of course I will be glad to answer any questions about that detailed account as well as others.

First issue is the rationale for the president's vision. The president describes this vision as a journey, not a race, and it differs profoundly from the Apollo paradigm of a single massive project requiring a large budget spike and an aggressive schedule.

In this new vision, milestones are established to guide planning on a series of discreet and mutually reinforcing projects whose aim at each step is to reduce the cost and the risk of all subsequent missions.

There are certain technical facts about space exploration that seem to be ignored in much of the public commentary and I describe these briefly in my written testimony. But the president's new paradigm takes these facts seriously, balancing robotic and human roles and dealing with them and mandates a step by step approach to address risks and costs within a steady and realistic flow of resources.

Regarding human exploration, the president's vision implies a fundamental change in ground rules. The idea, in his words, is, quote, To explore space and extend a human presence across our solar system making steady process, one mission, one voyage, one landing at a time.

It has the potential of providing mass for numerous uses in further exploration missions and therefore significantly reducing future costs. The long-term value of the moon is not primarily in its direct value to science but in its value to all future deep space operations.

The second issue is the deliberative process leading up to the president's announcement. I've described this process in my written statement. It was a normal White House policy process in which my staff and I were involved from the beginning as was NASA and Administrator O'Keefe.

An extensive literature with many analyses and reports exist on space exploration. I would describe the process as taking place in an information rich environment. I'll be glad to answer any further questions on process. Sean and I sat through a lot of meetings and we can talk about it but there was nothing particularly unusual about this process.

The third issue is the question of the science benefits of the vision. People have referred to that in the opening statements. The president's new paradigm will open up new opportunities to explore and understand the cosmos. Further, major advances and understanding the solar system and the universe beyond what is now technically possible will require much more complex operations in space or on the surface of solar system objects -- moons and planets and asteroids.

These would involve high power instrumentation, large area and long duration investigation of multiple planetary bodies and the possible assembly of sophisticated observatories in space or on the surface of other planets. <

Such complex missions are not possible today for several reasons that are detailed in my written testimony. These reasons are interrelated and overcoming them systematically will build the backbone for a robust exploration agenda.

Related to this issue is a sequence of enabling initiatives associated with the vision. Once again, there are several important enabling initiatives that are outlined in the president's vision and I urge you to read the more detailed analysis in my written testimony for each one of these components. I'll just name topics that are addressed in my written testimony: the International Space Station. What are we doing to do with that? The moon. Why the moon? What is it that we plan to get out of being on the moon? The role of robotics. Power and communications capabilities.

These are all -- there is a technical basis for a choice of emphasis on these topics and I will be glad to respond to questions about it.

Let me take a little bit more time in my oral remarks to discuss the next issue, which is the impact on existing science activities. That is of immediate importance to many committee members. Much of the $11 billion that are reprioritized within the FY 2005-2009 budget comes from discontinuing the launch technology program and savings derived from shuttle retirement and reprioritization of research on the International Space Station.

In this budget, space science continues to be robust. The vision specifically calls for a new series of robotic exploration missions to the moon and Mars. The outer planets continue to be a research priority with the Jupiter Icy Moons Orbiter -- JMIO -- and a mission to Pluto also included.

The Sun-Earth connection research also remains a priority despite the stretch out of the solar terrestrial probes awards; this program and all others in NASA's Sun-Earth connection theme are scheduled to continue.

A whole new generation of space observatories is being planned. The FY '05 budget maintains the web telescopes scheduled 2011 launch date. Other observatory missions are described in the written version of my testimony. I will say more at the end of my remarks about the Hubble telescope.

NASA's Earth science enterprise has been and will continue to be the largest contributor to the interagency climate change science program. The president's FY '05 budget supports the NASA aeronautics blueprint with the request for $919 billion. This maintains the funding levels for aeronautics that was in the president's '04 budget plan.

The presence of FY '04 earmarks in the budget numbers creates the impression that reductions have been made to content in this program, which is not the case. We are committed to aeronautics and NASA has created a new enterprise specifically focused on aeronautics within its administrative structure.

The technology development necessary to execute and implement the president's vision will accelerate advances in robotics, autonomous and fault tolerant systems, human-machine interface, materials, life support systems and (inaudible) novel applications of nanotechnology and microdevices. And finally, a framework and a vision for a sustainable exploration coupled with intellectually stimulating problems is a powerful asset in our continuing campaign to spark interest in science and technology among young people.

Mr. Chairman, this vision opens up a new era of space exploration. It articulates the purpose for humans in space and it is good for science. Now I would like to take a few minutes in the remaining portion of my testimony to go into the technical issues related to the Hubble Space Telescope.

BOEHLERT: By all means do so. Ignore the red light. We're just keeping it on as a guidance, so we can focus our attention.

MARBURGER: Thank you. You did ask me some specific questions about the Hubble Space Telescope and there is a longer version of these comments in my testimony.

First of all, let me say that the decision to cancel the SM4 servicing mission to the Hubble was based on NASA's safety assessment and recommendations made by the Columbia accident investigation board.

I fully support NASA's concerns about safety and I support the administrator's action in asking Admiral Gehman to review this matter and offer his unique perspective.

Now as to the Hubble's importance -- the authors of a 2001 National Research Council report said that, and I quote, The Hubble Space Telescope has arguably had a greater impact on astronomy than any instrument since the original astronomical telescope of Galileo.

In the 14 years since the Hubble was launched, however, and I go into many of the discoveries and the assets that Hubble brings in my written testimony -- in the 14 years of its 15 year estimated lifetime when it was designed, tremendous progress has been made in improving the quality of ground based telescopes -- using adaptive optics, ground based telescopes are now capable of resolution competitive with and in some cases better than the Hubble at its longer wavelengths and near infrared.

In its assessment of space astronomy, the National Research Council report that I quoted did not recommend new missions in the Hubble wavelength regime for three reasons and let me quote from their report, 2001 report. This report is known as the most recent decadal survey, a very excellent report the astronomy community compiles periodically to guide its future programs.

First, many of the key science opportunities in this wavelength regime are predominantly in the infrared. Second, the IR region has been studied much less than the optical region so that the potential for discovery is much greater and third, much of the important optical astronomy can be done from the ground.

The Hubble is an optical telescope reaching into the near infrared. The committee wrote its report assuming the SM4 service mission would take place, but its statements regarding the evolving role of the Hubble relative to other priorities are important in the present discussion about risk versus benefits.

I might add that the charter for this hearing incorrectly states that a National Academy panel called for yet another servicing mission beyond SM4. The panel indicated that the benefits of such a mission would have to be assessed by a review similar to the one that led to the report that I quoted.

If serviced, I have no doubt that the Hubble would continue to provide world class scientific data and be used to further refine our understanding of our universe, but the safety issues cannot be ignored and they must be considered not only with respect to the Hubble capability, but also the ever increasing capability of visible ground based telescopes combined with the exciting next generations space observatories now being built.

Thank you, Mr. Chairman, for giving me time to make this statement.

BOEHLERT: Thank you very much, Dr. Marburger, and we've given you a little more than double the normal time for opening and we would accord Administrator O'Keefe the same courtesy because

it is such an important aspect, but I would hope that we could avoid what I refer to as a schmoozing aspect of these hearings. I don't want my colleagues in the committee thanking me for making this hearing possible. Circumstances make it necessary and we know we have good working, solid working relationships.

(UNKNOWN): Mr. Chairman, I'd like to thank you for saying that.

BOEHLERT: I would like to remind everyone of the solid working relationship we have with Administrator O'Keefe and the agency and with Dr. Marburger and the White House crew. What we are interested in is as much factual content in this first of many hearings as we can possibly get. With that, let me introduce my good friend, Sean O'Keefe.

O'KEEFE: Thank you, Mr. Chairman. I thank the members of the committee. I appreciate the opportunity to be here and to summarize, I think, in slightly different direction here than Dr. Marburger has done. I think he gave a very comprehensive review of the overall strategy and I'll just try to touch on a couple of highlights that augment that as well.

First and foremost, last August 26, the Columbia accident investigation board, I think very pointedly, observed the absence of strategy and national goals as being contributing factor in the space policy drift as they referred to it over the past, as they called it, three decades . It was interagency process that Dr. Marburger described and as we go into some detail in the prepared statement to address and accelerate those very questions and to examine this point very specifically.

The Congress and certainly in multiple hearings as well as on both sides of the Hill as well as countless editorial pages call for the president to offer a vision. On January 14, the president did just that. It's a journey, not a race . That was his primary phrase and that was the function I think he was really trying to drive home as a long-term objective. So this is not a program for which there can be discrete elements that you toed (ph) up and determined what the ultimate consequence is. This is something that over a longer period of time we can assess and must assess progress as we approach this journey, not towards a singular objective.

It is not a crash program. It is not something intended to be a take everything out and put everything you've got towards it in order to achieve a single point destination objectives. It is a long-term set of objectives, which I think Dr. Marburger touched on very extensively.

It is a deliberate focus on lunar, Mars and beyond objectives. The exploration will be informed by the scientific objectives. That is a primary function of exploration informed by the science as we move forward. It's a deliberate focused approach to knock down the technology obstacles and hurdles necessary to achieve each goal in turn.

The strategy of a stepping stone approach is to build on successes as realized, not to anticipate inventions along the way for the success of each stage. Instead, as successes materialize, then you adapt the plans and you adjust the necessary to accomplish the longer-term goals the president has laid out.

It is fiscally responsible. The president's budget is $16.2 billion and rising in the five year plan is well within the president's fiscal policy to contain discretionary spending at 4 percent growth and to cut the deficit in half within five years. All of that has been accommodated in the proposal the president submitted on February 2.

It's achievable, it's ambitious, it's focused and it's affordable. The vision document that all of you have before you is the bridge, if you will, between the president's statement, his policy directive and the budget that is in place. And we've put that together as a means to try to describe the entire approach on how this journey will play out in degrees and by chapter.

There is no massive commitment today that will be expected to be paid for by a future Congress. At each step and every interval along the way, the president and the Congress annually will have the opportunity to evaluate their progress, consider proposals about how that next chapter will proceed. This is the overall game plan. It's the objectives of what has been articulated. In terms of how it is successfully taken on is an annual matter of review and there is no commitment that is being requested today that commits to a large balloon note in the future. Each of it is progressively developed.

Mr. Chairman, if I could offer the observation, I guess, that has been included in several editorial pages as well, is the divergence or disparate views within the public condition right now.

The public interest is there. I offer to you just an anecdote. In the last 40 days, the NASA web site has received 6 billion hits -- 6 billion hits. That involves 47 unique different visitors -- 47 million, excuse me. So as a consequence it's not only...

BOEHLERT: There's not 47 people hitting the same button at the same time.

