

## Senate Appropriations Subcommittee on VA, HUD and Independent Agencies Holds Hearing on FY2004 Appropriations: NASA

BOND:

Welcome. The Senate VA, HUD appropriation subcommittee will come to order. Today we welcome NASA administrator Sean O'Keefe and our other guests from NASA who have joined us today to testify on the president's fiscal year 2004 budget request for the National Aeronautics and Space Administration, NASA.

In the beginning of the year, I expected the NASA budget hearing to be a hearing of hope and optimism, of a renewed commitment to the international space station as well as continued emphasis on the importance of space and earth sciences.

In some ways, I have not been disappointed. Sean, as administrator since you took the helm of NASA, I have been impressed consistently with your efforts and commitment in ensuring the fiscal integrity of NASA's programs and activities, while also focusing - refocusing the priorities of the international space station to ensure the station can meet its goal of its primary mission as a working on-orbit science lab.

Unfortunately, with the tragic loss of the Columbia orbiter on February 1, NASA is again at a crossroads where the nation's manned space flight program must be reexamined so that we understand fully the risks alike that is part of every mission.

We also must acknowledge the bravery and heroism of every astronaut in the space shuttle program. Since manned space flight is inherently risky and will remain inherently risky for the foreseeable future.

I have been very much impressed with the Columbia accident investigation's board with Admiral Gehman at its helm. Because of the board's fine work, I believe that we are beginning to gain the needed insight that will allow us to move past the Columbia tragedy and take the necessary steps to minimize the risk of a recurrent tragedy.

It has only been three months since the Columbia tragedy and I applaud the board for its substantial progress made already on the very complex and serious issues that underlie this disaster.

We also plan to hold at least one additional hearing on the tragedy. Once we reach a point where the board tells us and NASA tells us there is additional useful and conclusive information that we hope can help guide NASA decision making, as provide some solace and peace in the families of the brave heroes of Columbia.

Without regard to the Columbia tragedy, NASA is requesting some \$15.5 billion for fiscal year '04, an increase of some \$130 million over the '03 funding level. The proposed '04 budget for NASA was submitted prior to the Columbia tragedy and the ripple effect of this tragedy inevitably will impact the future funding of manned space programs as well as other missions in the space and earth science's programs.

For example, we provided a down payment of \$50 million for NASA to respond to the Columbia tragedy and we expect these costs to rise. We also have a very tight allocation this year for fiscal year '04 which, regrettably, could result in some significant reductions to the number of VA, HUD funded programs, including NASA programs, especially new starts.

Unless we can get some relief, we are in for a very difficult time. However, I assure you that we will continue to explore avenues for getting some relief.

The future of the space shuttle is a key issue for NASA as well as this subcommittee. I support the shuttle program and manned space flight, but NASA and the Columbia accident investigation board will need to identify the key safety issues that must be addressed to support continued man space flight.

In particular, what are the key causes of the Columbia tragedy? What is the useful life of the remaining orbiters and what alternative successor programs to the shuttle program are under review by NASA and, of course, what is the timeline and, as we must address here, the estimated cost to meet all these concerns.

In addition, what is the impact of the Columbia tragedy on the international space station. I am gratified that our partners in the international community have responded to the immediate needs of the international space station since the Columbia tragedy.

This commitment by our international partners was most evident this past Monday when a Russian Progress delivered a new crew of two to the international space station with the intent of relieving the current crew of three who had been on the station since November 25 of last year.

This international cooperation bodes well for the future of the station and for a relationship with our partners to the international space station. Nevertheless, the subcommittee needs to understand the future expectations and potential cost issues facing the space station under this international partnership.

Finally, what is the impact of the shuttle program on other missions, including those which are part of the earth and space science programs. What missions have been delayed? What additional costs can we expect that will be incurred.

We have a number of questions on these issues and other concerns that I will either raise today or issue as questions for the record. We are supposed to have a vote beginning at 10:15, which is going to

cause us an interruption. I hope we can - I'll see how far we can get and then we will recess the hearing and whoever gets back here, we'll start the hearing - we'll restart the hearing.

But now I turn to Senator Mikulski for her comments.

MIKULSKI:

Thank you very much, Mr. Chairman. Welcome back. We are glad to see you on your feet again. Senator Bond had a hip replacement.

In the interest of time, I am going to ask unanimous consent that my full statement be included in the record.

BOND:

Without objection.

MIKULSKI:

But I think we're all clear that on February 1, our nation suffered this tragic loss in which the space shuttle Columbia exploded and seven astronauts lost their lives and two countries, India and Israel, shared in our grief.

We all agreed that the best way to honor our astronauts is to get back into flight again. But Senator Hutchison, before I talk about the Columbia, I'd also like to thank and acknowledge the wonderful work that the people of Texas did in those little towns, working so faithfully and assiduously and swiftly to recover the debris that has been so part of the investigation.

So, for all those little people that got out there in Texas and Louisiana and those people coming forth with their video film, I think it has been a heroic and extraordinary effort, but a special salute to

the people of Texas. It was a hard job, but again, Texas was - the Lone Star State is going to help us get back to the stars.

When we look at where we are now, I think we're all in agreement that there needs to be a thorough and rigorous and candid investigation of what went wrong. The Columbia accident investigation board is conducting their analysis and will report to the Congress with the American people and from what we can see, it would be candor.

But what I am concerned about is, as we get that report, will we have a direction and will we have the resources to proceed. My number one priority both as when I chaired and then as ranking has been shuttle safety. It has been a shared, bipartisan commitment that we would have shuttle safety. This is what we need to be sure that we have focused on, that safety must come first, no matter who was chair and who was ranking.

For the last two years, we've included report language that the safety of the shuttle and its astronauts must be a priority and I think we included funds to do this. So, my questions will focus on shuttle safety.

Also, there are the long range issues of NASA that must be addressed. The future of the shuttle, whether the shuttle - whither thou goest, will it be able to go. We are also facing, I think, it points out an aging work force and an aging infrastructure and I am really deeply concerned about the challenges meeting those.

And then, of course, the work that we continue to need to do in the area of space science and aeronautics that is so important to us. The president's budget is \$15.5 billion. This is just a little bit above the 2003 level. It is a status quo budget. So, I am not sure where is the money going to be to make sure Columbia can fly again. What are we going to do in space science and also how will we pursue some very interesting new initiatives.

For 2004, the budget proposes close to \$4 billion for the shuttle. That is one third of NASA's entire budget. This includes \$281 million to upgrade the shuttle and its infrastructure, but we have to see what this means. We have to know what your plans are.

The space station budget - we have a big question mark about the space station. What is going to be the impact of the Columbia on the station. What are our international partners doing and the whole issue of also the astronauts up there and is the Soyuz progress really reliable enough to get us through this difficult phase.

There is, of course, the science issues. Just look where we are on the Hubble. How will we be able to service the Hubble. Will we be able to service the Hubble. You know, the Hubble is very special to those of us in Maryland because so much of the analysis is done over in the John Hopkins campus and Goddard is its catcher's mitt.

Hubble rewrites the science books every year. But what are we going to do about that. Where are we on the next generation?

And, of course, there is this issue of aging workforce and aging infrastructure. I understand 20 percent of NASA's scientists and engineers are eligible to retire within five years. The Apollo generation is retiring and again, most of the NASA centers are 40 years old. If NASA is to be ready for the future, what are we going to do about those issues.

Those are a quick thumbnail of what we want to talk about - the broad policy issues and then what are the appropriations necessary to do that. Mr. Chairman, I will pursue other more amplified remarks as we proceed in the questioning.

**BOND:**

Thank you very much, Senator Mikulski. I share, number one, your congratulations and thanks to the people of Texas, New Mexico and

Louisiana and others. Your comments about the shuttle safety are right on. We have pursued that. And we've been discussing the problem of the aging personnel at NASA. This is a huge question coming down the pike that we need to review.

I am going to turn now to the others for their introductory comments. If the buzzer rings for the vote, I will turn the gavel over to Senator Mikulski or to anybody else who will stay here so we can continue with the opening statements. It takes me a long time to get there and to get back, so I am going to start whenever it does.

With that, I believe the first one to join us was Senator Hutchison.

Senator?

HUTCHISON:

Thank you, Mr. Chairman, and I do appreciate the comments of both the chairman and the ranking member regarding the people of Texas. I have been to the area since the Columbia tragedy and they just were so happy to be able to be helpful. Not happy about the situation, but they felt such a part of the finding the answer. The people there felt that it was a very important mission they had. They took it that way and wanted to make the contribution that I do believe they have made.

I want to talk just for a minute about the - certainly, the future of the shuttle, because I think it is just absolutely essential that we renew our commitment to the shuttle and to the manned shuttle, because NASA has done so much. Space exploration has done so much for our preeminence in the field of research and technology growth.

