

Remarks by NASA Deputy Administrator

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Good morning everyone. Thank you to Jim Kirkpatrick and the American Astronautical Society for arranging this symposium. I have attended this conference many times before, but never as the keynote (I do recognize I wouldn't be doing it if Charlie were not at Heads of Agency in Japan)... after I speak, you will hear from each mission directorate about the exciting work it is doing and what we plan to do with the President's budget should it be approved by Congress. You will hear the ways that NASA can contribute to this nation, and how we hope to transform ourselves from an agency that often has done missions somewhat in isolation of what is going on in the Nation to an agency that is focusing our activities on bettering the future for our country and for the world.

The President's budget, should it be approved by Congress, will enable NASA to align with the priorities of the Nation and to more optimally contribute to our Nation's future.

These key national priorities that I am referring to are:

- Economic development (poverty, hunger, jobs)
- International leadership/geo-politics (world peace)
- Education (societal advancement)
- Environment (future of planet and humanity)

This budget gives NASA an increase of \$6 billion dollars for NASA over 5 years at a time of great financial austerity in federal discretionary spending. You have heard me say this before, but I need to emphasize it again. I need to reinforce how much we need to value and treasure this increase, because the President sees the great value in NASA and in the way NASA can better contribute to society. However, this budget is only sustainable in future years if we truly do as the President asks and change the way we operate as an agency to focus on our Nation's priorities.

So how do we do that? We will do so in each of our mission directorates and through our Chief Technologist Office. We will do this through new ways of operating, with new partnerships with the private sector, both industry and entrepreneurial, with the international community, and with academic expertise therefore creating new jobs and seeding innovation, as well as creating opportunities for students all of which are the main drivers of our Nation's future economy.

Space exploration is a highlight of the President's new transformative plan for NASA. The new program proposed by the President changes the philosophy and the approach for deep space exploration. The new approach allows us to pursue the goal of humans exploring the frontiers of space for the benefit of all. As we transition away from the Constellation Program, we plan to enable new ways of doing business, and focusing on inventing and demonstrating new space exploration technologies and capabilities. We will seek new ideas from more sources, seed innovation across the country, and create a space exploration program for the 21st century.

ESMD will be leading the charge to create the knowledge and capabilities we need to explore space broadly, sustainably and economically. They will develop must-have technologies such as advanced engines for launch and in-space travel, super light-weight space materials, new types of space habitats (including inflatables), new entry systems, space resource processing, and radiation protection for people and space systems. And more importantly, they will *demonstrate* these capabilities in space, so that we will easily be able to incorporate them into our next generation rockets and space ships – the vehicles that will carry humans to the Moon, Mars and asteroids.

As we develop key capabilities, we will also seek critical knowledge of our destinations. Where exactly are those resources on the Moon, and what does it take to extract them for our use? How will we best operate with humans at an asteroid and which ones make the best targets? Is the dust on Mars toxic to our explorers or our flight systems? And how will we live on Mars for extended periods? These and other key questions will drive our Exploration Robotic Precursor missions as we make key discoveries about our future human spaceflight destinations.

And as we invest in the most innovative research and technology, we will also work to cultivate an expanded space exploration industry through a commercial crew program that seeks to spur competition and innovation in American industry, ultimately resulting in commercial human spaceflight services. Once established, these services will not only allow astronauts to travel to the International Space Station, they will ultimately open space travel to many more people across the globe.

To accomplish these great goals in space exploration, we need to bring our nation's space craft and launch vehicle processing and launch capabilities into the 21st Century. Today's space launch and launch site operations employ outdated technology and equipment that is expensive and time-consuming to maintain and operate. An estimated 45% to 60% of the total life cycle costs of a space transportation system are attributed to ground and launch operations. Current technologies and approaches isolate launch sites from one another forcing duplication of functions and preventing potentially global synergies that could dramatically boost overall flight safety while reducing costs. NASA and the aerospace industry have off and on been tackling the challenge of achieving low-cost, routine, safe access to space, but with little success. Two primary factors present obstacles to achieving these goals:

First, access to space has at times not been viewed as a business proposition. NASA and the Air Force traditionally have been primarily focused on mission effectiveness and

secondly on cost effectiveness or efficiency from a business perspective. Both have historically responded to political mandates or national security threats and have not been driven by market requirements.