O'KEEFE: ...to achieve 6 billion hits. It's 47 million people who are in turn then returning repetitively to the web site in the course of that time. Over the span of this 40 day period, that is more than twice the total number of hits we received all of last year. All of last year was four times that which we've ever received before.

So as a consequence, the interest level in what is going on and what is involved is extremely high. It involves 430 million page views that are involved in this. It is effectively the

equivalent of distributing all of what is contained in the Library of Congress seven and a half times over the course of 40 days. That's what has been delivered through the web site alone.

It also includes a wide range of disparate kinds of interests involved. There are more than a thousand schools in the United States and universities which have access to the web page over the span of this time. It includes not only K through 12 programs, but also university efforts.

Now the sections that are being hit -- it's not isolated to one area. It not only includes the Mars rover updates but the kid's section, which is up five times, the student's section, which is up three times. Educators, are going to this in a factor of three higher than they've ever gone into it before.

So as a prospect of this or a consequence of it, the interest level across everything we are engaged in is pretty high. Just to give you a quick flavor of what it is they are looking at, there are a couple of charts -- before I was going to give it to you as a graphic as well -- very brief.

Certainly the immediate image or interests are on the success of the two Mars rovers. The first image is a color image taken by the panoramic camera taken aboard Spirit showing the Adirondack which I think was appropriately named given its formation as well as (inaudible).

The next is a medium resolution version of a 360 degree view of the Martian surface taken aboard Spirit and its camera. The next is a drag mark that was made by the Spirit as it moved off of the deflated area and moved on to an area referred to as magic carpet as it moved along.

The next series is Opportunity, a picture taken soon after Opportunity landed, showing the interior of the crater, which it is now exploring. The next is an image is by Opportunity's navigation camera, showing an overhead perspective of the rover itself and how it initially landed at that point on the Challenger Memorial Station location.

And finally we have a Martian postcard from the panoramic camera of Opportunity showing the Martian landscape southwest of the rover. This is the area that they're really examining with great detail as it works across that.

And a final image of what was also being struck several times is that of the Spitzer space telescope. This past December, two months ago, Spitzer became operational. It observes the cosmos in an infrared capacity with unprecedented sensitivity, exactly as Dr. Marburger described. In the comparative images you see here, is one versus in a smaller inset is what visible light would otherwise provide. The one to the right in the larger image is what Spitzer has provided as a consequence of the infrared capability. It is now operational and being access

multimillion times as a consequence of the availability on the web site today.

With that, Mr. Chairman, I thank you very much for the opportunity to testify and look forward to your questions, sir.

BOEHLERT: Thank you very much. I would observe that most of us in this room are part of the 47 million people who have been excited and are responsible for those 6 billion hits on your web site. I'll also point out that it is an unmanned mission that is exciting the world and we're here mainly to concentrate on the manned exploration portion of the president's initiative. That's where we're going to be very specific in addressing.

Mr. O'Keefe, is a plan as long range and far reaching as the exploration initiative necessarily has to budget for many items whose cost cannot be known with any certainty at this point. What items in the exploration initiative are most likely to cost significantly more or less than is currently budgeted. Presumably the figures you used to calculate the budget for the initiative are sort of in the middle range of possible costs. Can you give us the full range of the costs of the initiative and how likely is that the initiative can be accomplished for the amount budgeted. A comprehensive question.

O'KEEFE: Thank you, Mr. Chairman. First of all, there is no way to put a price tag on a program that is in definition. Again, the objective is to lay out the longer term objectives and that is exactly what the president's directive does.

At each successive stage, there will be a price tag attended to it. Along the way, too, in slight contrast to your opening comment, this is a combination of both human capacity as well as robotic capacity. That's what is included in the exploration objectives and all of it is a set of precursor missions that require or demand robotic capabilities beforehand.

So the definition of the price tag of those is going to get higher and easier to define as we move along in this particular approach. In the immediate term, what the plan calls for is an immediate cost of return to flight, completion of the International Space Station and on those two I think we can give you a much greater definition of cost estimate for those accomplishments than our many other elements of it.

And the next stages from there are to develop a project constellation, the crew exploration vehicle, which will extend beyond the scope of this decade, and during the course of this time, $6.6 billion has been budgeted and more to follow as we continue to that development.

BOEHLERT: I am assuming middle range of projections, that those are the assumptions that we are operating under, but where is the greatest uncertainty. Is it the CEV? Is it the shuttle? Is it development? Where is the greatest uncertainty at this juncture?

O'KEEFE: I personally think the greatest uncertainty will be the cost to develop power generation and propulsion capacities and over what span of time. Right now we have no means to generate power or to propel anywhere. It is all based on solar power collection and that's it. What we're trying to do with project Prometheus is develop the capacity to propel anywhere which will get you there faster as well as inform the science opportunities that generate more power for the science packages as well.

That was the one I think has got the greatest prospect of uncertainty in terms of what its overall cost is depending on how you want to size its use. Do you want to apply it just to robotic capabilities? Do you want to include downstream towards the power and generate power for and propel a crew exploration vehicle. Those would be the primary ones I think would be the limitations.

BOEHLERT: Well is the propulsion for the CEV or for later.

O'KEEFE: Both.

BOEHLERT: Both?

O'KEEFE: Yes, sir.

BOEHLERT: Next question. In the past, Congress has often invested so heavily in NASA programs that it seems too late to cancel a program even after it proves to be troubled. We've seen an example of that. What milestones of for assessment are built into the major aspects of the expiration initiative. At what point should NASA and the Congress reexamine the initiative, particularly CEV development to determine whether it is appropriate to proceed to completion.

O'KEEFE: Yes, sir. Thank you for the question. It's an exactly critical one in the sense that the approach we're taking here is a strategy that gives multiple opportunities to assess progress. The approach with the crew exploration vehicle under project constellation is specifically to develop and use a spiral development technique which will require the deployment of unmanned capacity on at least a couple of occasions, probably more, between now and the time that we develop a human rated capability.

So what you do is each component in turn is launched to demonstrate that success and then build on it. As that success is evaluated, you make the decision to move the next phase thereafter. Along the way, concurrently with that is also a range of robotic capabilities for lunar exploration as well as potential power generation capability there as well. But again will be assessed each in turn by mission and to the extent there is an adjustment necessary, an acceleration or a slow down of those activities based on the relative success of each of those steps, that's where we make the decision to move off.

So there isn't a one time commitment that will in turn to create a balloon note down the road at each step to make a judgment about how you progress ahead.

BOEHLERT: Thank you. Mr. Gordon?

GORDON: Thank you, Mr. Chairman. Thank you for your cue to get down to business. Let me repeat Mr. Augustine's comments yesterday. It would be a grave mistake to undertake a major new space objective on the cheap. To do so in my opinion would be an invitation to disaster. Certainly nobody here wants a human disaster or a financial disaster and I think a financial disaster is getting a quarter of the way down, 20 percent of the way down, 50 percent of the way down the line and saying we can't afford this, we're going to do something else. They'll be some benefits, but we don't want to do that.

And for Mr. O'Keefe, this dollar cost is something that we're all concerned about. I had written you and asked you specifically about that. Your response was in terms of cost, it depends, what was pretty much what you said here today, it depends.

But we need a benchmark and I know you can do various things, so if we gave you a benchmark by going to the moon by the year 2020, what would be your estimation of that cost.

O'KEEFE: Well, sir, first and foremost, let me suggest that Augustine's comment yesterday, Mr. Augustine's comment yesterday was also that he had not read any of the details involved in the plan. So I think he quoted that point as well.

The second point of exactly how we would return to the moon by 2020 depends on which components you...

GORDON: You take any set of components you want. You just take one, just get us there and tell me what it is going to cost.

O'KEEFE: OK. Yes, sir. The robotic capability to return to the moon within this decade should not cost more than $500 million to $600 million for that robotic capacity. Then after that you make a judgment of whether you want to go back with what capabilities.

GORDON: You go ahead. You go just ahead and lay a benchmark out of what you think would be reasonable and tell me what it costs.

O'KEEFE: You wouldn't want to presume success at any stage. I want to make sure each step along the way goes properly.

GORDON: Just go ahead and presume a reasonable course and tell me what it would cost.

O'KEEFE: Over the course of this past year and since February 1, 2003, I have made it a point not to anticipate success beyond the next stage.

GORDON: Let me put it this way. Dr. Marburger said that you went through a very extensive program, lots of meetings, it was an environment, as he said, that was information rich. And you told me that the president was very engaged in this.

Now surely the president wouldn't have a pig in the poke. Did the president never ask you what this was going to cost?

O'KEEFE: Yes.

I think it is important to realize this is not a single mission Apollo-like program and the...

GORDON: If I could, please. I am going to lose time. You know, you take anything you want. Just tell me, did the president, in this discussion at any time say, what is this going to cost.

O'KEEFE: Absolutely.

GORDON: And what was your answer?

O'KEEFE: The president's budget request has multiyear budget commitments that he is prepared to support that go beyond...

GORDON: It's only five years, isn't it. Anything beyond the five years?

O'KEEFE: Yes, it goes out to 2020. And there is a budget profile that goes with that. It is calibrated, I presume, in 2004 dollars.

GORDON: So what's it going to cost by 2020 to go to the moon.

O'KEEFE: You'd have to integrate under that curve to find the total cost but the curve goes up on a line that is quite consistent with the FY '04 approved budget...

GORDON: So what does that cost?

O'KEEFE: The mass of budget in the year 2020 according to this would be about $22 billion.

GORDON: What is the cumulative cost, then, to get to the moon by 2020.

O'KEEFE: This includes the entire NASA budget and their components. It looks like only...

GORDON: Again, if I could, did the president never asked you what the cost of the program was going to be?

O'KEEFE: The president understands that we are enabling all future space exploration by putting into place...

MARBURGER: Yes, of course.

GORDON: All right. And what did you tell him?

MARBURGER: And we showed him this chart.

(UNKNOWN): (inaudible).

GORDON: OK. All right. And could you tell me -- could you add that up and tell me what that means, then?

MARBURGER: I mean, I would have to do some calculations on this chart.

GORDON: So you haven't done the calculations before?

MARBURGER: Yes. I'm sorry. These precise numbers that you are asking me here are not part of what I carry in my head.

GORDON: I'm asking just a general number of what's it going to cost. You know, did the president ever ask you what is it going to cost to go the moon?

MARBURGER: Actually, the question of going to the moon is part of the program that would be accomplished according to the timetables in this (inaudible).

GORDON: OK. I'm not trying to be argumentative.

MARBURGER: Well, I'm looking at the same pictures that you are.

GORDON: All right. So when the president asked you what it's going to cost, you didn't tell him? You just gave him this chart?

MARBURGER: There are tables of numbers associated with this that do appear in the FY '05 presidential report (ph).

GORDON: All right. Did the president ever ask you what anything was going to cost?

MARBURGER: Yes, of course.