It is one of the reasons that the United States has maintained its superiority in economic growth in the world. And all of the jobs that have been created from this - even the Columbia has made a huge contribution in scientific research because they were able to feed

back every day, every hour, every minute, the results of their tests. They actually did do some research that might one day lead to advances in the elimination of prostate cancer and there were many other scientific experiments that we were able to retrieve, even from the Columbia.

But I think there is no substitute for having people involved in the research that we are doing. So, the idea of sending up unmanned shuttles, which can be effective in some ways and for some purposes, but not as a substitute for having people there to do the experiments and to correct things and adjust.

Secondly, I do want to say in the budget request that I am pleased to see the support for the base budget for the National Space Biomedical Research Institute for \$30 million. I think this is one of the great success stories of our ongoing efforts with space exploration and I think there is so much more than we can do in this area and we need to make sure that we have the capability to bring back the data that we have and the tissues that we are using to have a place then to dissect and use the information.

HUTCHISON:

So, I am very pleased about that. In fact, I have to say that I believe NASA is getting its budget priorities straight. I was one of the harshest questioners of you, Mr. O'Keefe, because I was worried very much that NASA was drifting from their core experimental and technological advance mission.

When you came on board, you wanted to take a look and see what the priorities should be. You had your scientific committee that came forward and said, Yes, in fact, they did renew the commitment to scientific research and you are taking that ball down, I think, running with it as the budget shows.

So, I want to say that I am pleased with that. The other thing I just want to mention regarding manned spacecraft and shuttles is that I

believe the investigation has been open and candid, which is very important and certainly something we learned that was not the case for the Challenger and it took a longer time.

But I do hope that as things are beginning to come out and we are beginning to come to closure, that you are going to come back to us with a system of communications from the bottom to the top so that we will know that even, maybe, some irrelevant observations will be brought forward because it is worth it to separate the wheat from the chaff in this instance.

I don't know and I assume you don't know if something could have been done after the takeoff that would have made the difference, but there clearly were concerns at the bottom. I think that having a communications system to assess those concerns and determine if, in fact, there is something that could be done, is essential for manned spacecraft.

So, I will say, with that, that I do think we're getting on track. You have taken the time and I think - I've never seen a sadder face on any person that I saw on you following the Columbia accident and I know you have taken to heart all of the issues that have been brought forward and I think you are doing the right thing by keeping it open. I want you to continue to do the right thing by keeping our priorities, keeping our vision, keeping our focus and making sure we have the communications systems in place to implement that vision.

Thank you.

BOND:

Thank you, Senator, I appreciate it very much.

MIKULSKI:

Senator Shelby?

SHELBY:

I ask that my entire written statement be made part of the record.

MIKULSKI:

Without objection.

SHELBY:

Mr. O'Keefe, I just want to welcome you here. I have a number of questions later on after your testimony. We appreciate what you are doing. The leadership that you have brought in difficult times with NASA, we - all of us that sit on this committee and have funded NASA basically for many years, most of us, if not all, believe that NASA is still vastly underfunded, considering the potential there, the missions and so forth and I want to work with you and the administration to try to get more funding for vital programs that come under your jurisdiction at NASA.

I just believe that we have profited so much from the basic research and the technology that has been brought forth from NASA itself over the years.

So, with that, I am going to try to vote. I'll be back later to get your questions.

O'KEEFE:

Thank you, sir.

MIKULSKI:

Thank you, Senator Shelby.

Senator Dewine?

DEWINE:

Mr. O'Keefe, thank you for joining us. I just want to congratulate you for the excellent job that you have done as administrator and really,

the great job you have done in light of this horrible tragedy that has hit NASA. I think everyone is really proud of the job that you have done. We appreciate that very much.

I want to join my colleague from Alabama and also say that I believe that NASA is underfunded and we're going to try to, over time, work on that issue as well. So, I look forward to hearing your testimony and I appreciate your being here.

O'KEEFE:

Very good. Thank you, sir.

MIKULSKI:

The committee will now stand in recess subject to the return of the chair and at such time, we will take the testimony of Sean O'Keefe, our administrator.

RECESS

BOND:

All right. We'll reconvene the hearing. And now we are ready for the testimony of Administrator O'Keefe. Sean, please go ahead.

O'KEEFE:

Thank you, Mr. Chairman. I appreciate the opportunity to be here. I'll summarize the statement and ask that the full statement be inserted into the record.

BOND:

Without objection.

O'KEEFE:

This is an opportunity to appear before the committee to discuss the president's 2004 budget proposal for \$15.5 billion for NASA. This is a \$500 million increase over last year's proposal from the president. The Congress subsequently acted on that request a few months after the submission of this one for 2003.

That request demonstrates the administration's continued confidence in NASA's ability to advance the nation's science and technology agenda. It is also an opportunity, I must say, from a personal standpoint as a committee staff alum to appear here before the committee. You always treat me, Mr. Chairman and Senator Mikulski, as the equivalent of an amicus brief or a friend of the court in that regard and I thank you for that courtesy.

The budget we believe is responsible. It funds our highest priorities. It is credible for bills and reserves for technically challenging programs and fully accounts for program costs. We hope to and would like to think that it is a compelling effort which enables new initiatives tied to our strategic objectives.

It advances our mission goals to a stepping stone approach to future exploration objectives and provides transformational technologies and capabilities will all open new pathways.

Proposals about a new strategic direction for NASA and how we plan to shift resources towards longer term goals outlined by our mission and it is summarized in the 2003 strategic plan which is on the web site. There are a couple of remarkable features to it. The first one is that it is short. It is readable. It is written in English and it is on a web site in time for submission of the president's budget as opposed to submitted in September as it is typically is in most federal agencies and department's so I would hope that would get some currency across the board.

Before describing some of the initiatives, I would appreciate it, sir, in giving the opening statements just to describe a brief update on the shuttle Columbia recovery efforts.

The ground, air and water search for Columbia is complete. The base camps at Nachogdoches, Palestine, Corsicana and Hemphill are either closed or in the process in the next few days of closing. The main consolidation and operations point at Lufkin will close by 9 May and all the effort has been timed not around a calendar, but based on the completion of the recovery itself.

The charts that we brought along here - which got there a few weeks ago when I was reviewing the current progress, each of those were an attempt during the course - just to give you a sample of it, because it goes on forever, but each of these grids that they have approached here that they will designate in a green color once they have completed that, having the U.S. Forest Service, the EPA and NASA and other folks that actually searching the areas.

At this point, they're all green. They have covered every single acre of the 550,000 acres that stretch along that blue strip there from south of Dallas-Fort Worth to the Texas-Louisiana border across Toledo Bend, which represents about a 250 mile range about 10 miles wide in every acre of that which accounts roughly to the equivalent to the size of the state of Rhode Island is what has been covered in the course of that time.

BOND:

On the - is there any pattern where there was significant debris. Is there some kind of submission you can give us to show where it was found and does that have a - does the location have importance in assessment of the causes?

O'KEEFE:

Yes, sir. It did indeed. As a matter of fact, the pattern is - as you see the blue line intensifying there in that area. Even if you saw it up close, it would be an area, again, south of Dallas-Fort Worth to the far left. The Texas-Louisiana border is right there on the point where

it is light green shifting to the kind of brownish and that blue line is the intensity, the primary areas where everything was picked up.

The wreckage field, again, was about 10 miles wide. But that is where it was intensely focused and you are exactly right. There were certain compartments and certain pieces that you could pick and certain areas that you knew that after time, it started to unfold a pattern of exactly how this occurred.

The left wing, which has been much written about, the wreckage is much further downstream and closer towards the Corsicana, Nacogdoches area, which is on the left side of that debris field. The right wing, which stands to reason, stayed in place for a longer period of time was among the last things to break up as well as the crew compartment, et cetera, which was closer to the Hemphill area, which is right near the Louisiana border.

So, from that, that is exactly - we've been able to piece together a much more comprehensive understanding of precisely how this happened. The Columbia accident investigation board is coming to a conclusion on hypothesis and theories based on exactly that sequence of not only what you find but also where you find it and exactly what condition it is in as you move along.

During the course of this last 90 days, they have - all these teams have collected 85,000 pounds of debris. That represents about 40 percent of the Columbia's weight. Of more than 80,000 specific items that were picked up, approximately 76,000 have actually been tagged and identified. I was just down at the Kennedy Space Center Monday evening and they've identified the better part - again, that is 76,000 - they have actually arrayed out about 10 percent of it that demonstrates exactly what the pattern - of what the wreckage would tell us occurred on that terrible morning.

Of that grouping, about 1,000 pieces came from the left wing and they have now been able to piece that together and reassemble significant portions of the left wing so you could actually examine

what the intensity of the heat as well as the heat flow demonstrated on that particular event.

