SENATE COMMITTEE ON COMMERCE, SCIENCE, AND TRANSPORTATION: QUESTIONS FOR THE RECORD

HEARING ON
NASA AT A CROSSROADS: REASSERTING AMERICAN LEADERSHIP IN SPACE EXPLORATION
Wednesday, July 13, 2016

Questions for Dr. Mary Lynne Dittmar, Executive Director, Coalition for Deep Space Exploration

From Senator Rubio

Question 1. Kennedy Space Center and the state of Florida is the world's space capital with the largest concentration of aerospace launch providers and suppliers. We've already seen Apollo, Shuttle, and ISS cargo launches from there and soon both Commercial Crew and SLS/Orion will be launching. Could you discuss what this means for the future of Florida's Space Coast, and what you foresee happening in the State in the next few years?

Kennedy Space Center (KSC) and Florida are indeed critical to U.S. development and use of launch capabilities, and competitiveness vis-à-vis launch markets across the world. The entrance of new players into launch markets has had disruptive effects in both the positive and negative sense. On the positive side, innovation appears to be driving down cost, which will in turn make U.S. markets more competitive, assuming that performance follows. On the negative side, uncertainty regarding outcomes poses challenges for the government, industry, customers, and investors who have been and may continue seek entrée to what they see as a growing space sector. It is imperative that we leverage new opportunities to the benefit of U.S. taxpayers and the economy without compromising core capabilities and missions that are essential to national security and civil missions, including NASA's exploration program.

Assuming that current trends continue in a positive direction, KSC's work – including spacecraft prep and payload integration, development of ground systems, and the actual launch operations themselves – are an integral part of both government and non-government (private) programs. As the nation's most active spaceport, KSC (and Cape Canaveral Air Force Station/CCAFS) are crucial enablers of the economic development of low-Earth orbit, and for launching the new generation of exploration-class super-heavy launch vehicle – the Space Launch System – carrying the Orion crew vehicle farther into space than ever before. The state of Florida should continue to benefit as it recovers from earlier reductions in force at the Space Coast following the end of the shuttle program and will attract more aerospace workers who are contributors to the local economy. Thus KSC is a 'launch pad' in more than one way, returning benefits locally and regionally as well as supporting U.S. leadership in the peaceful exploration of deep space.

Question 2. During the birth of the Apollo program, the United States, under the leadership from President John F. Kennedy, was determined to beat the Soviets to the moon. Is the United States still in a position to remain competitive and challenge the likes of other global powers?

The United States is still in a position to remain competitive. However, our ability to maintain our global leadership is dependent upon political will and sufficient funding for what are long-lead-time programs, with horizons that stretch across multiple Congresses and Administrations. It is said that Rome wasn't built in a day -- indeed it wasn't; it was built over hundreds of years. The same goes for the pyramids of Egypt. Those governments operated on a very different set of values and principles from those of the U.S. in the 21st century. However, successive leaders in those days were able to grasp the vision and importance for their nations (or nation-states) to build such monuments, establishing them as centers of their regions and – in the case of Rome, for a time – the world. Surely we are capable of the same vision, and understand the value of global leadership. The architecture we are building – in low Earth orbit, and in deep space – these are *our* pyramids.

History teaches us that great nations explore, and that those that turn away from exploring, flounder. The case of China burning its massive exploration fleet and falling back, away from the burgeoning global trade routes and eventually turning inward into feudal states may be instructive. It is critical that the U.S. Administration(s) and Congress(es) work together to build upon the extraordinary achievements of NASA and her industry partners over the past 50 years. Together we have taken men to the Moon, furthered détente and the peaceful use of outer space with Apollo-Soyuz, built and flown the space shuttle – establishing knowledge and experience that continues to inform innovators struggling to address reusability today – assembled and operated the International Space Station that has now involved over 90 countries in the peaceful pursuit of knowledge and the establishment of nascent economic development in low Earth orbit.

We are now at the cusp of a new era of exploration, one that will take humans farther, faster than ever before, and will open the door to new scientific missions using the Space Launch System and the Orion crew vehicle – leveraging the expertise and leadership that only the American space program can provide the world. These systems are pushing the limits of technology, employing new manufacturing methods to extraordinary tolerances, inventing solutions to the challenges of deep space. Just as Apollo did 50 years ago, the knowledge gained by NASA's "pushing the envelope" will be returned to all American citizens, eventually spurring even more innovation and advancing U.S. competitiveness. It is imperative that the U.S not turn back. We must look ahead and beckon the future with the type of vision and commitment we as a nation have demonstrated so many times before. Our international partners will follow us, and support our exploration goals, if we continue to demonstrate continuity of purpose and opportunity for them to join America on its journey in space.

Question 3. As the Senate looks to reauthorize NASA in the coming year, what reforms do you suggest?

The 2010 NASA Authorization Act (PL 111-267) defines the primary goal of NASA's human space exploration program as "to expand permanent human presence beyond low earth orbit and to do so, where practical, in a manner involving international partners."

To this I would add "….in a manner involving international and industry partners." (To be clear, all industry partners are "commercial" by their very nature, returning profit to shareholders or investors.) The key thought here is that this vision – wherein the United States leads humanity into the solar system on a permanent basis – will require collaboration, technology, innovation, industry, other nations, new technology development, and the ability to manage technology acquisition and programs with a degree of complexity the agency has never before attempted (although the International Space Station program is an excellent precursor and teacher). A new Authorization Act should reaffirm this as a goal, and state explicitly that continuing to expand our scientific technical, human exploration and habitation, and economic spheres beyond low Earth orbit is imperative if the U.S. wishes to control its own destiny. Human space exploration has for 50 years been an indicator of global leadership; we dare not cede that leadership and our ability to guide the rules of engagement in space. Particularly at transitions in Administration – such as the one upcoming – Congress should reaffirm these goals and our national commitment to them.