Second, approaches have been vehicle-centric and not space transportation centric. Space programs have historically focused on the design of the vehicle instead of the payload it carries to space or its interoperability on the ground. When focusing only on the vehicle itself, cost effectiveness and efficiency to the payload customer and ground operators become secondary considerations.

In our industry, investments have historically been applied to the launch vehicle element technologies (propulsion, structures, and thermal protection) and payload, mission, and flight control elements, while spaceport and range element technologies have been extensively ignored. What little has been applied to spaceport and range technologies have been limited to unique or individual launch vehicle architectures and have not benefited the whole.

The advent of the 21st Century Space Launch Complex program provides a unique opportunity to obtain a better understanding of the market needs and develop capabilities to meet those needs. The goal is to make vehicle/payload preparation and launch operations cost effective and efficient, not just for NASA and the Air Force, but for a broader commercial space industry.

A vital part of our space exploration efforts is the International Space Station. The President's budget gives new life to the International Space Station so that we can use the Station as originally intended with a robust research and technology demonstration program. After 25 years of planning, design, and breath-taking on orbit assembly operations, the ISS is completed. All of the mission performance specifications that were set 15 years ago at Critical Design Review have been achieved. The ISS will be in "mission-ready" mode by the end of this year after we provision it with enough spares and supplies to carry us forward into the next generation of commercial transportation services.

The President increases funding for ISS utilization by \$2 billion over 5 years. We're now completing our final plans for re-positioning the ISS to operate productively over the next decade. The R&D program will include a diverse portfolio of peer-reviewed, basic scientific research and market-driven applications development. We have partnerships in place with the US government agencies that lead our national research efforts -- NIH for human health, USDA for plant & animal biology, NSF for basic sciences, DOE for particle physics (AMS), and DOD agencies like DARPA and NRL for defense sciences.

We have private partners already engaged in market-driven applications research for areas as diverse as:

- 1) vaccines & therapeutics to battle salmonella and staph pathogens;
- 2) unique new plant cultivars for biofuels; and,
- 3) novel new electric propulsion systems of the future (VASIMR- variable specific impulse magnetoplasma rocket).

Research conducted aboard the station and Shuttle has already improved the methods of delivery of cancer drugs and other applicable studies of cardiovascular disease. Our understanding of how the microgravity of space changes the human body can be applied to improve treatment of disease here on Earth. By extending the station's life and providing resources for the station's national laboratory status, the typical astronaut, explorer and Earth-bound patient will benefit.

The International Space Station also provides many opportunities for applications on Earth that would benefit society and support NASA Applied Sciences projects such as SERVIR. Many of you have heard me talk about SERVIR before, but what I recently learned was that the ISS has great potential for wonderful projects like SERVIR which have incredible benefits for all of us here on Earth.

SERVIR is a joint NASA and USAID project that uses satellite Earth observations to address many problems in the developing world including environmental degradation, disasters, humanitarian crises, and adaptation to climate change. For example, SERVIR products were used after the recent Haiti earthquake as well as to address environmental crises such as harmful algal blooms and human-set fires in tropical forests. Currently, SERVIR operates in Central America and the Caribbean and also East Africa, with plans to expand to other regions around the world.

Because ISS has a relatively low altitude and passes over 95% of the populated places on the planet, automated high resolution sensors could be installed to support applications needs and disaster response. Moreover, because ISS is an existing asset, it provides a "fast track" and reduced cost approach for access to low Earth orbit for Earth applications. In fact, NASA is currently soliciting its centers for different technology demonstrations focused on utilization of ISS that can provide a real benefit here on Earth.