On the 29th, I met with the research teams in Lufkin, Texas. Again, we have essentially closed all of the four primary base camps and NASA has formally acknowledged and appreciates very much the efforts that the folks in east Texas and west Louisiana have contributed in this particular effort. It is indescribable the activities that all of the 120 agencies from federal, state and local activities have contributed as well as that of the communities, which have been absolutely exemplary, to the point of inviting volunteers as well as federal public servants into their homes during the course of this very, very arduous effort.

The initial prediction was that we might find and recover on the order of 10 percent, maybe. It has exceeded that by a factor of four and that is largely due to the extraordinary efforts on the part of an awful lot of folks who live in the east Texas area who have been just incredible partners and assistance in all this.

So, Senator Mikulski, your points were exactly right. They have been really unbelievable folks and the Lone Star State has helped us return on this particular case.

The independent Columbia accident investigation board, as you mentioned, Mr. Chairman, under Admiral Hal Gehman, has made significant progress in organizing the work and again, looking at the - not only the facts and evidence that came back from the mission control information, but also a lot of the OEX recorder that was recovered a few weeks back. And to your question again, Mr. Chairman, that was located in the area very much towards the southeast portion of this stream, right near the Louisiana border and it was found on the second pass over that same acreage. This really has been an incredible case of not only a lot of human effort, literally walking over every single acre of examining the debris field itself, but also using that analysis to inform where other parts might be.

O'KEEFE:

To your observation, Mr. Chairman, the OEX recorder was in a specific compartment that we found several different pieces of in a very specified grid on that debris field right near Hemphill. Having returned after covering it the first time and not having found the recorder and having seen the analysis that indicated here are all the other parts we did find, a lot of our folks asked the U.S. Forest Service, the EPA and our people to go back and look over that acreage one more time in an area about five acres, because if it was going to be found, it was going to be found on that second pass, they found it.

It was really using the technology and the analysis of what we found, where we found it, how it was recovered and what condition it was in that really led us to a lot of the efforts that have gone on here. So, it was an enormous effort to inform the nature of the investigation and the Columbia accident investigation board has really valued that contribution.

We have kept the pledge and I appreciate your comments to all the opening comments of the members of the committee here that we have indeed handled this in an open manner. We are candid with the accident investigation board, even if that means that some of the earlier findings or theories prove to be opposite of that. That's fine. We're hoping and planning that the facts will speak for what occurred here and we continue to work with them to determine the nature of this.

So, I concur with you, sir, that Admiral Gehman has been incredibly diligent in working through this effort. They have been very forthcoming in all of the public hearings and press conferences in describing exactly the direction they are moving. They are narrowing in on a set of theories they are hoping to release in the weeks ahead.

I would also like to point out that the past week, on April 24th, we celebrated the 13th anniversary of the launching of the Hubble Space Telescope. In honor of that anniversary, we released a Hubble image that was passed around here for you, which we have characterized as the perfect storm of turbulent gasses shot. It's got a more formal title which is the Omega Nebula. But it is one that was just released this past week.

The image captures a small region in a very specific area known as the Omega or Swan Nebula, located about 550,000 light years away from the constellation Sagittarius. There is another one we are going to release next week and as a preview of coming attractions, we will pass that around as well, which is the Helix Nebula that is also just a stunning piece, that will be released publicly early next week from the Hubble Institute as well.

The 2004 budget contains nine specific initiatives tied to the mission's goals that again, are built on the strategic plan which again, we like to think is very short, easily readable and specific. They include, first and foremost, an effort to really address the power generation and power limitations, propulsion limitations we currently wrestle with on every mission that we are engaged with, so we are looking for a new power generation and propulsion capability in the time ahead to accomplish not only speed, but orbit, kind of examination of any of the outer planetary missions we may engage in.

Project Prometheus is our effort to do that. It is an ambition effort to develop and to build nuclear reactors for the purpose of providing propulsion and power generation capabilities and we tend to enlist the experience of better than 40 years of our friends in the naval reactors community to design reactors that are significantly smaller than that, but generate about a factor of 100 greater power than what we currently deal with today on every single space probe mission.

The second major area, I think, is of particular focus as well and it is also a limitation that we have dealt with for a long time and need to wrestle and understand better how to conquer. It was to develop a human research initiative, expanded biomedical research and technology development to enable long duration missions on the international space station or any other vehicle as a potential means of missions beyond low earth orbit.

Now, the benefits that come from this are, I think, again, just this past June, less than a year ago, we set the longest duration U.S. space flight record of 196 days - Dan Bursch and Carl Walz accomplished that task. That was about the time it takes to get from here to Mars and that is it. That's the longest we have had anywhere.

So, the idea of either experiencing that particular effort is a real challenge, because the physiological consequence of that is just downright profound. During the course of any stay on the international space station, every astronaut and cosmonaut receives the equivalent radiation dosage of 8 chest x-rays a day.

During the course of the missions as we see in the case of expedition four, the Dan Bursch and Carl Walz worked through as well as those who were returning, Ken Baris (ph), Don Pettit and Nikolai Budarin coming back this weekend after five and a half months there. They will likely experience what we typically find of about a 30 percent muscle mass and about a 10 percent bone mass degeneration.

If we can figure out ways to arrest this in the human research initiative that we have budgeted for and specifically provided a very aggressive effort to understand better, arrest that degeneration as well as provide for the appropriate shielding for the exposure, that will have applications not only for long duration space flight and the opportunities for future space explorations, but it has direct applications to all of us here on earth.

If we can determine how to arrest that - just the bone mass deterioration issue, that in turn may make you one of the few folks that will have to go through hip replacement in the future, Mr. Chairman, and hopefully accomplish that so those who follow won't have to suffer the challenges that you are wrestling with right now.

BOND:

It might be simpler if they didn't play rugby, but anyhow.

O'KEEFE:

Well, to look at some life habit kinds of changes as well, I guess that need to occur. But it nonetheless is an opportunity, I think, we can apply all kinds of different applications of approaches to these sets of challenges here on Earth.

The third area that we shall see emphasized is the applicable communications initiative. It's an investment in revolutionary laser communications technology that we intend to demonstrate on a mission to Mars later this decade by transmitting large volumes of information that right now take us a ferocious amount of time.

The effort that currently is underway is it takes us about a better part of two years, these last two, to map about 20 percent, roughly, of the planet Mars.

With this particular initiative, you can do that in about four months for the entire planet. That's the difference in speed of communications as well as capability.

The fourth area that you will see emphasized here is a "Beyond Einstein" effort. It's worked at a couple of specific observation observatories of deep space gravity wave director Lisa as well as constellation X, a mission probing to look at the edge of black holes, both of which are to look at those theories and specifically capitalize on those efforts and understand what's involved.

Fifth is the climate change research initiative. The president has directed all of us within several 11 different agencies to engage in and be involved with to collecting information, to accelerate research and to key scientific uncertainties that inform the kind of changes that are occurring within our own climate here and the environment that effects and is affected by the way we conduct our habits as human beings and to collect that data and then inform what the appropriate protocols would be to alter that set of habits.

The sixth is the aviation security initiative to expand research, develop technologies that will, in turn, we believe will reduce vulnerabilities of aviation to terrorist and criminal attacks. The proposition that anyone can use a commercial airliner for the purpose of terrorizing us and again, ought to be eliminated simply by the use of technology, which would eliminate their capability to take over aircraft in those circumstances.

The seventh is the national aerospace systems transformation augmentation which translates as trying to do better air space management. It is one thing to encounter, as we do nowadays since September 11, a very real change in the way we conduct our activities for commercial transportation and the amount of time we wait to go through security efforts, but it is another thing to have to have aircraft stacked up waiting for departure and landing opportunities as a way of, I think, improving that efficiency through air space management that we can help deal with.

Quiet aircraft technology certainly is a persistent issue of trying to deal with urban noise pollution that we know we can do some things with very specifically to improve.

And finally, the most important in terms of our effort to inspire the next generation of explorers as part of our mission objective, we have pursued the educator astronaut program, which was announced in late January and since that time, there have been over 1,600 applications from educators around the country, who seek to be astronauts as part of that effort. Better than 8,600 people

were nominated in the course of that time. The applications will close tomorrow. The course of that effort of that 1,600 applications we'll review in order to select three to six.

So, the interest in the wide range of activities in the astronaut corps certainly is unabated as a consequence of the tragedy of February 1. Indeed, it may have even heightened since that time.

Within the next few weeks, NASA will make 50 awards for NASA explorer schools involving unique partnerships between NASA and the school teams that the middle school grade levels across the country to join educators, administrators, students and families and sustain involvement with NASA research discoveries and missions.