In addition, I would offer the following recommendations:

1. Continuity of purpose for NASA's strategic direction, and its core exploration programs, including the Space Launch System, Orion and Exploration Ground Systems, to restore our ability to send humans to deep space in 2021, following an un-crewed "shakedown cruise" in 2018.
2. Support the development of key exploration capabilities, such as deep space habitats and in-space propulsion, to enable robust Exploration Missions on SLS and Orion during the 2020's.
3. Reaffirmation of the current path for human space exploration, with the horizon destination of Mars as the eventual goal, but with emphasis upon a "learn as you go", discovery-based approach that emplaces the next capability (for example, a deep space habitat), and then the next, as we learn to operate, explore, and conduct science capitalizing on the unique capabilities of human beings. A "race to Mars" that may ensue should the focus shift solely to boots on that surface is not consistent with the goal to "expand human presence" on a permanent basis. Rather than a race – which we had with Apollo, and for good reason – we are embarked upon an American epoch in deep space, more akin to the opening of the West in our nation's history. This approach should be to emphasize meaningful progress with milestones that are demonstrable to Congress, the Administration, and in particular the American people.
4. Focused investment in key technologies that will be necessary to undertake opening a new epoch. These have been identified in many studies; most recently in the National Research Council's Pathways to Exploration report (2014) and include (a) radiation mitigation, (b) advanced in-space propulsion, and (c) the capabilities an technologies

required for entry, descent, landing, and ascent through the Martian atmosphere of hundreds of tons of equipment, consumables, and habitats enabling human presence.

5. Sufficient resources and direction to share the journey with the American people to the fullest extent possible – through video, documentaries, digital publishing, social media, remote viewing and virtual reality participation in missions, real-time mission information and updates, opportunities to capitalize on the increasing availability of technology and decreasing transaction costs for such interaction and participation. NASA leads all other agencies in its use of social media, but if this is our "pioneering" into space, as many of our citizens who can participate, should participate. As a side benefit, this approach will create missions that are more interactive and open up opportunities for science, education, and inspiration of the next generation of explorers.
6. Create an organization with a free hand to further develop and hone NASA's capabilities in technology scanning, selection, harvesting, acquisition, development, and rapid fail approaches. The world has changed, and is continually changing. NASA does not and cannot lead the world in the development of all technologies beneficial to and needed by science, aeronautics, and exploration; instead it must develop methods to identify and select technologies with clear potential to advance its missions, and to rapidly partner to bring these in house or establish reciprocal relationship with the owner or developer of that technology. This is all much easier said than done as it requires changes to procurement, contracting, technology requirements assessment, technology identification, and (probably) further evolution and refinement of the NASA "Technology Readiness Level" (TRL) successful pioneered by the agency many years ago and widely adopted since.
7. Authorize funding for NASA's exploration programs at the level required to avoid drawing out development beyond the point where costs necessarily rise as a result. In addition, authorize full funding for continued development and operation of the International Space Station, including acquisition of new equipment and capabilities as may be useful to private interests intent upon developing successful space-based businesses in low-Earth orbit. Similarly, continue full funding for NASA's "Commercial Crew" and "Commercial Resupply Services" that enable provisioning of the ISS and that will return American astronauts to flight to low-Earth orbit even as the Space Launch System will return American astronauts to deep space.
8. Fully fund and streamline the accounts associated with the Exploration Systems portfolio. Multiple accounts associated with Orion, SLS and Ground Systems reduce the flexibility of program managers to allocate funding as needed to buy down risk or, alternately, to speed development of elements or sub-elements in order to maintain an integrated program schedule, cost, and risk management approach. In addition, multiple accounts encourages additional overhead both within the agency and within extra-agency overseers, inevitably resulting in increased costs.
9. Reduce the number of duplicative studies demanded of NASA each year to the minimum required to provide sufficient oversight of NASA activities and expenditures.

Question 4. What programs within the agency pull its focus away from its intended main goal of placing humans on the surface of Mars?

With respect, this question is driven not by content of NASA's portfolio, but by competition within the portfolio engendered by NASA's funding profile, which numerous reviews, studies, assessments, reports, and evaluations have determined to be insufficient relative to its mission(s). In a budget-and-budget-process-constrained environment, it is difficult to argue for additional funding for the agency, yet additional funding is precisely what is needed. On the whole NASA manages its broad portfolio of science, human exploration, aeronautics and technology development/management well, arguably achieving more "bang for the buck" than any other agency.

The National Research Council's Pathways report recommended an increase of double the rate of inflation + another small percentage increase in NASA's exploration budget in order to achieve the goal of reaching Mars by the 2030's. This recommendation should be extended to the agency as a whole. At minimum NASA's funding should track inflation. NASA's funding is now less than ½ of 1% of GDP, yet NASA is the only agency in the government that is tasked specifically to create and bring about the vision of an optimistic future. As a nation we rely on all of NASA's portfolio to advance scientific knowledge, streamline and advance mass transportation technology, teach us about our own planet, find and fund promising technology, and push human presence into the solar system.

At the same time, NASA can and should continue to look for duplication, obsolescence, and for opportunities to streamline bureaucracy and acquisition approaches, as recommended by the "Pathways to Exploration" report.