GORDON: OK. What did he ask you, and what did you tell him?

MARBURGER: I'd like to respond to that in writing so that I can be sure of my response.

GORDON: OK.

MARBURGER: I would prefer not to try to calculate it from this draft at this point.

GORDON: But you have (ph) to calculate a response?

MARBURGER: But I will make a response.

GORDON: But if you were there in this environment rich (ph), you don't remember him asking you what anything was going to cost and what you told him?

MARBURGER: No. I'm sorry, Mr. Congressman, that I'm unable to answer these questions that you're asking in precisely this form. The emphasis in this vision is (inaudible)...

GORDON: OK. Well, I've got to go on. I'll try. Yes.

MARBURGER: ... sustainable, affordable...

GORDON: So let me ask this.

BOEHLERT (?): You said you were going to...

MARBURGER (?): We do not want to devote more of our discretionary budget than we can afford in any one year.

GORDON (?): OK.

MARBURGER: And we will adjust the timetables (inaudible)...

GORDON: I understand. I understand. Again, you said you would respond to me.

MARBURGER: Yes.

GORDON: My question to you was did the president ever ask you what anything was going to cost.

MARBURGER: Yes.

GORDON: What were those various things that he asked? And what did you respond?

MARBURGER: And...

GORDON: OK. You don't have to do it now. That's fine.

MARBURGER: I'd be glad to respond.

BOEHLERT: Thank you, Dr. Marburger, and submit it for the record. I would observe that the '05 budget projects out to '09, not beyond. So those are the figures we have (inaudible).

MARBURGER: The initial one in the budget, but this entire graph up through 2020 is an important part of the vision. It shows how the funds available for exploration, for a credible exploration program, can be made available within an affordable envelope. This is a very important part.

The reason we're having this problem is that we're looking at this from different perspectives. This is not an Apollo-like project. The key word is to enable future space exploration. We are going to become a space-faring nation to take advantage of the assets and the resources that exist...

BOEHLERT: Thank you, Dr. Marburger.

MARBURGER: ... these opportunities for discovery.

BOEHLERT: Thank you, Dr. Marburger. I just want you to know that it's evident, then, we've just had two -- I have also had the opportunity to ask some questions. But we're very interested in getting as precise information as we possibly can get. And we understand fully that in some instances there are going to have to be ranges. And we fully understand that there are assumptions and we are assuming -- and we want this verified -- that you can give us the ranges.

And I further assume that we're probably looking at the mid-point in the ranges. If some things go well, then the costs are reduced. If other things don't go as well as anticipated, costs are increased. So we're dealing with ranges. But we want as much specificity as we can possibly get.

For example, we've been told by the NASA comptroller that development to full completion of the CED could cost as much as $15 billion. True?

O'KEEFE: No, absolutely. Yes, sir. That's a fair range, and it's that very specific point of what is the development of that capability, that unique asset. The answer is in that range of $15 billion.

Everything we did on the orbital space plane, 75 percent of that effort is certainly transferable to the same kinds of activities we would pursue with crew exploration vehicle under Project Constellation. And that is in the range of about that. Six and-a- half billion of it is what is in the budget before you between fiscal year '05 and '09.

And as we move through those spiral development phases, the definition of that particular estimate will become much better understood. The first spiral development product that you have to deploy that'll be unmanned certainly by the end of this decade is a capability that is well within the range of the amounts we've budgeted so far. And depending on what the outcome of that is as to whether you commit future resources to it. But the overall cost of that asset to go anywhere is in that range of cost. By program (ph), by mission objective, that's a different question. It depends on how you employ it, where you go, when do you do it, how many times. Those are all factors that need to be resolved.

BOEHLERT: Thank you very much. I do appreciate that.

O'KEEFE: Thank you, Mr. Chairman.

BOEHLERT: The chair recognizes the distinguished chairman of the Committee on Space and Aeronautics, Mr. Rohrabacher.

ROHRABACHER: As long as you don't say the extinguished chairman, that's all right. I think that the question Mr. Gordon is asking is a very relevant question. And I think that we do need specifics.

Mr. Gordon, I'm complimenting you on your questions, Bart. Let me just note that I believe the line of questioning that you had is very justified. And we do need specifics.

But if I could go through some of the general areas, and maybe you could come back to us with as much specifics as you can. In order to handle this first phase that we're talking about in terms of the president's vision, our first step toward the moon, we have a CEV, which is a crew exploration vehicle, which we'll have to develop. Will we be developing a heavy lift capability, a new rocket that would have heavy lift? Is that necessary as well?

O'KEEFE: No, sir, I don't think so. But it could evolve that way. But that would involve a back-to-the-future approach, if you will, of saying let's do this just like we did Apollo. Let's put everything on one asset...

ROHRABACHER: OK.

O'KEEFE: ... and just brute force it right off this rock. OK? That's the approach we used with Apollo. The approach we've defined here is a spiral development approach in which you develop each component, launch them separately. So as a consequence, the available assets that are in inventory today at the initial phases of deployment, the expendable launch vehicles, Atlas and Titan as well as the potential combination of a shuttle stack -- there's a number of different alternatives that you could pursue (inaudible).

ROHRABACHER: When do you think we'll know if a new heavy lift rocket is necessary to actually fulfill the requirements?

O'KEEFE: I think certain definition of that would be reasonable within this next six months to a year.

ROHRABACHER: OK.

O'KEEFE: Because if it calls for something larger in terms of mass,...

ROHRABACHER: Right.

O'KEEFE: ... then you've got to go beyond the scope of Atlas and Titan or a shuttle stack or something else.

ROHRABACHER: But there may be ways of doing this, having a certain amount of support equipment lean (ph) on another rocket (inaudible)...

O'KEEFE: Exactly.

ROHRABACHER: ... that doesn't need to go up with the crew?

O'KEEFE: Exactly. And at each component, you could potentially do a launch and assembly thereafter as opposed to a one-size-fits-all, let's get the static displays of the Saturn Fives out, stand them straight up and try to use them again. I mean, that's just not part of the cards here.

ROHRABACHER: OK. And also, another element of this is, of course, expenditure that we're going to need to know the specifics on is how much it's going to cost for the robotics. It seems the president just outlined the vision. We don't know exactly what robotics capabilities will be necessary right now. But how long will it take before we know exactly what those capabilities will require and how much that will cost?

O'KEEFE: Sure. Yes, sir. With precision I can give you the numbers -- and we'll submit it for the record here -- on the future Mars exploration missions we have that are all robotic.

ROHRABACHER: Right.

O'KEEFE: And they're scheduled for '07 and '09. And there are some very specific missions that go with that that we can give you a price tag of what that out-year projection is. The lunar missions, as Mr. Gordon was inquiring about earlier, will require the development here over the next six months. But again, I'm looking at something in the range of five to $600 million worth of initial lunar robotic exploration capacity that will be (inaudible).

ROHRABACHER: But we actually have not determined -- I mean, the president has just sat down his goal. We have not determined exactly to what extent the robotics cost of development will be because we don't know how much robotics capability we'll need at this point in terms of the moon part of the goal.

O'KEEFE: Yes, sir. That's correct, sir.

ROHRABACHER: Because we may need robotic robots that, for example, might do extensive work with soil analysis or other type of exploration.

O'KEEFE: Yes, sir.

ROHRABACHER: And we may not. But that will be determined within the next six months?

O'KEEFE: Yes, sir. And as a reserve in the five-year projection of the kind of resources that would be available for specifically those robotic objectives.

ROHRABACHER: OK. So the crew exploration vehicle -- let me note that I think that $15 billion for the development of a crew exploration vehicle is a pretty big ticket item. And that sounds a little out of line to me, and I'm really going to look at that as it moves forward.

Also, I would suggest there are rumors running around that people might be thinking that they're going to design this crew exploration vehicle that's going to be used both on the moon as well as on the Mars part of this presidential challenge. Just an admonition from this congressman, just as it's hard to plan budgets 20 years out, I think that the idea of trying to have a vehicle that we're planning right now that's going to be accomplishing both of those goals, even though those goals will be about 10 years in differential and when you achieve those goals is not really a rational way to plan that stepped (ph) approach that you're talking about.

O'KEEFE: Indeed. And that's the precise reason why answering the question of exactly how much will it cost to do the following thing is right now an imponderable point because depending on how you weigh the components necessary and develop them in each stage of the spiral development for the crew exploration vehicle gives you a different configuration.

ROHRABACHER: Yes.

O'KEEFE: And again, the answer on Project Constellation for right now is finite of $6.5 billion in the budget right there by line item '05 through '09 and then the additional costs thereafter to develop all of the following spirals for a human rating capacity is what would occur in the next phase (inaudible).

ROHRABACHER: And as I say, Mr. Gordon is absolutely right in asking for specifics. But I think that the question is more appropriate to say do we expect specifics as we move forward.

O'KEEFE: Yes, sir.

ROHRABACHER: And we don't expect to have just, you know, a general plan in the future.

O'KEEFE: Exactly.

ROHRABACHER: OK.

O'KEEFE: No, at each stage you get a (inaudible).

ROHRABACHER: OK. Now let me note the space launch initiative, which is something that I put a lot of time and effort in getting into the budget -- and finally I got it accepted -- the idea that we were going to actually have some part of the budget committed to developing new launch systems. That seems to be the line item in the budget that has been most cannibalized by this effort. I am not upset about that. I would expect that -- let me just say that, you know, this has been my baby.

I would expect that those funds would be used in a priority fashion to help fulfill the president's goals. And I would hope that all the rest of us as we move forward -- we all have

things that we pay special attention to in the budget and things that we have pride in -- that we don't let our ego get in the way of letting those funds be used to help us prioritize and achieve the goals the president's outlined.

BOEHLERT: Thank you very much, Mr. Rohrabacher.

O'KEEFE: If I could, Congressman, very quickly? The space launch initiative did its job. You did exactly what, I think, it was intended to do, which is it served up the options, and we made the selection of the options. It worked exactly right, and it provided us the capacity to be where we are right now. So I thank you, sir.

BOEHLERT: Thank you very much. And I think it's very evident from what has been said to date that all of us are looking at this, not in isolation, not as just one piece to the overall puzzle. We want to see the big picture and how this impacts on every other piece so that we can make rational judgments and develop responsible policy.

Speaking about responsible policy, Mr. Lampson?

LAMPSON: Thank you, Mr. Chairman. And speaking of what you were saying, I think you led right into what I wanted to ask.

I have a couple of questions. There are many things that we want clarification on. Let me try to focus on two of them in my very short five minutes here.

Mr. O'Keefe, NASA's budget charts indicate that there won't be U.S. funding for the International Space Station beyond 2016. We need to know what you intend to do with the U.S. portion of the space station beyond that time. When you responded to Mr. Gordon's written question on that topic, you said then, NASA will continue the operation and maintenance of the ISS consistent with the U.S. space exploration goals.