The budget also builds on the work of this committee and the Congress in the February enactment of the Omnibus Appropriations bill, containing many needed elements to help address key power, propulsion, transportation and human capability restraints. The budget specifically funds the international space station, as you said, Mr. Chairman, in your opening statement. There is no difference to speak of, between three different estimates of what it will cost. We know what that is going to be and we've now developed a plan which will complete the international space station as soon as we can return to safe flight.

It accommodates our international partner elements, it maintains progress on research priorities. As Senator Hutchison alluded to in her opening statement and continues to build out the international space station in order to then organize all the research through the non-governmental organization like the Hubble Institute to specifically organize up with the international space station research will do in the years ahead.

The integrated transportation plan, which again, we appreciate the endorsement and support of this committee as you did in the fiscal year 2003 budget to specifically make investments in not only the service operational life efforts for upgrades and modernizations, but

the orbital space plane, to get that started as a crew transfer vehicle between here and the international space station often and the next generation launch technology efforts in propulsion, structures and operations which will provide that future replacement for shuttle in time.

Along with the strategic plan that I mentioned, we're also submitting an integrated budget performance document and performance and accountability report, all earlier than it is typically required by law in order to give some meaning in the context of the budget that we had planned, developed and released on February 3.

The documents reflect agency - specific areas of dealing with budget restructuring, in which in accordance with the committee's instruction in that regard, full cost accounting and management in order to reflect the total cost of what it takes to do something as opposed to having it spread throughout the budget and trying to find what the pieces and parts are. You can now look at the fiscal year '04 budget and see what the total expense is in order to actually carry out some task.

The third area is the integrated budget performance effort to try and demonstrate the linkages between performance and what the budget request is that we have pending before you to inform the Congress the promised cost schedule and technical perimeters to approve projects, merging budget with performance plans specifically.

Then the integrated financial management system, which again, the endorsement of this committee has been invaluable to proceed with. It is the our third attempt to doing this. I want to advise us how this one is successful. It is being implemented now. The last three centers, Goddard, the Dryden flight center out in California and the final one is - Goddard is the third. It escaped my memory for the moment, but of the three, they will be implemented by June. The rest are already on this system and that core financial system is

operating today, right now. So, by July, it will be one financial system at the National Aeronautics and Space Administration.

Finally, on this vain, we have completed and have an extended dialogue about last year, as you recall, the hearing to review the budget before this committee on the audited financial statements. We have received a clean opinion this year, unqualified. It is - the books are in order. We've got a lot of work to do to maintain that in the future and a lot of what is going to be involved in the integrated financial management program in that one single core financial system is going to help us achieve that year after year. I don't anticipate a repeat of last year's disqualified opinion.

And in conclusion, let me just offer, I guess, a thought that Senator Mikulski introduced in her opening statement as it pertains to the human resource challenges we have. Indeed, that is a matter that we are really deeply concerned about, but can get ahead of now if we do some things today and in the future, the very near future, in order to look to recruit, retain as well as professional development of those who are within the agency today.

The president has submitted legislation back in June of last year that would provide those specific tools. There are two pieces of legislation introduced. Senator Voinovich here in the Senate as well as Congressman (inaudible) in the House have introduced legislation that specifically moves those initiatives forward. We seek enactment of those as soon as is possible in order to develop those tools, use them, and get ahead of this particular biwave of retirements that we see looming here in the very, very near future.

So, it is an opportunity today to deal with that as opposed to dealing with it in a crisis condition just a couple of years from now.

Mr. Chairman, again, thank you very much for your indulgence. I appreciate the opportunity to be here.

**BOND:**

Thank you very much, Mr. Administrator. I am going to yield my time to the chairman of the full committee, Senator Stevens

BOND:

the full committee, Senator Stevens.

STEVENS:

Administrator, I do have a couple of comments. I look forward to working with you, my good friend.

I note the reduction in aeronautics allocation and the reduction in the education allocation as compared to 2003. This is the 100th anniversary of man's flight. We are, I think, in a position where we ought to demonstrate to the world that we recognize the great impact of that flight and I hope that we're not going to be eliminating some of the research that, from my point of view, is very vital to the future of aeronautics.

For instance, you did have a - you used to have a research project going on trying to find out a way to deal with a sonic boom. I haven't hear about that for several years, but currently we cannot fly across the land mass with commercial aviation beyond the speed of sound because of the impact of the sonic booms.

We also have in terms of education program, I think, a series of initiatives that inspired young people to consider a career in space and in your agency. I'm one that firmly believes that the dreams and desires that you form as a child, even in the fifth, sixth or seventh year are the ones that you really want to pursue for the rest of your life.

I think it is highly important that we continue that stimulus through the education programs. I would be interested to see how you are going to allocate that the decrease within your department, because I do hope that we maintain the concepts that we need for that.

My only question to you though, if I may ask you a question right now is what are you going to do about the Wright Brothers celebration in December.

O'KEEFE:

Thank you, Mr. Chairman. I appreciate that. We are always guided by your superior wisdom, no doubt about it.

STEVENS:

Not wisdom. Inquires, inquires.

O'KEEFE:

As it pertains to aeronautics, again, in the coming year, it is a 5 percent increase. What is really at question is the outyear projects. Working with Marion Blakey at the FAA, I think we'll see some change in that.

So, our outyear projections for decline here, I think we're going to go back and take a look at. But we've really kind of held that as a baseline in order to develop this effort in concert with FAA to specifically look at aeronautics improvements on a variety of different issues. For '04, it's an increase up and we'll continue that along.

STEVENS:

Some time ago I suggested that there be a sort of a task force between DOD, FAA and NASA to assure that there would be not a redundancy but there would be a sharing of effort in the future aspects of aeronautics research. I hope that that continues.

O'KEEFE:

Yes, sir. Absolutely. As a matter of fact, that is precisely where we are going. Marion Blakey will be leading that. I'll be participating

along with Dr. Ron Sega from Defense and the three agencies and departments engage in this, heading exactly the road you are talking about. That is why I think the outyear numbers, at best, are a placeholder baseline that I would anticipate we will adjust as the consequence of the efforts that will come out of this effort that Marion is putting together now.

On the education front, I need to get some numbers for the record, because our intent was to increase and increase dramatically in terms of the education focus any activities we are involved in. We are really looking at a lot of outreach programs as well as support for a range of the other non-profit or non-governmental organizations that have been really dedicated to research and education focus.

The educator-astronaut issue, and so forth, has all been designed to specifically stimulate that kind of interest for precisely the age group you are talking about. If you don't catch folks in that middle school, junior high kind of focus area, they are likely not to want to pursue math, science, engineering, technology related activities.

So, we spend a lot of time really focusing our energies on that age group more than any other, because in many respects, that is where the formulative kind of ages are really based in the pursuit of those kinds of professional opportunities in the time ahead.

So, we are concentrating on that an awful lot. I want to provide some better information for you. I think we'll have an opportunity later this afternoon to get together. I'll make sure I'll bring that with me.

STEVENS:

I would like to see something in the record on that, if we could.

O'KEEFE:

Yes, sir. Absolutely, sir. Thank you, Mr. Chairman.

BOND:

Thank you, Senator Stevens.

MIKULSKI (OFF-MIKE):

Senator Stevens, before you go, (inaudible) that Senator Bond and I did last year and this is to increase graduate students going into science.

Working with Senator Bond through the National Science Foundation, graduate students' stipends in the basic science - physics, chemistry, the things we need were 18 grand a year. We raised it to 22 and Dr. Caldwell said that we've gotten a 30 percent increase in the number of American graduate - interest in going to graduate school in these fields.

So, we're working on it. We want to talk to you about this.

STEVENS:

Good. Thank you.

MIKULSKI:

We're on the same broadband.

BOND:

Senator Mikulski?

MIKULSKI:

Senator Bond, why don't you go right ahead. I mean, we afforded the courtesy to the chair for appropriations. You are the chair of the committee. Why don't you lead it off?

BOND:

Thank you, Senator.

Shuttle costs. We've not yet...

MIKULSKI:

Senator Stevens is a (inaudible). I mean we don't - he goes first no matter what.

BOND:

We're all equal. He is just a little more equal.

OK. So much for the first half minute. Potential shuttle costs. What funding requirements do you anticipate in '03 and '04 to respond to the Columbia accident for repairing the shuttle, slips to the space station and shuttle changes to the research. I know we don't have the final, but do you have a ball park guess here, an estimate of what that might be.

O'KEEFE:

(inaudible) the recovery effort is largely been covered by the federal emergency management agency as a consequence of their disaster relief allotment to our allocation that the Congress provides each year.

That is going to total something on the order of about \$230 million as the current estimate that FEMA is using to reimburse the U.S. Forest Service, the EPA, other federal agencies and the state and local government activities.

