Testimony
of
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General Issues on NASA and Its FY2010 Budget Request
before the
Subcommittee on Space and Aeronautics
of the House Committee on Science and Technology

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Madame Chairwoman and members of the Subcommittee, I appreciate the opportunity to appear before you today. My name is Ray Colladay and the personal views I express are shaped by my 40 years of experience in aerospace, through positions I have held in government, industry, and academia. I chair the Aeronautics and Space Engineering Board (ASEB) of the National Research Council (NRC) and although I have insights into NASA acquired through that position, my views are my own and do not represent an official position of the NRC.

With your permission, I would like to submit my prepared testimony for the record and summarize my views for you here this morning, leaving sufficient time to answer any questions you may have.

Civil, commercial, and national security space and aviation affects every part of our lives. It inspires, it facilitates a one-world community, it encourages training and education in science and engineering, it protects our future, and addresses the profound questions of our place in the universe—how did we get here and are we alone? NASA has demonstrated its ability to accomplish great things. It has a vision for the future for which there is general consensus in broad terms even as the finer details are debated. There are two fundamental questions that are pertinent to the subject of this hearing in dealing with NASA and its primary role of providing U.S. leadership in space and aeronautics: are the programs and the goals of the agency the right ones for the nation to be pursuing?—which is to say is the path and the destination right? And are there sufficient resources to effectively implement the program and the vision being pursued? I would like to address both of these questions in my remarks this morning.

There are a number of issues in the human space flight program that need to be untangled like what to do with the ISS beyond 2016; is the Constellation program headed in the right direction and does it have the commitment and support of this administration; is the timing for Shuttle retirement right; and are the replacement vehicles—Ares and Orion—the best approach to move beyond low-Earth orbit? The recently appointed Augustine Human Space Flight Review Committee will address these issues and present options charting a clear way forward.

Until the disposition of the ISS is decided, there is a big hole in mission planning with uncertain out-year budget implications. The issue is not just are we going to keep the station beyond 2016, which seems likely given how much we have spent finally getting it assembled and ready for full occupancy, but more importantly, what are we going to use it for? This is a remarkable facility and a significant accomplishment in engineering design and on-orbit assembly. It is a modern-day example of cooperative program management on an international scale; not a simple feat. As we transition from the assembly phase to untilization, we should take full advantage of its utility for research to expand our knowledge of how to live and work in space. Having said that, however, the vision and destination for human space flight should be outward, beyond low Earth orbit. The ISS is a way-point in that journey outward and I believe it will prove to be indispensable in learning to take the next steps.

The NASA science program continues to amaze the world with its spectacular achievements. The science community has led the way in providing consensus views on planning and roadmaps for the future through its Decadal Surveys. We borrowed the technique on the Aeronautics and Space Engineering Board for the Decadal Survey of Civil Aeronautics in 2006. Others will address the state of space science and I will limit my remarks to a shared concern about cost growth in ongoing programs and projects that put other projects at risk and crowd out new-start opportunities.

There are a number of reasons for cost growth on projects—from poor initial cost estimates to over-confidence in what can be done with constrained budgets to years of inadequate attention paid to advance space technology development. I would like to specifically address the last point. Because of budget pressures, NASA has turned away from putting a priority on advanced technology development, even though the Space Act of 1958 and every subsequent amendment calls for NASA to be a leader in R&D. Today the advanced technology base is so deficient it is costing us in lost opportunities to do bold things with more capable systems and is costing us valuable resources in overruns some of which could be avoided with a more robust technology base.

Aeronautics is underfunded, but a broad-based, innovative advanced space technology development program that is organizationally independent of ongoing hardware development programs is nonexistent. The downward trend started soon after aeronautics and space technology, once logically managed together, were split apart. A decision soon followed to focus technology specifically on major development program needs by moving the resources to mission areas it intended to serve. Predictably, once all technology development was placed with the major development efforts it became near-term oriented as a risk reduction effort backstopping hardware development. The Aeronautics and Space Engineering Board sponsored study on the Exploration Technology Development Program for Constellation done last year expressed concern on just that point of the need for more emphasis on longer-term research. With budget and schedule

pressures as demanding as ever, the situation has not improved. Clearly, there is a need for focused, risk-reduction technology that is defined by explicit mission requirements and funded by the mission office, but it does not fill the need for the agency on a broader level to pursue long-term technology "push" well out in front of requirements and broad in scope supporting civil (not just NASA) and commercial space. An agency that has inspired us with bold missions and spectacular accomplishments needs to be investing in technology that continually seeks to transform state-of-the-art capabilities and enable future missions that some day we may want to do, if we only knew how.