However, that statement is contradicted by the budget plan that accompanies the president's initiative. So which is it? Is NASA going to continue to fund the U.S. participation in the space station after 2016? If so, about how much will it cost and for how long? And if not, what did you mean by Mr. Gordon's question and your response to Mr. Gordon's question?

And let me say one other thing before you answer that.

O'KEEFE: Yes, sir. I appreciate that. And thank you for the question. First of all, the objective of the next dozen years between now, 2004 and 2016 is the targeted span that we're looking at to really refocus all of the research effort that the U.S. modules will be conducting focused on human physiology and long duration space flight consequence.

So all of the other priorities that were outlined in the re-map effort, you may recall, a year and a half ago that we went through of looking at what science prioritization, the answer

now is there is one priority. We're focusing on life sciences. We're focusing on what the challenges of understanding the research necessary to inform long duration space flight.

LAMPSON: Is there an expectation, then, that we can end that by 2016?

O'KEEFE: Yes, sir. Yes, sir. That's the expectation, that that research will take us through the middle of the next decade of 10 to 12 years to achieve that. If it doesn't, we'll have to continue that activity beyond that point.

LAMPSON: OK. At what point do we have to notify our international partners of what we're going to do? Because it impacts them as well.

O'KEEFE: Yes, sir, absolutely. And we discuss with our international partners on a regular basis. They are meeting and convening today. We will continue to do so on a regular basis, and we'll constantly update them as we move through this.

They do not feel as though there's an abandonment that's occurring here. Their view is that as we step through this, we've got to determine what the components and modules look like, what the laboratory segments look like, when they deploy and how long we want to all deploy them or operate them.

LAMPSON: And in 2016 if this ends, is there a plan, then, to bring it back?

O'KEEFE: No, sir. Again, there's no presumption here that upon the completion of our research endeavor to examine the human physiology effects on long duration space flight that we turn out the lights on station. Our partners intend to continue operating. And we may, too.

LAMPSON: So our partners...

O'KEEFE: And may, too. And we may, too. So as a consequence, it is designed through the next decade to continue on. And there is no presumption here of turning off the lights on station by the middle of the next decade.

LAMPSON: OK. OK. That was the budget. Well, let me go to my next one, because I've run out of time.

O'KEEFE: Yes, sir. But that only (ph) goes through 2009. The budget only goes through 2009. So the longer-term projection is we're trying to give you visibility over what the research plan is. We're trying to lay out goals to the research community to say within the next 10 to 12 years, we have to conquer these particular challenges of long duration space flight.

LAMPSON: Doesn't that end on your chart in 2017?

O'KEEFE: Yes, sir. That is the specific cost and the activities related to long duration space flight human physiology life

sciences research. How that may be adapted beyond that point to build the capacity on what station can still afford is something that we've got an opportunity to examine.

LAMPSON: OK. We may have some more questions on that.

O'KEEFE: Yes, sir.

LAMPSON: But right now, let me switch quickly to the issue of the Russian Soyuz. It's clear that we will have some dependence on the Russians for Soyuz crew transfers to and from the space station after 2010 when the shuttle fleet is abandoned. It's also clear that we'll need to acquire Soyuz vehicles for the space station starting in 2006, which is less than two years from now.

We know that it takes about 18 months or so, 16 or 18 months, to build a Soyuz. I wanted to make a comment about outsourcing our jobs and talent to Russia, but I won't. And, in fact, 2005, NASA's budget plan now includes a multi-year funding stream for ISS cargo, crew services, that NASA concedes may include payments for Soyuz services.

Yet as we have discussed in the past, the Iran Non-Proliferation Act prohibits such payments to Russia in the absence of a presidential certification on non-proliferation. And that has not been forthcoming. And the State Department has made it clear in writing, in written testimony to this committee, that payments to U.S. companies purchasing Soyuz vehicles or services from Russian companies, quote, would raise questions under Section 6 of the Iran Non-Proliferation Act and would likely be viewed as an evasion of the law.

Similarly, the State Department has made it clear to the committee that having our other international partners purchase Soyuz vehicles or services from the Russians in exchange for compensation from the United States would also, quote, raise legal questions under Section 6 and would likely be viewed by me as an evasion of the law.

So here we are. Your administration is saying that you can't acquire Soyuzes from the Russians without violating the INA. And yet your approach to the space station is critically dependent on a continuing supply of Soyuz vehicles.

Do you plan to seek a legislative repeal or modification of the INA to permit you to acquire Soyuzes? If so, when? Will you notify Congress of that intent? And if not, what specifically is your plan?

BOEHLERT: That's a very important question. The gentleman's time is expired, but we're allowing additional time because he's hit the heart of a very important issue.

Mr. O'Keefe?

O'KEEFE: Yes, sir. Thank you, Mr. Chairman.

We are not seeking exemptions of the law at this time. We are negotiating with all of our international partners on what our continuing challenges to operate station will entail. Right now, the only means to achieve access to station is by the Soyuz craft.

There is clearly an intent on the part of all of our partners to expand the crew size aboard the International Space Station once space shuttle returns to flight and we continue to build out the capacity of International Space Station. So all of that will require a modification to our current agreements, which expire in '06, among all of us as partners, all 16 nations. And we're enjoining in that question now beginning today.

All of the partners are in town. And they'll be continuing activities through the end of March, early April with the heads of agencies to discuss exactly these points. Our intent at this moment at this time is not to seek either an amendment to or repeal of the Iran Non-Proliferation Act.

LAMPSON: OK. And there's (inaudible) a plan yet (inaudible)? Mr. Boehlert, thank you for your indulgence.

BOEHLERT: OK. You said that your intent now is not to seek.

O'KEEFE: At this moment on this date, no. We're beginning negotiations starting today with all of our partners on what the way ahead is for both cargo as well as crew transfer and building in the proposition of when we return to flight and how we continue to build the station out and what all those implications may portend. So we're beginning among the 16 nations to have that discussion starting today.

BOEHLERT: I'm sure, Mr. O'Keefe, you recognize as much as we do the importance of this very issue.

O'KEEFE: Yes, sir.

BOEHLERT: Thank you very much.

ROHRABACHER: Mr. Chairman? Mr. Chairman?

BOEHLERT: Who seeks recognition?

Mr. Rohrabacher?

ROHRABACHER: Just a point of personal privilege for one moment.

BOEHLERT: Yes, sir.

ROHRABACHER: And being one of the co-authors of the Iran Non-Proliferation Act and...

BOEHLERT: Mr. Rohrabacher, you're recognized for...

ROHRABACHER: For 10, 15 seconds just to note that there are exceptions in that act, especially when the lives of American astronauts are at stake that could be, you know, analyzed in a way or interpreted in a way that would not create the barriers that we're talking about. So it is possible that it is not the barrier that we think it is. But it has to be looked at very closely.

O'KEEFE: Thank you very much for the intervention.

BOEHLERT: Mr. Smith?

SMITH: Thank you, Mr. Chairman.

Is it worth it at this time of record-high deficit spending? Is it worth it to borrow this money from our kids and our grand-kids for this kind of venture at this time?

As chairman of the Research Subcommittee and with the understanding that the main purpose of the space station is scientific research and as a place for the shuttles to travel to, I've often questioned witnesses on the justification for manned space flight as well as the space station. Some witnesses have expressed concern that the costs are too high and the benefits too few compared to the results that we could get by investing this money in other research that can better help us in our future with research efforts as well as our economy.

With a $500 billion plus deficit, limited dollars for research are there and as we make this balance between our efforts, especially in manned space versus unmanned space flight and the achievements that you demonstrated with the pictures with unmanned space flight, part of the decision of this committee and of the Appropriations Committee has got to be the priorities on where we can best spend this money. It seems to me that the question I have is with the growing reluctance of other countries to contribute. Is there a possibility that we should or we could put the space station expenditures on hold for the time being?

Mr. O'Keefe, earlier you have stated before this committee that you thought it was possible to maintain the space station with unmanned flight. And I'm just very concerned with borrowing with the tremendous pressure on the budget. And I would just suggest that we are going to reduce the budget below what the president has suggested overall. And so, setting those priorities is even more important.

And I am afraid that I am tempted with the comments that we've had from other countries of their reluctance to contribute more and more to the space station. With the cap that we set a few years ago of $25 billion, number one, should we consider delaying this project for the time being? And number two, are other countries more and more reluctant to contribute more and more dollars to their cooperative effort in the space station?

O'KEEFE: Well, thank you, Congressman, for a very important question. If anything, what we've seen demonstrated in this past year is exactly the contrary. Our partners have stepped up in a way that is absolutely unbelievable. We have paid not one dime more for the continuing activities of access to the International Space Station during this time in which we have grounded the shuttle over this past year.

So all of the activities, all of the logistic support, everything has been contributed to by our partners and us in participating in that. And it's not cost us one dime more as a consequence of it. So as a result, if anything, the depth and strength of this partnership has been demonstrated (inaudible)...

SMITH: Yes. But you say not one dime more, but over the next five years, what we're looking at is about a $12.6 billion increase because of this new suggested venture.

O'KEEFE: Yes, sir. You've asked two different questions. I'll try to focus on the first part, which was your questions about International Space Station. And then we'll get to the exploration discussion if you'd like.

But the first part is what we have done during the course of this time -- and your assertion of the reluctance of partners to contribute. No, to the contrary. They've been contributing more in this span of the last year than, frankly, I would have ever anticipated and what we may have otherwise thought was possible. And the continuing operations of station are occurring today as a consequence of the partnership and the strength thereof.

The second point would be that our whole focus now on the research on International Space Station, once we return to flight and we've continued building the -- and complete the assembly of station, is to focus on life sciences research, human physiology. One of the biggest problems we have to conquer is the degradation of muscle mass and bone mass. If from that we can also understand how to arrest the consequences of osteoporosis...

SMITH: Or radiation. But this is within... O'KEEFE: ... or radiation.

SMITH: This is within the Van Allen Belt, so I've been told that the simulation can be done just as adequately on the ground in terms of the irradiation consequences. Do we want to send a man in space? Do we want to occupy Mars or the moon at this time when the economic pressures are so great on this country? And is it something that we can put off? Or is it something that we should consider abandoning altogether?

BOEHLERT: The gentleman's time is expired.

O'KEEFE: I mean, we're...

(CROSSTALK)

BOEHLERT: I think the science adviser to the president is in a good position to get a broader view on that question.

MARBURGER: We must not abandon the vision of space exploration. I believe that the vision of space exploration is an inspiring vision. There is a reason for humans to be in space. We must overcome the technical difficulties and obstacles in the way.

And as we make the investments to do so, we will also energize our economy. There is no question that the technologies that are necessary to embark on this venture, on this new vision for space exploration, will have a very positive affect on our economic competitiveness and on the basic technologies that form the infrastructure of our society.