Our costs at NASA are well within the \$50 million incremental cost differences that the Congress provided funding for in the fiscal year 2003 appropriation made in February. Our efforts primarily are in support of again, the Columbia accident investigation board and within that full - that allocation, that will cover the incremental differences of what we are incurring.

In total cost for all activities, if we added everything that we did in this, it would probably...

BOND:

Just NASA. What will NASA need?

O'KEEFE:

Again, within that \$50 million, you provided it there, we're going to cover that as an incremental cost difference and that is going to work. To the extent there is any incremental cost above that we'll be back in touch to advise what that will take, but it's really not - at this juncture, we think it is going to be well within on an incremental marginal cost basis.

The differences in shuttle station, so forth, right now we're not incurring the cost, because the fleet is crowded. So, the expense to continue in a ready status the ability to return a flight as expeditiously as we can is well within the allocations that have been made for shuttle launches as well as international space station, we are processing the modules as we have been in order to ready for that return to flight as quickly as we can get there.

BOND:

The international space station's resupply's mission, I understand the partners who have yet to come up with the final agreement on how to provide \$100 million per addition Russian vehicles.

I would like to know what the status is in discussion with the other partners regarding how to fund the Russian production and will they be able to provide the needed funding are we going to have to ask for a waiver from or an amendment to the Iran Non-proliferation Act so NASA can provide some of the funding?

O'KEEFE:

Well, as you mentioned in your opening statement, sir, the actions are speaking louder than anything else. The Russian's launch the Soyuz rocket and is - Ed Lew (ph) and Yuri Malechenko not only launched successfully, they are there on the international space station today. Ken Bowersocks (ph) and Don Pettit and Nikolai Budarin will come back on the Soyuz. The progress flights that were planned, the unmanned logistics resupply flights. They are planned as one going up in June. There is another we are seeking to accelerate to November.

All those are going exactly as according to the plan. And the Russians have stepped up in a very substantial way. I am leaving tomorrow to go to welcome come Don, Ken and Nikolai and I will spend a little time with Yuri Koptev, the head of the Russavia Cosmos (ph) - Russia's space agency.

I do not anticipate any requirements to waive or consider the non-proliferation act. The partners are acting like partners.

BOND:

Well, again, the fact that we are so dependent on the Russians. The orbital space plane would provide an alternate both to the Russian vehicle and to the shuttle for taking crews and a limited amount of cargo to the space station.

What extent can the development of the orbital space plane be accelerated so that the capability is available as soon as possible. What is your current estimate for the cost of the orbital space plane?

O'KEEFE:

Well, currently, I just went through an exercise here in the last couple of weeks to try to look at all of the acceleration options that may be necessary, or possible. It turns on two things. First one is there are competing designs. At least three major contractors who

have different approaches on how to deal with what is a very short list of requirements.

We have kept this very minimal. You can list all of the requirements for the orbital space plane on a single page. There isn't any ambiguity about what it is we are looking for in terms of its requirements and capabilities we seek it to perform that.

Now, depending on what kind of approach those various contract proposals those may come back with here in the next nine months, that will tell us a lot more about how fast or how slow it is going to be in terms of delivery and in terms of overall cost, I wouldn't want to compromise their ingenuity, imagination or creativity one dime until we see what they come up and produce.

BOND:

OK. I got that answer. Senator Mikulski?

MIKULSKI:

Thank you, Mr. Chairman.

Mr. O'Keefe, when do you think the shuttle will fly again? I understand that NASA announced, was taking interim steps to prepare a return to flight before the Gehman commission had finished its final report.

O'KEEFE:

Oh, no, no. What we announced is we are preparing, making preparations now to return to flight as early as the end of this calendar year so that we can be in position, so if all the findings and recommendations come forward and do not impede that opportunity, that we not be in a position when the report comes out to say, well, I guess we ought to start thinking about returning to flight.

We're trying to do all the preparation work in order to do that. We are implementing their findings and recommendations...

MIKULSKI:

Here goes my question, because I think the Gehman report is not going to be done until July. I am not rushing to return to flight. I think when we go, we have to be sure in the most meticulous, arduous way that we are ready to go and therefore turn to the lessons learned from the Gehman commission, both not only in what went wrong, but how we can prevent other issues. I have a whole host of questions on that.

But my question is, as you are working to go back, because there are consequences of not launching, then one, how are you preparing and number two, not only from the technical and engineering and safety aspects, but how are you preparing in terms of the money. In the president's budget request, NASA only gets \$55 million more, OK. That is just slightly above 2003. Here is my worst fear from a financial standpoint is that we have the Gehman. That comes in July.

We've already marked up. We are already moving that one on our flight track. There is a substantial price tag to being ready to return to flight. It won't be - how do we get it in the appropriations and if we don't, then we cannot have that whole issue of NASA going to other important programs to get the money they did when station was running such horrific cost overruns and congratulations to you for bringing about that discipline there.

So, you see what I am worried about (AUDIO GAP).

OKEEFE:

(AUDIO GAP) possibly can to make absolutely certain we've tacked down every prospect of what is necessary and what they are observing as changes necessary to return to safe flight.

So, if we are diligent about that and if there are no hardware process show stoppers in this, we anticipate we could be looking at the early part of next fiscal year flying again.

Between now and then, we plan six flights for this fiscal year. We only conducted two. It was STS 113 (ph) and STS (ph) 107.

MIKULSKI:

So, you have money in the pipeline.

O'KEEFE:

Yes, ma'am.

MIKULSKI:

I have other questions, so.

O'KEEFE:

Absolutely. That is there. We are not expending the cost of launch services as a result of that effort.

MIKULSKI:

So, you don't anticipate that you're not going to need additional funds?

O'KEEFE:

No. I didn't suggest that. I think we are doing fine right now in order to prepare for flight. As soon as we get the full report and understand all the findings of what is going on, then we will be receiving those over the course of the next two months. We may be in a position to better estimate what that will take and advise the Congress in terms of what direction to go.

MIKULSKI:

Do you have any concept even now or you are reluctant to say.

O'KEEFE:

I sincerely mean this. I have no even perimeter of what the cost difference will be relative to how much we have in the budget today. Until you really get the findings and recommendations from the board, it really does not lend itself to that kind of - the only things we have got right now is an estimate, for example, on differing options...

MIKULSKI:

I understand. Let me just say this. I am very troubled by the president's budget request. I think it is status quo. And I think we needed another \$500 million more - one to catch up on a tattered and worn infrastructure, the other things that got worn well before you came and then kind of a banking of what we might need for the shuttle, you know, the ability to deal with the shuttle recommendations. So, to only have \$55 million and not in the president's budget request, we are really going to be shackled in terms of how to proceed here.

We don't want to short change these other items that you listed, very worthwhile projects, some exciting, some crucial to saving lives, not only of astronauts but here on Earth and new ideas for new products for our economy.

So, we like where you are heading. But I am afraid we're going to be heading for a real fiscal issue in the appropriations process and then also thanks to the Russians - they are doing Soyuz and so on. That has worked as a little lifeboat in space, but that is a financially strapped country. That is why Senator Bond asked how we can reimburse them so that it really goes to the space agency and not scatter through the other Russian financial problems.

So, I am very concerned that we support what you need to do and have the wherewithal that we really help the Russians meet their responsibilities and we're grateful for that and the spirit in which they came forth and I know my time is up, but you see where I am heading. And I've got a lot of questions about Hubble (inaudible) aging infrastructure.

O'KEEFE:

If I could, Mr. Chairman, real quick. The budget that we submitted on February 3 is empirically about \$460 million more than what the president requested the year before. The Congress acted on that request weeks later.

So, what you have observed here is absolutely accurate. Relative to the appropriation that the Congress enacted weeks after this budget was submitted to you at the time, it was again, \$450 odd million difference versus the difference of \$100 million as a consequence of what the Congress did enact during the course of the subsequent action on the part of the Omnibus appropriations bill.

We will continue to look at this. I assure you, our intent is not to rob other programs in order to pay for shuttle costs. That will not be in the mix. Not the intent, won't do it.

BOND:

Thank you very much, Sean.

Senator Craig?

CRAIG:

Mr. Chairman, thank you and I'll be brief. I've got to run to another committee, but I did want to stop by and say hello, Administrator O'Keefe. Again, thank you. I appreciate the visit we had at NASA earlier this year. I guess it was last year, now. How time flies. And I know you've all been tragically busy since that time and of course, I

think all of us are very anxious for the report to be completed and to get our shuttles flying again under all of the conditions that are safe and appropriate because clearly, I think the combination of the advancement and the space agenda and our science agenda that you play such a key role in is critical.