This use of the ISS for projects like SERVIR fits in completely with the recommendations of the Earth Science Decadal Survey, which states,

"The United States government, working in concert with the private sector, academia, the public, and our international partners, should renew its investment in Earth observing systems and restore its leadership in Earth science and applications."

So, with that segue, let me now focus on science in the President's budget. With this budget, we will fly new missions throughout the planetary systems of our solar system and fly unprecedented missions to the sun that will teach us more about our celestial neighbors.

Our Earth and climate science budget will be increased \$382 million over FY2010 as enacted, and \$1.8 billion over the four years. The budget recognizes the need to better monitor and understand Earth's evolving climate by accelerating the design and development of new satellite systems that will enhance global observations. It will expand and accelerate the development of new, Venture-class, competitive P.I.-led missions. It provides expanded climate change modeling capabilities, so NASA can

develop more accurate forecasts of regional and other weather and atmospheric changes.

The President's budget also allows us to strengthen partnerships that get little attention but are vitally important. One such partnership is between NASA and NOAA to provide 24/7 space weather forecasts that are vital to the ISS and Shuttle but also to weather, communication, and other Earth resource satellites. I recently visited the NOAA Space Weather Center in Boulder and I was amazed by the vast use of NASA heliophysics data for this purpose.

Many vital industries might be impacted by space weather. A geomagnetic storm, for instance, could result in a huge electric power outage, and could result in a direct loss to US Gross Domestic Product of \$3 - \$6 billion. It has been estimated that the use of good forecasts by the power industry could save the US at least \$365M per year. GPS also greatly depends on space weather forecasts. And it is NASA that provides this vital data to NOAA for space weather prediction and yet we do not publicize this nearly enough.

In aviation and aeronautics, President's budget strongly endorses and supports NASA's efforts to bring technological solutions to current and future aviation challenges. The commercial aviation enterprise is vital to the nation's economic well-being. In the U.S. more than 60 certified domestic carriers operate more than 28,000 flights daily, moving nearly a million travelers each day. We expect these flights to be safe, affordable, and convenient. The continued health of the aviation enterprise is dependent upon the ability to increase system capacity while reducing environmental impact.

In this fiscal year, we started a new \$62M Integrated Systems Research Program to demonstrate at a systems level the most promising "environmentally friendly" engine and airframe concepts emerging from our foundational research programs. In FY11, we are augmenting this effort with an additional \$20M targeted to identifying and maturing early-stage innovative concepts for reducing aviation environmental impact.

Another game-changer for aviation is the emergence of unmanned aircraft systems, which offer the potential for major advances in earth observation, weather forecasting, national security, and commercial applications. These systems cannot currently be used in the National Airspace System without special FAA waivers. With the FY11 President's Budget, we will initiate a \$30M targeted effort to address operational and safety issues related to the integration of UAS into the National Airspace System.

Finally, we are committed to supporting the development of the Next Generation Air Transportation System (NextGen). The Joint Planning and Development Office has identified Verification and Validation (V&V) of aviation flight-critical hardware and software systems as one of the major capability gaps in the development of NextGen because prohibitive development and certification costs of new systems are impeding innovations. In FY11, we are therefore augmenting our current aviation safety research activities with a new \$20 million effort on V&V of aviation flight-critical systems to insure that they will perform reliably, securely, and safely as intended.

So this is what we mean in the new budget- better aligning NASA with our Nation's priorities. It will bring us greater environmental quality. It will drive our economy through greater emphasis on technology and innovation. It will contribute to our country's international relations through increased opportunities for international collaboration in many NASA programs, through benefits to people around the world, and through the extended use of the Space Station. It will inspire young people to go into science, technology, and math because there are so many more hands-on opportunities to work on NASA-related projects that truly contribute to society. And from a purely NASA-centric standpoint, NASA had to change in order to be relevant and sustainable in the future and to position ourselves for a bright future. Thank you and I am happy to take questions.