BOEHLERT: Thank you very much, Dr. Marburger.

MARBURGER: Thank you, Mr. Chairman.

BOEHLERT: Ms. Lofgren?

LOFGREN: Thank you, Mr. Chairman.

And thank you, witnesses, for being here today. I have a bunch of questions, and we don't have a lot of time, so I may follow-up in writing with some of the questions that I have. But one of the things that I'm puzzling over is your new accounting system and how to figure out really what's happening on the ground in the proposed budget.

And taking a look at Ames Research Center, which I know that you value and you've visited on many occasions as to (ph) the nanotechnology work they're doing and robotics and the like. I see a $90 million reduction in the proposed budget. And it's in something called service pools (ph).

Now I think $55 million of that is the wind tunnel that's going away. But I'm not clear how the other $35 million -- is that a programmatic cut? Or exactly what is that? That's question number one.

But the land is really not the sum total of the asset. I mean, it's the human power. I mean, it's so much more than just taking a look at real estate and how the science will be integrated in the analysis. I'm interested in hearing from you. And obviously all of the Science Committee members will want to be involved in this process. And I'm wondering if it is your intention to close one or more centers. And if so, you know, what the timeframe is and the parameters are and the like.

And finally, I have an interest and a concern over the future of space as a demilitarized zone. You know, in past years and past administrations, we've talked about space exploration. But I see the word security popping up in the discussion of space at this point in a way that's relatively new. And I'm

interested in whether the administration has a design or interest in arming space in a way that humankind has not done in the past.

Those are my three questions for now. And I'll follow-up with you in writing on the others, if I may, Administrator O'Keefe.

O'KEEFE: Yes. Thank you, Congresswoman. As it pertains to the Ames Research Center's budget, yes, indeed, there is a transfer that's occurred between '03 and '04 and now continued in '05 of now capturing all of the costs associated with an activity in what's called a full- cost accounting method.

LOFGREN: Right.

O'KEEFE: So now when you look at a program, you see the total cost of what it takes to counter that out as opposed to fractions of it or incremental pieces that are buried in lots of other locations. You can now make an informed decision each year on what you think the value of a program is. And one of the advantages of the discussion we had earlier here is we'll be able to add with precision each year exactly what the cost of that next increment of achieving these exploration goals will encounter.

Let me give you a table for the record, if you would, of the comparison year to year as it pertains to the Ames Research Center budget. But there is a specific effort that needs to go on in the next few months -- it'll probably be completed by summer -- to really transfer all of the data to be comparable, apples to oranges, so you can see what the differences are.

Because in one case, you had to assemble it all based on all the disparate pieces. Now you get the assemblage all in one place. And we'll provide that for the record. So I couldn't speak to the specific differences between that dialogue versus the other dialogue at this moment.

LOFGREN: Right. So the reduction from $172 million to $74 million is just little bits and pieces? There's not a particular program that's being proposed?

O'KEEFE: Indeed. Indeed. And again, we'll give you more specificity on that.

LOFGREN: I would very much value that.

O'KEEFE: Yes, ma'am. On the second point, the gentleman we have recruited in is a fellow named Cassidy (ph).

LOFGREN: Right.

O'KEEFE: And he was in the last administration was at the Defense Department during the base realignment effort in 1993 and '95.

LOFGREN: Right.

O'KEEFE: He has been brought in a month ago following a comprehensive effort that we conducted last year to look at real property assessments, what do we have out there just in terms of inventorying what we have. The approach that we asked for and have developed now, developing a strategy, is how do we use those facilities in the most cost-effective way.
 There is no specific intention to look at a realignment or closure activity. It's more just an inventory of what we have. His expertise was primarily in the realignment phase working with individual communities to assure transition from one mission to another.

And so, given that expertise and his capacity in that regard, we've asked that rather than reinventing the wheel ourselves, we bring him in for his understanding of how that activity occurs as we move ahead from this point. There'll be several different steps in this, a strategy, a business plan and ultimately a mission analysis effort that we'll work with you to define exactly what each of those steps are as we proceed ahead.

And finally on the national security objectives, there is no implied or specifically stated objective to expand this to a national security mission. That's not an intention here. It is a broader definition of security of the nation, economic and otherwise, that we intend to proceed with this exploration agenda. LOFGREN: If I may, just a quick follow-up on getting back to the real estate analysis as well. One of the issues, as you know, is Ames is co-located at a spot that used to be the Moffett Naval Air Station and there are huge toxic issues that, unfortunately, the Navy never dealt with. And that's, unfortunately, been the case all across the country.

So the local communities -- it's not in my district, but the local communities have pushed for a long time for cleanup of that base. And I'm hopeful that if we're doing an analysis, we can make sure that the massive cleanup costs are, once again, raised to the attention of the Navy. Maybe we can get them to do something about that.

And thank you very much for...

O'KEEFE: Yes, ma'am. This is an interesting irony having served as secretary of the Navy at the time the Moffett Air Field was part of the Naval establishment and then coming back to NASA and finding we now have it, it seems to be a deed that I carry with me wherever I go.

LOFGREN: Right.

O'KEEFE: But it is one that we are evaluating and trying to assess exactly what the environmental impact would be.

LOFGREN: Finally, I'd like to -- not at this point, because other members have questions and time is running short. But I do have some concerns about how full-cost accounting is

working. I certainly don't have an objection to understanding overhead and how it works and the like.

But I do have a concern when you have, I think, Ames -- and I think it would be also true at Langley -- where you have a multiplicity of science projects that are not huge projects and yet essential to the mission in robotics or whatever allocating the overhead.

There's no consistent one project to do it, and so, we may have the unintended consequence of really starving five projects that are going to end up to be essential for the broader mission later. And I know that you don't want that, and I don't want that. But I'm interested in how we might avoid that consequence.

O'KEEFE: That's a very, very important question. And again, it is really -- you want to make sure that the process you develop in this particular case doesn't serve, you know, an unintended consequence like that.

LOFGREN: Right.

O'KEEFE: And what we've tried to put together here is in full concert, in compliance with, the government performance Results Act, how do you develop a full-cost visibility in what's involved. We've introduced that -- and that's the primary purpose and objective we're after here -- and a budget and program integration effort so you can see with total visibility what that will entail.

BOEHLERT: Thank you very much, Mr. O'Keefe. You're bringing several of your hats back, you know, former secretary of the Navy, LLB (ph). We're getting you on all sides.

The chair now recognizes Dr. Bartlett.

BARTLETT: Thank you very much.

Mr. O'Keefe, I was pleased that you mentioned an emphasis on human physiology. In a former life, I was a human physiologist. I was involved with the very earliest space exploration. I was at the School of Aviation Medicine at Pensacola, Florida, in the first sub- orbital primate flight, monkey Baker. You may remember that the Army lost their monkey, Abel, when they were taking the impending electrodes out and they gave him a general anesthetic.

I went on to Johns Hopkins University Applied Physics Laboratory where I was involved -- you mentioned Ames -- I was involved with a rebuild of satellite to launch an experiment for Dr. Tory Gaulthiearati (ph) where he had developed the technique for putting an electrode in a single fiber of the outer (ph) lip, which is the only organ in the body that specifically directly responds to gravity. So I've had a long, familiarity with the space program. And I appreciate the importance you place on human physiology.

You know, I think that perhaps the best justification for going back to the moon and on to Mars has yet to be articulated. Let me explain. This is a challenge that we face that's been building for more than three decades. Three decades ago, I was at IBM.

By the way, one of the major reasons for this challenge is the tyranny of the urgent. The urgent always takes precedence over the important. So here we are because we always let that tyranny exist.

Three decades ago, I was at IBM, and we were concerned that we at IBM and we, the United States, were going to lose our superiority in computers to Japan. That just about happened for one simple reason. Every year, Japan was turning out more and at least as good and maybe better (inaudible) scientists, mathematicians and engineers. And we knew at IBM that if that continued, we were not, at IBM, going to be able to remain the world's premier company in computers.

The country now faces that challenge. It's been going on and increasing for three decades now. For a short time, it is a threat to our economic superiority. All you have to do is go to one of our, any of our, major universities and look who the students are in the technical areas.

Fewer and fewer of them are from this country. I have a son, our tenth child who just got his Ph.D. two years ago from Carnegie Mellon. He was so fervently courted by our national labs that he felt compelled to go there. And the reason he was courted was that very few of those graduates were American citizens. You know, you can't give a security clearance to a foreign national. So he now is out in Sandia Labs in New Mexico. For the short term, this is a threat to our economic superiority. We will not continue to be the world's superior, supreme economic power unless we turn out more scientists, mathematicians and engineers. And for the longer term, it is a threat to our national security. We will not continue to be the world's premier military power unless we turn out adequate numbers of well-trained scientists, mathematicians and engineers.

Our country desperately needs something that captures the imagination of our people and inspires our young people to go into careers in science, math and engineering. Right now, the best and brightest of our young people are increasingly going into destructive pursuits. We have more and more lawyers and more and more political scientists.

Mr. Chairman, we need a few of each of those. But we've gone beyond that few, at least, that we need. And we now really need something that entices our young people to go into careers of science, math and engineering. Hopefully this program, rightly conducted, will do that.

This really has to do with our national survival. And we're making an investment here, sir, that's going to pay big, big dividends. This is not a cost. This is an investment. I don't think we can afford not to do it. And I hope that when you do it, you do it in such a fashion that you do capture the imagination of our people and inspire our young people.

Because I am a physiologist, a scientist, and because this is the science committee, let me ask a question. It's not clear to me the extent that this initiative will be driven by science. And in some of the documents, it talks increasingly about exploration. I would hope that in capturing the imagination of our people and inspiring our young people, you really do focus on science because our people have a lot of curiosity. And this, science, brings us there very well, I think.

As you put the plan together, are you going to continue to focus on science? Is that going to be a high priority that drives what you do?

O'KEEFE: Absolutely, Congressman. Thank you very much for the question. It is an exploration agenda informed by the science objectives. There is a science objective behind each of these exploration activities that we would be pursuing.

As we see playing out right now on Mars, with both of the Mars rovers, the objectives are very clearly -- this is a good characteristic example of the precursor missions we're envisioning. They have very specific science agenda and objectives that are to be informed. And it's an exploration opportunity in addition to that.

To your earlier part, and just anecdotally in terms of what the interest level is among folks who are accessing what we're into and what we're doing, in the Web site statistics I offered earlier, based on anybody that's filled out the surveys here, roughly 20 percent of everyone who is coming to the NASA Web site of these 6 billion hits, 20 percent of them are K through 12 students. Fifteen percent are college and graduate students.

I mean, the level of interest in the kind of activities we're involved with here is inspiring that next generation of explorers. We want to continue that. And it's unabated. This is not a spike that's occurred in interest and then it's dropping off. It's continuing.