Slowly but surely, this Congress is shifting a little bit towards the physical sciences again. We are very pleased about that. We have expended a great deal in the biological sciences and we are proud of that. So, we also recognize that we need to push the other envelope a bit more than we have, so I am pleased about it.

I would suggest you take a look at a bill that just came out of the energy committee, Director O'Keefe, as it relates to your nuclear systems initiative. We have got not only this, we hope this Congress and certainly this administration moving in a new direction again as it relates to nuclear reactors and new passive safe reactors and, of course, coupling with the Navy is appropriate for where you want to go and I think most appropriate, the efficiencies we've achieved there are exciting, but gen 4 (ph) reactors and new advanced fuel cell technology may well couple with what we want to do, what you want to do out there in space with that kind of power plant that should be able to be done effectively and in a miniature or small way that we're looking at.

So, hopefully we can move this agenda with the cooperation of our colleagues. It is a bold one and this administration appears to want to be bold in that area and I am confident that a good many of us now do recognize the importance of that. We're going to couple that particular project with hydrogen, hydrogen electrolysis creation and so we hope to get this Congress looking forward with energy instead of standing still.

Of course, your mention of radiation, as I was coming in, is important to all of us. As you know, our University of Idaho has played a great role and our colleagues there and their association with you and radiation and hardening electronics.

So, I am excited that we advanced that. We've learned something with the ability to protect our tools. Now we ought to be able to learn something about the ability to protect our people a little more in the appropriate way.

And lastly, if we can get our shuttles flying again, your educator in space program flies with it and that is exciting. Our friend, Barbara Morgan from Idaho who has played such a key role there. Thank you again for allowing her what she does so well. Those are all important to us. I am hoping this committee and this administration will stay high on what we are doing out at NASA. I think it is important for the future of our country and if we don't think what we do doesn't have application across the board, the pushing of the sciences and the technology, it just got demonstrated so effectively in another part of the world that sets us apart as a unique country, but our willingness to use those technologies for mankind's betterment is also demonstrated largely through, in part, of what you do.

So, thank you for your work and I'll be here encouraging and working with our chairman and our ranking member to make sure the resources are available.

O'KEEFE:

Thank you, Senator. I appreciate your support very, very much. Thank you.

BOND:

Thank you very much, Senator Craig.

Senator Shelby?

SHELBY:

Thank you, Mr. Chairman. I believe NASA integrated space transportation plan contains three important and critical elements for

our nation's future in space -- the shuttle life extension, the orbital space plane and the next generation launch technology program.

Given that the next generation launch technology program, NGLT is largely a technology development program, is it at risk becoming a player for any cost over runs associated with shuttle life extension program, orbital space plane?

O'KEEFE:

I don't believe so. As a matter of fact, I think in the time not too far ahead, we'll be seeing greater definition for the next generation launch technologies that we are working very, very closely with the defense department in order to get a co partnered and joint program kind of effort that is compatible to assure access to space, which is then - and then launch access, which is their concern as well, that I think we'll really put some definition to that.

Our intent would certainly not be to have that be a bill payer for anything. Each program stands on its own. We are looking for that to be the mantra that we live by.

SHELBY:

What about NASA's unique needs and DOD requirements. What kind of challenge do you have there and how do you address those challenges?

O'KEEFE:

It is - the efforts that really are very common between NASA for launch technologies and the various approaches, whether they be horizontal or vertical in terms of the efforts that can be carried out, one of the ways we are looking to identify where those common technologies really have greatest application is through the national aerospace initiative that Dr. Ron Sega is championing to really emphasize our partnering arrangements with them on hypersonics

and a range of very specific structures and propulsion initiatives they have, pursue that we're doing jointly with them.

And that becomes the areas where I think our greatest leverage of each other's capability can really be expanded in order to see some specific yield for both NASA and DOD.

SHELBY:

On February 3 of this year, NASA released an announcement of opportunity for the explorer program focused on small explorers and missions of opportunity. I have been told that in spite of marshals, the extensive experience and the development and management of science spacecraft, that this announcement of opportunity explicitly prevents marshal from having a project management or end systems engineering row.

If that is true, this announcement of opportunity doesn't track with what I understand to be NASA's philosophy and your philosophy of one NASA. Are you familiar with that announcement?

O'KEEFE:

No, sir. I'm not. Let me look into it and I'll get right back to you.

SHELBY:

Will you check on that and get back with me?

O'KEEFE:

You bet.

SHELBY:

We would appreciate that very much.

Propulsion. We know that you are developing a portfolio of propulsion research in both earth to orbit application and in space

applications. Can you describe, Sean - Mr. Administrator, excuse me - the balance that you are trying to strike between the two investments here and what challenges do you see on the horizon with one of these activities.

O'KEEFE:

Yes, sir. Thank you. The first, I think as we discussed a moment ago, in terms of launch technology is primarily in the next generation launch technologies focus (inaudible) space transportation plan. So, much of what you see there is not commingled or in competition with the in-space propulsion effort, which is almost, well, largely focused on the project Prometheus effort that is both power generation and propulsion capabilities. An awful lot of effort and energy on both fronts, but they're not - again, they're being looked at as separate propositions.

One is, how do you accomplish the thrill of eight and a half minutes of low earth orbit, as on a launch technology as well as, once there, how do you find any in-space propulsion capability, of which we have none right now. The only capability we have, however limited - I shouldn't say none - is we use gravity assists. We really hope to get into the right orbit pattern in order to head anywhere in this solar system is about the best we can do, that uses a very, very limited kind of solar electric generated power source.

The capabilities - just to give you a context of that that must be utilized on any mission for a spacecraft unmanned, particularly, has to have a maximum power generation yield of no more than two 60 watt light bulbs. So, this room would be max energy they've never had, anywhere. With the nuclear systems effort and the power project Prometheus will provide is about 100 times this kind of power generation capability in order to provide for propulsion of any variety...

SHELBY:

A big leap in...

O'KEEFE:

A huge. Or power generation but also the ability to sustain the science and research aboard. Two very distinct approaches were taken to this, not in any competition with each other at all.

SHELBY:

Mr. Chairman, I've got some other questions. I'll wait until my next turn.

BOND:

Thank you, Senator Shelby.

(UNKNOWN)

Mr. Administrator, speaking of Prometheus, I've got some questions about it. You have shown in your request about three billion needed for the first five years, 2004 to 2008. But I understand the head of NASA's space science office, Dr. Wyler (ph), was quoted in Science Magazine recently as saying the cost of Prometheus through 2012 would be \$8 billion to \$9 billion. And, of course, unfortunately we know the preliminary cost increases are never overblown.

I am concerned about whether this project is going to consume such a large amount of the space science funding that other initiatives are funded are not going to be funded. What percentage of the funding is for building spacecraft and what for building nuclear power and propulsion systems and could the cost be lowered by a less ambitious spacecraft?

CHAIRMAN:

since, you know, since this is the first shot and if something goes awry, we don't want to lose it. Give me a little idea of your cost containment on this.

O'KEEFE:

Yes, sir. I appreciate that. The budget before you are the numbers I stand by and they are through the next - at that five year span, a little over \$3 billion. The development effort for nuclear propulsion and power generation capabilities. It also begins the first demonstrator, if you will, of that capability which will provide around Jupiter's moons a mission in the early part of next decade of multiple on orbit pass. So, for example, take, if you look at the number of on orbit passes, we could do - it would probably take the better end of 10 to 20 missions. If each one of them costs some numbers of hundreds of millions of dollars, multiply it by that number and that is how much it could take in order to pursue this.

So, this is going to be significantly less expensive to pursue on a multiple on orbit efforts at various planetary objects than anything we could do elsewhere. Because you only get one fly by on every other spacecraft. One. And if the cameras don't work, the instrumentation isn't right, whatever, it's a lost mission entirely.

So, this is an approach that is really going to enhance the capability to do many, many flybys, get there a lot faster, do it in a more expeditious period of time and the development cost in these next five years is that much.

Then from there on, each of the individual missions are going to be stand alone costs and in the case of the Jupiter's moons project, which will be the first demo of that capability, which is due to launch before the end of the decade, beginning of the next, that will be an estimate we will refine over the course of the next few years so which we will be able to provide much more authoritative number of what that is going to cost.

In terms of development expenses, it is three and a half million bucks.

CHAIRMAN:

And then you've got the orbital space plan. That could be another \$3 billion, so you've got some big ticket items that are, you know, are you sure you aren't going to be squeezing something. Somebody is going to have to - OMB is going to have to start smiling on you and us a lot more kindly if you are going to get all of these done.

O'KEEFE:

Well, the five year plan that is projected is part of this budget request, has the agency submission rising to nearly \$18 billion by the end of fiscal year 2008, I believe it is, and this is fully funded. That's the total estimate, we believe, is going to take to do everything that is in there. This is the president's budget request, so everybody is in agreement with what those numbers say.