In DARPA, when I was Director, we sought to be disruptive with technology that challenges or disrupts conventional thinking and it is still doing that today. By setting up a healthy tension in an organization between technology push focused on long-term research and technology pull from programs, someone is always asking not only "what for?", but also "what if?" and "why not?" An advanced research and technology development mission of NASA would be exploring advanced launch systems in pursuit of low cost access to space; compact nuclear power systems; plasma- and other electric-propulsion concepts; energy storage technology; highly energetic propellants; affordable space-based solar power systems; multi-spectral sensors; advanced space-based communications; closed-loop life-support systems; radiation shielding concepts; highly intelligent and mobile robotics—the list could go on with a host of other areas of research not being addressed in today's constrained environment. And you will not see requirements for such systems, because we do not write a requirement for something no one knows how to do.

NASA should revitalize advanced space technology development as a priority mission area of the agency. It should engage the best science and engineering talent in the country wherever it resides in universities, industry, NASA centers or other government labs focused on world-class research and innovation and not driven by the need to maintain ten healthy centers. It should support not only future NASA missions, but other government agencies and commercial space. The "customers" for its technology products would be industry, NASA itself, other government agencies like NOAA, and military space where dual-use technology is applicable. Having this broad mandate would make it similar in the breadth of customers served to the NASA role in aeronautics with its heritage in NACA going back almost a century.

That brings me to the aeronautics program where there is good news and bad. Aviation has a major impact on U.S. economic competitiveness and our leadership position in the world. No one questions that it is vitally important particularly in the U.S. in moving people and goods throughout the country and the world. The good news regarding the NASA aeronautics program is the restructured program in fundamental research is stable and providing excellent results. I am particularly pleased with the new emphasis in systems research in this year's request. The Environmental Responsible Aviation (ERA) program

builds on the progress in the base research program and begins to address the complex system interactions accompanying the integration of technology to achieve lower fuel consumption, lower emissions, lower noise, improved safety, and greater air-traffic system capacity. These attributes, all desirable in isolation, tend to work against each other when integrated into a system. The newly formed category of Integrated Systems Research, of which the ERA program is the first in the category, enables NASA, in cooperation with industry and universities, to explore the system advances that will make aviation more energy independent and environmentally friendly. More resources in the out-years would be helpful. The Recovery Act funding that the Congress was able to add to the NASA aeronautics budget this year were very helpful in jump starting this important area of research and it is also being put to good use in facilitating the transition of NextGen focused technologies to the FAA.

This year's budget request is very encouraging and a positive step. However, NASA's investment in aeronautics is a fraction of what it was just a short time ago, and that is the bad news. Ten years ago the aeronautics budget was over 3 times what it is today in equivalent full-cost accounting terms and today's dollars. Then, it was 10 percent of the total NASA budget. The Congress has consistently recognized inadequate funding for aeronautics by augmenting past administration requests, but unless that level is reflected in the runout budget request by the administration, the research efforts at the higher level cannot be sustained, year-to-year. More resources would be helpful in areas of system-level testbeds and taking technology to higher readiness levels for the advances in the Airspace Systems and Aviation Safety programs in support of NextGen. Also, it would enable NASA to shift the balance of R&D to be a better blend of in-house and out-of-house research with universities and industry—something the NRC Decadal Survey on Civil Aeronautics also recommended.

Taking aeronautics and space technology together, an investment of at least ten percent of the total agency's budget for advanced *aerospace* technology development focused on forward-looking innovation is not unreasonable, in my view, for a government agency that has a mandate to help maintain U.S. leadership in aerospace science, engineering, research, and advanced technology development. One does not need to go too far back to a time when it exceeded that level.

Coming full circle to my opening comment about having the right program content and the right amount of resources to implement it, I have touched on where I think some of the holes are in program content and underfunded technology and of course the Augustine Committee will untangle the big issues in human space flight. I must be perfectly clear that the areas I mentioned needing more funding cannot and should not be solved by transferring money from other parts of NASA. Every time I look at the current scope of the NASA program and consider what budget level it takes to do it right, I come up with a level of around $22-23 Billion for the agency. This figure is not based on a rigorous, detailed

assessment, but a well-informed opinion. It would seem that at this level, NASA's space and aeronautics mission should compete favorably for discretionary resources against other priority national needs, particularly given how it supports many of those needs of broad national interest. Much less than that level of funding means something has to give—some combination of mission scope, program content, schedule, or institutional infrastructure. This subcommittee has taken aggressive steps in the past to recognize the need for increased funding for NASA. I hope the testimony given at this hearing is helpful in your deliberations on the FY 2010 budget.

That completes the remarks I wanted to make and I would be pleased to take questions if you have them. Thank you.