MARBURGER: I would just like to add that exploration is part of science. And as clever and fascinating as the Mars rovers are, their capabilities are very, very limited. Now we can imagine much more sophisticated and extensive robotic networks, but eventually the complexity and especially the need to do things at a distance where there are tremendous communication lags because of the distance of the destinations from earth, they ultimately need human oversight.

And the more sophisticated and complex the exploration and science missions become, the greater need there will be for

human presence, not just to go out and plant flags, but actually to do something that's important in reaping the assets and the resources of space.

BARTLETT: Thank you, Mr. Chairman.

BOEHLERT: Thank you very much.

Mr. Udall?

UDALL: Thank you, Mr. Chairman. I, too, want to welcome the panel. Thank you for your testimony. I'm going to take my time to focus on the Hubble. And I feel moved to make a series of statements. I hope I'll give you a chance to reply. But hang tight here.

I share the concern of a lot of people across the country about the decision that was made in regards to the Hubble. And I wanted to share a couple of perspectives that have been presented to me, if I might.

And with that sort of an approach, adaptive optics will allow us to see 1 percent of the whole sky. The Hubble gives us 100 percent across the spectrum of wavelengths. Adaptive optics only work in the infrared wavelength. And Hubble works both in the visible and infrared.

There are two instruments that have been built in my district. I should offer that disclaimer that this is important to the 2nd Congressional District, the costs in the wide field three. And if we were to deliver those instruments on service mission four, we would further enhance Hubble's advantages over land-based capabilities.

The COS adds ultraviolet wavelength capability, and the wide field three improves infrared and visible wavelength capability. So I wanted to just put that into the record.

If I might, let me move on and talk a little bit about the arguments that I think have been made to cancel the Hubble. The one has been cost. And I think if you really step back and look at the cost, I don't think that that argument really can be justified.

An extra mission is about $100 million. If we were to cancel the entire shuttle program, then I think that's a legitimate reason on a cost basis. But to do a fifth mission, say, in a year to service the Hubble, from what I understand, it's in the order of $100 million. And it's a small cost relative to the cost it takes to maintain the army of engineers and technicians.

The second argument is the safety argument. And I share all of your concerns about safety. But I think you can make the argument -- I not only think, I believe you can make the argument -- if it's safe enough to fly to the ISS, then it's safe enough to fly to Hubble.

So we've asked, as Congress, manufacturers to make $167 million worth of instruments that I mentioned, the wide field and the COS, only to be told that we're not going to fly those instruments to the Hubble because of safety concerns. But if that's the behavior we're going to accept, if we're going to work off that approach, then what guarantee do we have that if we spend billions to prepare a manned moon or Mars mission, that in the future we're not going to get cold feet and cancel that mission?

So in sum, it's difficult for me to understand. If we're too risk-adverse to send up a servicing mission to Hubble, where does that leave us when we're talking about going to a piloted mission to Mars or the moon? When I look at the CAIB's recommendations -- and I'm going to quote their recommendation.

The ultimate as it regards safety in on-orbit repair and inspection capability for the shuttle -- I want to quote. The ultimate objective should be a fully autonomous capability for all missions to address the possibility that an International Space Station mission fails to achieve the correct orbit, fails to dock successfully or is damaged during or after undocking.

Now, this is an unambiguous recommendation. It applies to all flights, whether the space shuttle or for some other mission. I mean, to the space station. Excuse me. The initiative of the president calls for retiring the shuttle in 2010, which means there'd be another 25 to 30 flights.

When does NASA intend to comply with the recommendation that I just read, in the first three flights, the first five, the first 10? Because at that point, if you're complying in the first 10 flights, even the first 15 flights, that still provides a window to do that servicing mission to Hubble and keep it up and running for another seven to 10 years before the Web is fully operational. I guess I have left you a little bit of time to answer my questions.

MARBURGER: Good. Let me respond briefly to the science issue. No one is disputing that the Hubble is a very valuable instrument. It's an extremely useful and productive instrument. And I'm not suggesting that adaptive optics is a killer argument here. But it's also true that the Hubble's uniqueness is diminishing and that it has essentially approached the end of its design life.

Yes, we could continue to keep it alive by servicing it in this way. But there are alternative ways of getting the same or similar scientific data so that the risk-benefit equation has been altered as a result of technical progress. That's a point that hasn't been made very strongly in this discussion. And I just thought it was important to make it. I'm not suggesting that decision is easy or that there aren't still some unique qualities that the Hubble has.

But I think the deliberations of the National Research Council Group on the decadal survey are quite interesting in this context, which is why I quoted them. As far as risk is concerned, risk is also to some extent a technical issue. And I believe that the CAIB and Admiral Gehman are among the experts on the issue of risk. And I do think that it was a very wise decision by the administrator to call upon them to assess this aspect of the Hubble equation.

UDALL: I might ask the administrator his thoughts on when we would have that capability to repair the shuttle, the autonomous capability. And then if I could, since the chairman's been indulging all of us, if you would give us a sense of where are we with the review, Admiral Gehman's role. And how do you intend to respond to his recommendation or his comments?

Mr. O'Keefe, if I might just interrupt, Dr. Marburger, I just was passed a note. Somebody reminded me that the B-52 also had a long passed design life, but it's still useful. So I think that's important to acknowledge, that there are technologies that have long- time applications for us.

O'KEEFE: This was among the most painful decisions I've ever had to confront. It is a remarkable piece of scientific achievement. And its capacity to continue to operate is just amazing.

That said, my concern was not generated by a risk aversion, Congressman. It was more generated by a capacity to honestly tell you that we intend to embrace the recommendations of the Columbia Accident Investigation Board Report and that facing the prospect that the point in which that mission, singularly the only mission that would go to any other location than station, would not be able to achieve, I believe, at the time of that launch compliance with all of those recommendations in a manner in which we said we would.

The issues you identified are among many that are involved in this particular question. The autonomous report capacity has to be demonstrated on the first two flights. That's our objective. That's our approach in what we want to do. I have no idea whether that's going to be successful or not. So here we are making a decision about its success before we've ever demonstrated it. That's point one.

The second one is it requires a development of tools and capabilities we currently do not have in the inventory and would have to develop in order to do this. And, yes, that's right. We'd have to use it for station as well as Hubble. But nonetheless, they have not been developed at this time and won't be demonstrated until those first two flights.

And so, as a consequence, we'd be assuming success at a time we're planning on a servicing mission when we could be diverting that attention towards how to maintain and operate this capacity for a longer period of time than we're currently

expecting. There are a number of different ways we could do that short of a servicing mission. So those are the kinds of things we're trying to examine as well.

The third factor that comes to play is the question of contingency planning, of what do you do in the event of a challenge, a problem, much like we saw on the Columbia mission. To the extent that were to occur, the objective on station is you have multiple means to examine the shuttle as it approaches the International Space Station on a number of maneuvers we have designed.

Then in turn, as it docks, you have the capacity to examine it thoroughly. There is no comparable means on Hubble. So as a result, the only way that you can accommodate this is to literally stack two shuttles, two orbiters on two pads, the second one being available in the event of a contingency. And the only means by which you can achieve a safe haven maneuver for the damaged shuttle would be to literally tether the entire crew across during a mid-orbit maneuver where you bring everybody outside and you put what would amount to about 10 people on one shuttle flight to bring them home. We have never tried it. We've never performed it. It is strictly on paper. And a full analysis of that was contained in the Columbia Accident Investigation Board's recommendations in the appendix.

ACTING CHAIRMAN: The gentleman's time is expired.

I thank you for the explanation.

I happen to be next on the list. Unfortunately, I have approximately two hours worth of questions. I thought perhaps I could arrange a private briefing, but now that I have the chair, perhaps I can just do it all here. But let me reassure my colleagues I will not do that.

Several observations since time is limited and then a few specific questions on the crew exploration vehicle. I may sound like a nay-sayer, but I don't intend to be. I am supportive of the president's proposal. At the same time, I am very skeptical about many of the details of it. I am concerned about the assumptions that I see underlying that chart up there. Time doesn't allow me to go into the details.

But with a history of cost overruns on major projects at NASA, I think I have good reason to be concerned. And that's not meant to be a derogatory statement. I know as a scientist you don't know what problems you're going to encounter until you get into it when you do something brand new.

But I'm concerned about the impact on other science, both within NASA and outside of NASA, the effects on continuing our efforts on space science. I think we have to continue that unabated. Our Earth science that NASA does is incredibly valuable to our nation and, in fact, to our planet. And we must continue that.

I'm concerned about the Mars mission, the purpose, the cost, the scientific value. I believe it must be an international effort. We simply cannot afford that as a nation alone. I think personally it'd be a foolish waste of money for us to go to Mars, given our present state of technology. We simply have to have better energy sources. We have to have better propulsion systems to even think about going to Mars.

Dr. Marburger, you mentioned the limited nature of the robots. And that's very true. And we all recognize that. At the same time, we can send approximately 1,000 robots to Mars for the cost of sending one human and bringing that human back. And so, we have to compare what we can do with 1,000 robotic flights compared to one human flight.

I'm concerned about the space station, its cost, its value, the science that is going to be done. If that's simply going to be to determine the long duration effects of flight in space flight, that's a mighty expensive way to do it. And that's something else I'd like to explore with you at some time. Let me now get down to a specific question, the crew exploration vehicle.

And I'm, first of all, very concerned, Mr. O'Keefe, with the idea that this is going to be the vehicle for the space station, for the moon and for Mars. And I need clarification in that. What are you envisioning this vehicle to do? I mean, that seems to me too much to expect from a single vehicle. Isn't that likely to lead to the same problems we have with the space shuttle, that we expected too much of it and it ended up being very, very expensive?

I would hope that you would not even think about developing a Mars vehicle until we are much further down the pike. Well, let me have you answer that first before we get into other questions on it.

O'KEEFE: Thank you, sir. The approach is not to devise or develop a one-size-fits-all answer to this. No question. Instead, the spiral development approach that we're trying to lay out is to test each component individually, and then you size and derive various depending on mission requirements. You need a substantially less volume requirement to get from here to the International Space Station. You certainly need more volume in order to get to the moon. You need even more to get beyond that.

So at each successive stage, you're looking at a different assemblage of modules and components in order to achieve that task. But at its core are a handful of fundamental aspects that you want to develop. And that's what the spiral development approach is designed to do.

The initial approach in these next few years is -- certainly by the end of the decade -- is to demonstrate those spiral developments and launch, unmanned, those capacities to see how each of those components then in turn can be lashed together.

But it is not an intent to have a one-size-fits-all approach. We are not going in that direction.

ACTING CHAIRMAN: Are you envisioning this to be a reusable vehicle? Or are you leaving that as an open question?

O'KEEFE: I don't know yet. There's a spirited argument on this on both sides. But there is certainly no predisposition either way at this juncture.