And so, as a consequence, he stands by them. I sure can stand by them, because he has put his imprinter on it.

CHAIRMAN:

I have been very much concerned, as Senator Mikulski is about the staffing of NASA and making sure that we have the right people. I know we are facing a significant shortage. We need homegrown new generation of engineers. There is science. There is a retirement crisis coming. And there is not an adequate pool now in the United States now to meet the needs.

So, we are, as the Senator said, been working with NSF, but I question whether NASA's needs incentives to retain staff, to NASA's credit, the employees see themselves as part of the family and they don't seem to be leaving, but I am particularly concerned about buy outs. Do we need additional buy out authority if 25 percent of the

current NASA work force is eligible for retirement within five years and there are not enough scientists and engineers to replace them?

So, I ask why we need (inaudible) and I am also concerned about buy out authority, because I understand that sometimes we buy out these employees. They leave and then go to work for a contractor at a higher salary and we get to pay that salary after we bought them out. We get to pay for a very wonderful, high-class scientist at a significantly increased rate.

What is the - how are you going to protect that problem. I am - I see this - I kind of have a different view of solving your staffing needs.

O'KEEFE:

Thank you, Mr. Chairman. The personnel management approach that can be taken, the full range of those tools we requested in the president's legislation he submitted last June to follow through with that. It is recruitment, it is retention, and it is also professional development, all the authority we need on buyouts and so forth. I concur with you. I think you have to be very targeted about how you do that and you use it under very limited circumstances, because right now, retention is a better approach.

The catch is, we are faced with an (inaudible) reality, which is, I represent the average age of the agency. I am 47. There are three times as many scientists and engineers who are over 60 than we got under 30.

So, no matter how long I try to retain folks, under any set of circumstances, it is an actual reality that is going to set in here. In some specific core competence fields, like, again, nuclear engineers, for example. We know we are going to need more of them in the time ahead. We have a current retirement rate that is on the hovering around the 50 percent range that will be eligible in the next three years.

So, now we need more folks in certain competencies, but you also need folks that are going to replace the seasoned veterans that are there before they actually depart.

So, the approach we are really looking to is heavy on the recruitment side, heavy on the professional development end for the folks that are there now, mid level entry of some of the people who have a decade of experience with an engineering firm of comparable nature to come in and be part of that pool and then some selected, targeted kind of retention efforts in order to keep that talent base around.

But again, as an actual matter, there are a lot of folks who simply aren't going to stay beyond a certain level and we're not really as anxious to look at moving people out as we bringing folks in in a timely enough manner to make that effective.

So, any combination of the president's proposal, the Voinovich bill, the Bullard (ph), whichever one you like, please vote early and often for any of those. We could use any of those tools. We are right now strapped to a position where we have what we are limited to at present.

BOND:

Thank you very much, Mr. Administrator. I have reached the end of my useful life cycle today and I am going to turn the hearing over to Senator Mikulski and then to Senator Shelby to continue as long as they wish. I look forward to reading at some later date the rest of your testimony. I thank you very much for your testimony today.

Senator Mikulski?

O'KEEFE:

Thank you very much, Mr. Chairman. I appreciate your courtesy as always.

MIKULSKI:

Mr. Administrator, my questions are going to be specific and because the time is moving along. I want to go to the Hubble and the consequences of what has happened to Columbia, to the Hubble. Columbia was supposed to service the Hubble telescope in 2004. The question is, will it be able to do that. I think the jury is out on that and therefore, what would be the consequences, first of all, would we be able accommodate Hubble servicing missions. Will we be able to extend the life of Hubble, because it needs servicing?

Can you describe to me the consequences to the Hubble because of the Columbia accident and number two, what then would be the consequences to the appropriations request?

O'KEEFE:

Thank you, Senator. The budget for fiscal year 2005 would cover the November 2004 launch of the servicing mission that was planned. And as soon as we get back to safe flight operations, we will assess that timing to determine if that date or some other, it won't just shift to the right. We will continue that servicing mission as soon as we need to in order to make sure Hubble stays viable, because you are exactly right. It is an unbelievable instrument. Here it is, 13 years later, considered to be something 13 years ago, that would be just a big pile of space junk has turned into the miracle that it is today in the astronomy community.

So, no question we want to sustain that and we will look at servicing mission as soon as we return to safe flight that is necessary. The pacing item is, there are four gyros that are aboard the Hubble right now that are all operational. We need at least three to operate in the pattern that it is in, so if we see a failure at any point in the near future, we may have to look at how fast that servicing mission has to be conducted.

The next mission in November 2004, had been planned to take six gyros up, replace them all out and so as a result, that becomes the big pacing item, in addition to a number of other things that we do on Hubble as well. But we will do that as soon as possible, independent of the international space station flight schedule.

MIKULSKI:

Well, we need to be kept posted on that.

O'KEEFE:

Yes, Senator. You bet.

MIKULSKI:

Another question is, the Hubble on terms of the information captured by Hubble to Goddard to a group called AURA, the Associated Universities' Research Associates, which is an NGO, operating on the Hopkins campus and in very modest circumstances. I understand that they had a contract to run this for about 10 years, but NASA has told them that they might want to re-compete the last two years of the contract. I am puzzled by that. I'm not against competition and so on, you know that. We've had other conversations.

But could you tell me why they would want to do that, because it places uncertainty on their ability to retain, really brilliant astrophysicists, et cetera and also even to be able to negotiate proper leases and so on.

O'KEEFE:

Absolutely. Let me look at the very specific case here as soon as I get back to the shop to figure out what the focus on this one or the AURA competition effort is all about. But as a general matter, I think exactly as you mentioned, it is very much a part of our persistent view of saying, let's always look at competitive alternatives for no

other reason that to satisfy ourselves that if the way we are doing it today is a good way, then let's retain that. Let's look at competitive alternatives.

MIKULSKI:

Well, I understand that. And I know that you are also looking at an NGO for the international space station methodology. I think the genius which has kept NASA so fresh and contemporary is we've had a core group of civil servants. We've discussed that in terms of aging work force. We've turned to private contractors, again, who have delivered - they have brought freshness and best practices and what a private sector brings. Then our work with universities - but also these groups.

Now, AURA is not part of Hopkins. It is on the campus, but again, you've got the retention of 300 people at stake. You don't pick them up. They are cosmologists, astrophysics, separate fields of physics that I couldn't even describe.

And at the same time, they maintain a very robust education program, because Hubble, other than our human (inaudible) is the attraction to young people in space. So, what they do in education with what the genius club finds is stunning.

So, therefore, if you are going to, you know, and again, you can tell me why competition, there might be things I don't know, but you could bust that wide open. We could lose 300 people, core competency in both what to do with Hubble information and also what to do about education, the magnet that we want it to be and then how they could also get best value in terms of what they need to procure, whether it is leasing space or so on.

So, could you get back to me on that and again, I don't want to take a position because I don't know the facts and I want to do that, too. But I do think we ought to look at it, because we don't want to create

uncertainty just for saying we want to compete. There is importance to competition. We'll discuss that further.

O'KEEFE:

Very good. Let me take a look at it. I appreciate your time, Senator, thank you.

SHELBY:

I'll try to be brief. I've got a couple more questions. We appreciate your patience.

Could you describe the state of the microgravity research program within NASA, in particular, how would you describe the state of the materials in biotech program?

O'KEEFE:

Yes, sir. The human research initiative that is part of our budget request is an effort to, again, aggressively look at what consequences microgravity really poses in terms of physiological, as well as physical sciences, kind of applications.

And the two areas that are really pretty staggering - I am not a scientist, so I am easily staggered on these kind of things. Maybe I am easily surprised is you see both an acceleration as well as dramatic deceleration or degradation of physiological conditions. You can grow certain cells (AUDIO GAP) and five would cover the November 2004 launch of the servicing mission that was planned.

And as soon as we get back to safe flight operations, we will assess that timing to determine if that date or some other won't just shift to the right based on it. We will continue that servicing mission as soon as we need to in order to make sure Hubble stays viable because you're exactly right -- it's an unbelievable instrument.

O'KEEFE:

Here it is 13 years later -- considered to be something 13 years ago that would be just a big pile of space junk has turned into the miracle that it is today in the astronomy community. So no question we want to sustain that. And we will look at servicing mission as soon as we return to safe flights that's necessary.

The pacing item is there are four gyros that are aboard the Hubble right now. They are all operational. We need at least three to operate in the -- in the pattern that's it's in. So if we see a failure at any point in the near future, we may have to look at how fast that servicing mission has to be conducted.

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UNKNOWN:

So we can -- OK.

UNKNOWN:

Just put that in there.

MIKULSKI:

Well, we need to be kept posted on that.

O'KEEFE:

Yes, Senator -- you bet.

MIKULSKI:

Another question is -- the Hubble, in terms of the information captured by Hubble to Goddard to a group called AURA -- the Associated University's Research Associates -- which is an NGO operating on the Hopkins campus -- and I might add in very modest circumstances.

I understand that they had a contract to run this work about 10 years, but NASA has told them that they might want to re-compete the last two years of the contract. I am puzzled by that. I'm not against competition and so on. You know that -- we've had other conversations. But could you tell me why they would want to do that? Because it places uncertainty on their ability to retain really brilliant astrophysicists, et cetera, and also even to negotiate proper leases and so on.

O'KEEFE:

Yes.

MIKULSKI:

So...

O'KEEFE:

Absolutely. Let me look at the very specific case here, as soon as I get back to the shop, to figure out what the focus on this one or the AURA competition effort's all about. But as a general matter, I think, you know, exactly as you mentioned, it is very much a part of our persistent view of saying, "Let's always look at competitive alternatives, just -- if for no other reason, to satisfy ourselves. And if the way we're doing it today is a good way of doing it, let's retain that. But let's look at competitive alternatives to..."

MIKULSKI:

Sure -- no, and I understand that.

O'KEEFE:

"... look at those options."

MIKULSKI:

And I know that you're also looking at an NGO for the international space station...

O'KEEFE:

Yes, ma'am.

MIKULSKI:

... methodology. I think the genius of what's kept NASA so fresh and contemporary is we have had a core group of civil servants. We have discussed that in terms of aging work force. We've turned to private contractors, again, who have delivered -- they've brought freshness and best practices and what a private sector brings -- then our work with universities, but also these groups.

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and then how they can also get best value in terms of what they need to procure, whether it's leasing space or so on.

So could you get back to me on that?

O'KEEFE:

Yes, ma'am.

MIKULSKI:

And again, I don't...

O'KEEFE:

Absolutely.

MIKULSKI:

... -- I don't want to take a position because I don't know the facts -- the facts and I want to do that, too. But I do think we ought to look at it because we don't want to create uncertainty just for a (inaudible). We want to -- we want to compete.

O'KEEFE:

I'll get back to you.

MIKULSKI:

There's importance to competition, you know, well you can -- we'll discuss that further.

O'KEEFE:

Very good -- let me take a look at it. Appreciate your time, Senator. Thank you.

BOND:

Thank you.

I'll try to brief. I've got a couple of more questions. We appreciate your patience.

O'KEEFE:

Well, thank you, Chairman.

CHAIRMAN:

Could you describe the state of the micro-gravity research program within NASA? In particular, how would you describe the state of the materials in the biotech program?

O'KEEFE:

Yes, sir. The human research initiative that is part of our budget request is an effort to, again, aggressively look at what consequences micro-gravity really poses in terms of physiological, as well as physical sciences kind of applications. And the two areas that are really pretty staggering that -- and I'm not a scientist, so I'm easily staggered, I guess...

(LAUGHTER)

... on these kind of things -- maybe I'm easily surprised -- is you see both an acceleration, as well as dramatic deceleration or degradation of physiological condition. You can grow certain cells in micro-gravity condition faster. And yet at the same time, it degrades other aspects of physiological condition. We don't understand that. We can't -- I haven't found a scientist yet who really can say, "Gee, we can't find -- we can tell you exactly why this phenomenon occurs in both directions -- some acceleration in one area and degradation in others."

CHAIRMAN:

It's got great potential in one area and negative aspects in others.

O'KEEFE:

Big time.

CHAIRMAN:

Is that what you're saying?

O'KEEFE:

Big time.

CHAIRMAN:

So -- but there's got to be an answer to it.

O'KEEFE:

Exactly. And so trying to crack that code is a big piece of what, you know, again, very -- as a plebeian in this one by comparison, understanding exactly that is a long pole in a tent for any human space flight objectives. We've got to understand what it takes in order to endure and persist in those kind of conditions.

On the physical sciences side, we have made some remarkable efforts, even to include on STS107 on the Columbia flight...

CHAIRMAN:

Yes.

O'KEEFE:

... on physical sciences and exactly how materials research can be conducted better in micro-gravity condition.

The focus, as previously alluded -- I think Senator Craig mentioned -  
- is on international space station -- more dominantly on the  
biological and physical physiology side of the -- of the equation. But  
there is an awful lot of physical materials research efforts that we  
are now looking to enhance, once we can get back to completing  
that laboratory condition, that is really quite illuminating. It opens a  
whole range of doors and we can figure out, just alone, what those -  
- what that phenomenon is of both degradation as well as  
acceleration of cell growth. That would open up a lot of things that  
would have tremendous application here on Earth.

CHAIRMAN:

Micro-gravity research -- overall looking at it -- has great promise  
and some unanswered questions too...

O'KEEFE:

Yes, sir...

CHAIRMAN:

... is what you're saying.

O'KEEFE:

... indeed.

CHAIRMAN:

Is that correct?

O'KEEFE:

Indeed. And the other side of it, too, that I think is really critical to  
understand is micro-gravity research conducted in an Earth-bound  
laboratory -- the best we have been able to do is sustain a micro-  
gravity condition that even vaguely assimilates to what we see on

orbit for about a month and that's it. Can't sustain it any for longer than that, whereas, of course, the permanent condition on international space station, as well as on shuttle.

So it has a phenomenon and a physiological consequence that is very different than any laboratory simulation we could create with a bioreactor or something else.

CHAIRMAN:

Unique.

O'KEEFE:

Very much so.

CHAIRMAN:

Recent language that was included in the '03 Omnibus Appropriations Bill directed NASA -- we know this is just a few months ago -- to reexamine the space station research priorities on a regular basis instead of using the remount recommendations as a one-time fix. Do you agree with the committee's direction there? Or do you have any -- have you -- have you had time to evaluate that?

O'KEEFE:

Yes, sir. No, we concur and agree entirely. There is no question. That's a -- the efforts last summer is just a start. And it's the first time, I am very pleased to say, that we got all the scientists from all these different communities to sit down and agree to a priority. Until they met, everything was number one. Everything was a top priority.

CHAIRMAN:

Yes.

O'KEEFE:

And so, as a consequence, nothing was a priority.

CHAIRMAN:

That's right.

O'KEEFE:

And we now have at least a baseline from which to make that determination. And that means there are some elements of the scientific community that aren't as happy with their placement in that priority rank as others. But at least it's a beginning. And so it needs to be reassessed. And we fully, wholeheartedly agree on the committee's recommendations and instruction on a regular effort to constantly update that and make it contemporary for what we see as the continuing development of international space station.

CHAIRMAN:

But you've got flexibility that way?

O'KEEFE:

Yes, sir, indeed.

CHAIRMAN:

You've talked about it a minute ago -- and that's the read -- regarding the development of nuclear-powered propulsion capabilities...

O'KEEFE:

Yes, sir.

CHAIRMAN:

... which is something I believe you have to go to. I understand that the jet propulsion lab of the Glenn Research Center and the Marshall Space Flight Center will play key roles in this program.

O'KEEFE:

Indeed.

CHAIRMAN:

Would you -- could you explain each -- how each of the field centers will contribute to the overall program?

O'KEEFE:

Yes, sir. The start-off focus here is the jet propulsion lab -- JPL -- will primarily be a design house because of the nature of -- they have handled all of the -- essentially the batteries that are nuclear powered RTGs that we have used with the Department of Energy over the last 20-odd years. So they have -- they have done a lot of design work on that side of it.

The Glenn Research Center will look at a lot of power generation capacities that we'll need in order to harness that ability that nuclear reactors can produce to then generate power for the science and research activities.

And Marshall is going to have a very strong lead in looking at a lot of the propulsion systems kind of activities, as will Glenn. So the combination of both of them on the power generation and propulsion capabilities will be very closely interrelated so that you've got something that generates power and uses it...

CHAIRMAN:

Sure.

O'KEEFE:

... for propulsion purposes.

So the prowess of both of those centers is going to be essential in understanding cooperation effort between the two in order to assure that we have a power generation and a propulsion capability that's going to be at least a factor of three better than what it is today.

CHAIRMAN:

Mr. Administrator, I think they've all abandoned us now.

(LAUGHTER)

So I'm through with my questions. There might be some questions for the record by other members.

We appreciate your appearance today. We appreciate your candor. And we apologize for the interruptions. But you know about the interruptions -- you worked here.

O'KEEFE:

Yes, sir. Thank you, Senator. Good to see you.

CHAIRMAN:

The committee is adjourned.

CQ Transcriptions, May 1, 2003

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WITNESS:

SEAN O'KEEFE, DIRECTOR, NASA

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