ACTING CHAIRMAN: These first specs that you're developing in four months, is that related to the Mars mission at all, or is that strictly a development of a CEV?

BONNER: Just one final comment, not a question. All of us who remember growing up watching the Apollo space program take off and man land on the moon, take the first steps -- and then we watched with pride in the shuttle program and the tragedy of Challenger and Columbia.

I think all of us, especially in this room and on this committee and really, as evidenced by the tremendous crowd that's here today on a day when the House is not in session, we support what you're doing. We're proud of the work you're doing.

That said, I think the American people, as we face these tough budget decisions, deserve a renewal of explanation of what space exploration has meant to them in terms of their daily lives, in terms of the advancements of medicine, miracles of medicine and some of the other technological breakthroughs that have a direct link. So that when we go home to our districts, when we go home and visit with the people that sent us here, we can give them an updated answer to the questions of why now, why this much money, why this bold a vision. And I would certainly encourage NASA to help us sell the story of NASA. And I think you'll find willing partners here.

Thank you so much, Mr. Chairman, for giving me an opportunity to ask some questions.

BOEHLERT: Thank you, Mr. Bonner.

O'KEEFE: Mr. Bonner, if I could very quickly, 10 seconds? I will get you a piece of paper that will give you the specific derivatives of all the things we've developed over the course of the last few years that can be available for us right now.

BONNER: Mr. O'Keefe, I wish we had 6 billion hits a net. And let me suggest to you that it's critically important in that part of your communications program that you explain to the American people all of the benefits that have come from our investments in the space program.

O'KEEFE: Yes, sir. BONNER: And, Mr. Chairman, especially those investments made in Alabama would be very helpful.

BOEHLERT: Understandable.

The chair recognizes Mr. Gordon.

GORDON: Thank you.

At the risk of being a broken record, I want to go back to the issue of cost. And I do so because I think I would be negligent in my job if I didn't. I don't want to overstate, but I think it's fair to say that most everyone, if not everyone on this committee, is, at a minimum, disappointed, potentially disillusioned with the cost estimates that we have been given, up until recently, even on the space station and the benefits that we were going to achieve.

So we need to get out in front of this. And so, Mr. O'Keefe, you know, I had written you and asked you for some cost estimates. And in your response, as I said earlier, you said it depends on timing, scope, technology and research. Here's what I would like to do. And what I really think is important for us -- let's set up just a benchmark, and then we can -- knowing that we can move beyond that. And I want you to set up that benchmark.

So we're going to say, OK, the first thing you said was we can't give a cost unless we know the timing. It could be from 2015 to 2020. Around here, things usually take longer rather than sooner. So let's say we'll give you the time. We'll fill in the blank, 20.

Then you say the scope. And that specific demonstration is carried out on the moon as well as the number, duration, type, size of missions to support these demonstrations. Why don't you just take what you think would be the reasonable scope. And the technology, the same thing and the research. Just let's set a definitive benchmark within these four areas of what you think would be reasonable things to achieve and then the new costs set out for us.

O'KEEFE: For what objective?

GORDON: So that we know what we're getting into. And so that we don't want to get into a situation where later on we decide we can't afford this, and we wish we hadn't spent all this money because there might have been a better approach.

O'KEEFE: Yes, sir.

GORDON: And I think when you were at OMB and if someone came before you, surely to goodness you would have asked those questions.

O'KEEFE: This is the functional equivalent of making assumptions on what 16 years from now the cost of my mortgage payment will be, what the light bill will be, any number of different...

GORDON: Isn't that what you did with that chart up there?
O'KEEFE: No. What this projects here, sir, is between '05 and '09 is the specific amounts that the president has proposed in the budget.

GORDON: OK. So we don't know what we're going to get for it? That's just what you're...

O'KEEFE: Sure, we do. I'm sorry. I apologize for interrupting. Let me let you finish.

GORDON: OK. Well, anyway, you know, again, surely I don't know what the interest rates are going to be in 10 years. But there are those folks that can make an estimate. And that's all I'm asking you to do is take the best information that you have. And it can be prefaced by those estimates as to what you think these costs will be. I don't really think that's too much to ask.

O'KEEFE: Yes, sir. And I appreciate that. In the period of time of '05 to '09 as the budget is presented before you from the president to the Congress, the total amount is $86 billion. >

GORDON: Yes.

O'KEEFE: That's the total amount we're requesting and proposing, projecting, forecasting to be spent on NASA activities. In this coming year, it's 16.2. That's the part that you have the most amount of control in terms of redirection to as well as those out-year forecasts.

GORDON: I just want to get your best -- you know, once you plug in the blanks as to timing, scope, technology and research, what you think it's going to cost to do that particular job.

O'KEEFE: Yes, sir.

GORDON: Again, let me ask you. Did the president ever ask you at any time in these information-rich hearings what the cost would be to go to the moon?

O'KEEFE: What he asked specifically is what are we planning to spend in this five-year span of time and does it create a balloon note. What this chart...

GORDON: But he never asked you what it was going to cost?

O'KEEFE: Yes, sir, he did. And I'm trying to answer that. I apologize, sir.

GORDON: OK.

O'KEEFE: Eight-six billion dollars is the amount that we specifically identified in this span of time from '05 to '09. And what this chart attempts to demonstrate is that in the out-years beyond that, not within the scope of the president's budget proposal to you, were we creating a set of commitments

that would be larger than the annual rate of inflation increase that would be reasonably anticipated for a budget proposal. And the answer is no.

The amount that's included here is a rearrangement specifically of the assets necessary to continue to pursue this exploration agenda informed by the scientific objectives. And as a result, what you see is a wind down of the shuttle program, a wind down ultimately of the...

GORDON: So if we add up that top -- I'm color blind, but I guess it's blue. You know, that blue chart on your chart. If we would add that up, then that would be the cost of getting us to the moon, in your opinion?

O'KEEFE: I think it's the combination of robotic missions, manned human space flight missions, a whole range of things to go to Mars, the moon, any other destination you'd like.

GORDON: OK. So then, you could tell us, then -- and I'll ask you, then, if you would add up those amounts and tell us what you expect that we're going to get from that by the year 2020.

O'KEEFE: And 20.

GORDON: Yes.

O'KEEFE: Yes, sir. Let me provide that for the record that gives you a specific breakdown of what those little sliced segments mean. I've forgotten off the top of my head exactly what those individual pieces are. But I'll provide that for the record because that is a projection of what this might entail beyond '09 to demonstrate that we're not trying to pass on...

GORDON: Right.

O'KEEFE: ... additional costs beyond the scope and visibility of what Congress has before you right now.

BOEHLERT: Thank you very much, Mr. Gordon.

Thank you, Administrator O'Keefe. We look forward to that written submission because it's information we all wish to become more familiar with.

Dealing with costs, let me go on to something that is in the '05 to '09 timeframe. NASA continues to refine its cost estimates to implement the Columbia Accident Investigation Board recommendations for shuttle return to flight. We appreciate your efforts in keeping the committee informed of the actions NASA is taking and the costs associated with the return to flight program.

In November of last year, NASA estimated costs for return to flight at $456 million over the next five years. Two weeks ago, we received from NASA a letter with another cost estimate of

more than $1 billion. The estimates have doubled in three months.

We understand that as work progresses, you're refining your estimates. And there's a lot of work left to complete. My question is do you expect costs to continue to grow, or do you think you have a pretty solid estimate right now. What areas of the return to flight activity entail the greatest risk for increased cost? What areas entail the greatest risk of slipping the schedule?

O'KEEFE: To my knowledge, sir, the last update that we released about a week ago for return to flight and the continuing implementation plan -- so in other words, monthly we update that -- still hovers in that neighborhood of about $450 million to $500 million, is my recollection. If there's another piece of paper we've sent to you, I'm not familiar with exactly what the differences of those numbers are at this juncture.

BOEHLERT: We have the document here. Let me tell you what the document is. It's from you, from NASA. And the projections are $1.79 billion in the document. I'll share this with you...

O'KEEFE: Yes, sir.
BOEHLERT: ... if you're not familiar with it.

O'KEEFE: I suspect that what that also -- I'm not familiar exactly with the document here.

BOEHLERT: It starts with '03, '04, '05, '06, '07, '08, '09.

O'KEEFE: Right. Let me reconcile that for the record for you.

BOEHLERT: OK. Good.

O'KEEFE: Because, again, the exact direct costs on return to flight still is in that range of $450 million. The out-year costs to, for example -- the longer term implications of creating the NASA Engineering and Safety Center and so forth, that's all additive to it. And I suspect that's what that is. But let me reconcile those two numbers.

BOEHLERT: That would be helpful, because you can see...

O'KEEFE: Yes, sir.

BOEHLERT: ... obviously...

O'KEEFE: Absolutely.

BOEHLERT: ... you know we'll recover from it.

O'KEEFE: Yes, sir.

BOEHLERT: We want to get as precise as we can.

O'KEEFE: Yes, sir. Yes, sir. No question.

BOEHLERT: All right. And then there's another question that is always on the minds of all of us. And that's schedule pressures. As you know, the Columbia Accident Investigation Board cited schedule pressure as a contributing cause of the Columbia accident. Members of CAIB said the schedule pressure would likely become excessive if the shuttle were flown more than four times a year. <

But the exploration initiative assumes five flights a year for each of the next five years starting this fall. And we're beginning to appreciate there might be some slippage with that. Isn't that guaranteed to create undue schedule pressure? And how will you prevent undue pressure from developing? Will NASA be hiring more personnel to accomplish five missions a year?

O'KEEFE: Yes, sir. No. Thank you for the question. The objective is to complete assembly of the International Space Station by the end of the decade. The president was very specific in the directive in, you know, terming it as the objective. The milestone is to complete assembly of the station.

We project that that's going to run four to five flights per year and are anticipating as many as five. The approach we've got to look to now is two things, the two drivers on the schedule that I've seen. Number one is, not only the systems integration challenge of when do you send the components and the modules, but also how do you have a spacing in between them that is sufficient to provide for a launch of the next vehicle in time to assure safe haven requirements while folks have been aboard station should there be any problem on the prior mission.

So the combination of both of those is going to give us that answer rather than what the current schedule says. And we're still working that through to figure out precisely what that will entail.

BOEHLERT: Let me ask you this. Is it still the operating assumption that you will be able to return to flight by September? Or is there some cause to pause and rethink that very ambitious schedule?

O'KEEFE: Based on the information I've seen just in the last 10 days and reviewed now a couple of times, there are two items that now make that prospect very low. The first one is the external tank, the determination by an external panel, group of folks, and the Stafford- Covey Task Force was to expand the coverage of the insulation area from 67 degrees off center line to 80 degrees. What that means is you're now looking at a wider area that needs certification from debris coming off of the insulation from the external tank.

The second one is the actual development of the imaging capacity on the boom that we're developing and have never tested is continuing to have issues that are not

insurmountable, but they may take longer. So I have my doubts, and I do not believe that the September, October timeframe will be met. I think it's more likely we're going to push that to the right. And we'll determine that conclusively next week on how we will revise that schedule.

BOEHLERT: Well, that's a good news and bad response. I mean, the bad news is obviously we can't do something we hoped to be able to do by a certain time period. But the good news, from my perspective, is that you're not so arbitrarily committed to a specific date that you let the pressure of meeting that date overturn good judgment. That's good news.

10th Add, f6040

U.S. Representative Sherwood L. Boehlert (R-Ny) Holds Hearing On Space Exploration

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The follow-up question I have is for Dr. Marburger.

When you participated in the interagency deliberations that led to the development of this new initiative and the vision by the president and the administration, you were, I hope, representing all science and not just the interest of science within NASA. In other words, I hope you were operating from a perspective of the bigger picture, focusing obviously of necessity because of the assignment on the program within the agency.

But there are all of us up here who are concerned about the impact on science overall. That is a concern that I know you share. And so, would you address that question, please?

MARBURGER: Yes. First of all, it is my responsibility to be concerned about all of science. The vision that the president set forth is a vision that extends long into the future. And I believe that the way this vision is structured is good for science. It establishes a framework that is independent of a specific scenario or a single project that has to be accomplished in a certain timeframe that actually reduces the risk of invading science budgets in the future.

This is provides more predictability. It provides a better framework for planning for all of science. And I particularly liked the aspect of this vision that joins robotics and human exploration in a rational, balanced approach so that the scientific goals associated with this vision, in my opinion, are stronger than they've ever been in NASA. The integration of science with human exploration is a very important feature of this. So I think that in the long run to embark on this course is actually better for science than what we had before.

(UNKNOWN): Mr. Chairman?

BOEHLERT: Mr. Lampson?

LAMPSON: Thank you, Mr. Chairman.

I'm still concerned about the Iran Non-Proliferation Act. And knowing that...

BOEHLERT (?): ... we were alternating the back and forth. Come on. You have a question? You have an opportunity. No, stay (ph) and do it. It's up to you.

ROHRABACHER: I'm sorry. I've got a plane in Dulles that I've got to run out for. I thank you very much, Mr. Chairman.

First and foremost, how will the shuttle delays that you just mentioned affect the rise in costs for your budgets for fiscal year '05 through '09?

O'KEEFE: I can't make an assessment right now, but I don't think this is going to be a cost driver. It's more a technical driver on the two, the external tank as well as the imaging boom, neither of which appear to be class drivers. They're more just technical development questions. So I don't anticipate a big cost differential here.

ROHRABACHER: Well, but just the time will cost money, will it not?

O'KEEFE: Sure. By definition, you know, we're not talking about -- single-digit months, not years.

ROHRABACHER: OK. Number one. Number two, let me just note for the record that as far as I'm concerned -- and I think a large number of people are concerned -- because we are in budget constraint, we're worried about science programs being cut. Anything that can be done commercially that will make it cheaper to achieve our goals in space, especially those concerning station, should be done because that leaves more money available for science projects and other projects.

And also, that includes the servicing of the space station, which there are private sector alternatives that have been offered. And if they're cheaper, they should be done. And finally, I guess we've talked about the pursuing of commercial interests, so that's just about it.

O'KEEFE: Thank you, sir. Yes, sir.

BOEHLERT: Well, have a great flight, Mr. Rohrabacher.

ROHRABACHER: Thank you.

BOEHLERT: The very distinguished chairman of the Committee on Space and Aeronautics, Mr. Lampson?

LAMPSON: Thanks, Mr. Chairman.

Just a quick statement about the INA that I still concern myself with. Mr. Rohrabacher made the comment earlier on his first time around about the exception for imminent danger that we can indeed deal with the Russians under those circumstances. There presently is not an imminent danger.

And the concern is that we only have Soyuzes that are going to be built, I think, two under construction. And soon we will not have anything there. And even though we are involved with discussions with our ISS partners, current law tells us we can't do it with the Russians. And there is pending legislation that would allow us to solve that problem, give the president the flexibility necessary, NASA the flexibility necessary to do these negotiations.

It just doesn't make sense that we're not looking at those opportunities. And it seems to me that we're going forward without a good plan with a major initiative here. And I yield my time to Mr. Gordon. <

Excuse me. A quick, final clarification, the post-2009, that period for the lunar/Mars, it looks to me like about $150 billion. Does that sound about right to you?

O'KEEFE: Well, sir, I'll have to go back and take a look at the numbers. I really can't offer it off the top of my head. I'm sorry.

LAMPSON: OK. But you're going to do that, though, right?

O'KEEFE: Yes, sir. Yes, sir.

LAMPSON: And the final thing is that's what you're allocating. And I assume that what you're allocating and what you think is necessary to complete the mission is the same thing.

O'KEEFE: No, sir. What is occurring in '09 and out is a projection of what the transition, the transformation of the approach we're taking here would import if you compare it to the annual cost of an inflation-level increase to the annual top line. That's all this attempts to do. But I'll try to parse that...

LAMPSON: OK. OK. So let me again, just for me -- so does that budget, then, get us to the moon or not?

O'KEEFE: It is not a budget. It is a projection.

LAMPSON: OK.

O'KEEFE: The only budget before you is '05 through '09.

LAMPSON: OK. Is that projecting what it's going to cost to get us to the moon?

O'KEEFE: No, sir, it does not.

LAMPSON: Then why are you doing it, then? What's the benefit of it?
O'KEEFE: To demonstrate as we continue this particular approach of, again, building on the successes at each successive stage, is there some balloon note beyond '09. And the answer is no. Based on this approach at the concurrent of time in which you're seeing a retirement of shuttle, you'll see an acceleration of the development on the Project Constellation crew exploration vehicle, the development of the human and robotic technologies...

LAMPSON: OK.

O'KEEFE: All that...

LAMPSON: But you don't know what you get, though?

O'KEEFE: Yes, sir. We can walk through that.

LAMPSON: OK.

O'KEEFE: But there is no pretense of precision of program numbers out through 2020 that would give you that level of granularity to say this is the cost of that broader set of mission objectives.

LAMPSON: OK.

O'KEEFE: It's going to be a combination of all of them and depending on which sequence you pursue.

LAMPSON: OK. Thank you.

O'KEEFE: Thank you, sir.

BOEHLERT: I thank you.

And now, as Martin Nigronski (ph) used to say, for the final word, Dr. Ehlers.

EHLERS: If it were the final word, I think everyone in the room would be overjoyed.

I do want to thank both of you for being here. And yesterday I sympathized with a panel who was being asked tough questions here, including Dr. Marburger. Today I sympathize with you in a deeper sense because you have a very, very tough job ahead of you as science is always difficult. But when you're doing it to this extent, it's also very expensive and a lot of dollars riding on the decisions you make every day. So I express my appreciation for you, but also my sympathy.

I want to ask a specific question about what I understand is a problem on the space station of a very crucial component.

Mr. O'Keefe, you mentioned the primary scientific purpose at this point is the study of human affects of long-term space

flight. And I understand a very important part of that is the Japanese centrifuge portion of the space station. I also understand that's in trouble and that you've been giving them some help, but that it's behind schedule. It may not be ready to launch.

The first question is will it be ready to launch before you discontinue the current shuttle. And secondly, what is the problem? Is it serious? Can it be remedied? And will they meet their timetable?

O'KEEFE: Yes, sir. Our Japanese partners have been examining a cost challenge that they're having with development of the centrifuge. It was due to be delivered and launched, I believe, in '08. And we're going to be examining that again beginning today through these next several weeks to look at what the sequence of that may mean on the schedule itself.

But what the cost is to them and what they may be experiencing in terms of overrun are (ph) their responsibility. But in terms of the actual delivery date of the module, that's the point we'll need to continue to work through.

EHLERS: Are you confident it'll be ready to fly before you discontinue the shuttle?

O'KEEFE: It appears that way, but, again, there may be tradeoffs of what we may come to based on the ultimate configuration of station, which may call for other modules or components to be considered. But that's part of what we're going through here in this current set of meetings that are convening today and going through the next several weeks and will continue on.

EHLERS: Isn't that correct, that that's a very crucial component if you really want to examine the affects of low gravity?

O'KEEFE: I'm going to let Dr. Marburger comment here in just a second. But I'm told that the approach that is taken depends really on the kind of experimentation you're looking for. And it essentially simulates a gravitational condition.

EHLERS: Yes.

O'KEEFE: So, therefore, it reverses the affects of what we're trying to understand about living in micro-gravity conditions.

EHLERS: Yes.

MARBURGER: I'll just say a technical word. The point of the centrifuge is to be able to tune the gravity from zero up to some value that the centrifuge is capable of. The unique thing about the space station environment is it has zero gravity.

We cannot achieve that on earth for long periods of time. So the availability of zero in that parameter already suggests a

lot of experiments you can do even if you can't tune all the way through the spectrum of values that gravity could have.

EHLERS: But I assume, though, we already knew a great deal about the affects of zero gravity in humans because we had the Mir Space Station, Skylab. People have been up there for many months.

MARBURGER: Not all those experiments were designed to get the kind of biomedical information that you can have. And many of them were done in an era where we knew much less about how the body works. We're in a much better position today to understand these problems scientifically than we were even a few years ago. So I believe that one of the values of focusing research is, in fact, to have a much more deliberate progress toward understanding these affects.

EHLERS: Can you give me an example of something that we could do now that we had no idea we needed to do before? I'm just surprised we didn't do better before. MARBURGER: Well, the way the systems of the human body work have benefited from these very large investments we've made in biomedical research for the last 10 years. And we understand them much better now. I might add that NASA works very closely with NIH in developing strategies for doing this work. It would be surprising if there weren't important developments we can take advantage of. But, you know, the objectives of many of these passed missions were not only focused on weightlessness issues.

BOEHLERT: Thank you very much. And that was the final...

O'KEEFE: I'm sorry, Mr. Chairman. Just a very short 10 seconds.

BOEHLERT: Please.

O'KEEFE: There is a National Academy of Science's study just released here on medical affects on astronauts and cosmonauts based on the limited information we have there. We're only three years into continuous presence. Our longest duration space flight on station is 196 days. That's it. So the cohort is pretty small in trying to make determinations here.

BOEHLERT: Thank you very much.

And I think as we conclude, it should be evident to all concerned in this very substantive probing analysis and exchange that costs are a major consideration. And there is a lot of uncertainty about the costs. And the chart, while attractive, leaves some questions for all of us.

This is not the beginning of the end. This is the end of the beginning. And we will have more substantive hearings like this one as we move forward together and try to identify with the shaping of the best possible responsible policy, not just for NASA, but for the nation.

Thank you very much. Hearing adjourned.

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