



“Human Space Exploration – It’s Worth the Risk”

Written Statement of
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Mr. Vice President, members of the National Space Council, Executive Secretary Pace, thank you for the opportunity to address you today about SPD-1 and our nation’s goal of returning to the Moon and on to Mars through commercial and international partnerships. I come before you as a former NASA program manager and as the current executive director of the world’s largest aerospace professional society, the American Institute of Aeronautics and Astronautics.

First, I would like to acknowledge and commend publicly the continued investments this administration is making in space exploration with SPD-1. This nation needs to achieve its exploration goals as quickly as possible, improve the sustainability of NASA's exploration campaign, expand the use of commercial and international partnerships, and implement efficient and effective procurement models to increase the probability of success for agency programs. Achieving these goals is crucial to building the space economy, enhance the U.S. leadership position in low Earth orbit and beyond, and, more importantly, provide opportunities for future generations of Americans and global citizens.

Recently, there have been noteworthy achievements across the space ecosystem. The InSight Mars Lander is digging into the surface of the Red Planet gathering important samples; the New Horizons spacecraft flew by Ultima Thule collecting data that may reveal new clues about the formation of the solar system; SpaceX and NASA brought us a step closer to once again launching American astronauts from American soil on American rockets with the successful Crew Demo-1 Mission; and Virgin Galactic has flown a passenger to space. There is also much to look forward to, including the launch of Boeing's CST100 Starliner Crew Capsule and SpaceX's Crew Demo-2 scheduled for later this year as well as continued Virgin Galactic flights and future Blue Origin flights. With the International Space Station's (ISS) research on in-space manufacturing, pharmaceuticals, and human health in space, the building blocks are in place for new economic and exploration opportunities that could improve life on Earth and help extend our human neighborhood to other planets.

To achieve the objectives of SPD-1, we must move deliberately and expeditiously. We must go back to the Moon. We need a lunar transportation node. We can then go to Mars—and we must do all of this in a sustainable manner, building a space economy and a future for those that follow us. These goals require complex infrastructure; human capital; an ability to take risks, address challenges, create business opportunities and plans; and adequate, long-term appropriations at the right time. This is a priority for our nation.

Space exploration is a challenge that tests the best of us in industry, academia, and government. It also facilitates a future economy—and perhaps a future home—for generations to come. It will test us (1) economically, (2) technically, (3) programmatically, (4) politically, and even (5) ethically. The United States must remain the leader and drive the evolution of the “rules of the road” as we progress further into space. Let us not forget that it was the United States that led the development of commercial and military aircraft—establishing and sustaining the aviation marketplace of today. Likewise, the Space Launch System (SLS) and Orion Crew Vehicle will be essential for long-term missions and national capabilities, providing the United States with the capability to remain the clear leader in space.

When the Space Shuttle Atlantis returned to Kennedy Space Center in July 2011, the United States was left without its own way to get humans to space and the International Space Station. It has taken us far too long to regain that preeminence in human space exploration that we held for many decades—and there is still work to do. There are the issues of funding, political will, the harsh realities of developing safe space hardware, and the manner in which programs are conducted.

Over the span of my 33-year career at NASA, I participated in several major space hardware development programs. I fully understand the opportunities and challenges presented by planning, designing, building, testing, and flying launch vehicles, particularly when human lives are at stake. The harsh realities of developing and flying space systems for humans require exacting engineering, our best talent, and persistence. We’re accelerating large systems to 17,500 miles per hour (35 times faster than we fly across the country today); protecting human life from the dangers of solar radiation, extreme temperatures, and the vacuum of space; and returning them home at re-entry temperatures approaching 5,000 degrees F. This is risky business.

Our challenge is to assess and accept the risk to accomplish our difficult goals. Largely because of the Challenger and Columbia accidents, NASA and its industry partners have become risk

averse, particularly in human space flight. It is absolutely proper that we should learn from the mistakes and failures of our past; however, we cannot allow the scar tissue to bind us up to the point of being unable to achieve progress. We know, and have demonstrated, that the benefit of exploration is worth the risk.

To achieve our space explorations goals and objectives we must meet our current challenges head-on with a renewed sense of urgency. Let me be clear on a key point: We need to design systems that are as safe as possible and use them as prudently as we can without becoming so risk averse that we sacrifice the overall mission. We must address concerns and engineer safety into the systems from the beginning, designing with this in mind. At the same time, we must accept that the act of exploration is inherently dangerous.

Based on my experience, I would like to summarize actionable and crucial suggestions:

- (1) There must be an overall strategy, driven by realistic and sustainable funding projections, to meet exploration objectives. "Design-to-cost," with funding as a true development and operations constraint or requirement, should be implemented. Program plans, milestones, schedules, and budgets must support the overall strategy. Periodic review based on funding projections and actual execution status of the supporting programs is essential.
- (2) The strategy, objectives, and necessary funding must be closely coordinated across the executive and legislative branches. Constant debate over budgets, approaches, goals, and program plans impedes progress, AND adds unnecessary risk to an already challenging effort.
- (3) NASA should allow program and project managers, with the essential input of technical and safety stakeholders, to accept more risk and make decisions quickly. The team must be allowed to assess opportunities and risks, be bold in pursuing the beneficial opportunities, and manage the risk toward achieving the program goals.
- (4) There needs to be clear accountability to the top of the agency for the development of the systems and technologies needed for NASA's important activities. This team should

be located at NASA Headquarters for direct access to agency leadership and timely access to the external stakeholders in the executive and legislative branches of our government.

(5) It is essential that the bureaucracy be held accountable to support the programs and strategy and not impede progress. The team executing the program should obviously be held accountable to achieve the plan, AND the team should be allowed to work with minimal interference.

(6) Transparency and trust are essential and must be established for the long term.

Exploration and resulting economic opportunities require all stakeholders at the table. By regularly convening stakeholders from across industry, academia, and government for frequent communication, problems can be anticipated early and potential solutions can be identified.

Humankind has long shared the goal of exploration that leads to a permanent human presence in space. We want to bring the resources of the solar system into the global economy. Development and utilization of these resources will enable humanity to continue its trajectory of ever-increasing prosperity and well-being while preserving, even enhancing, our unique home in the universe, Earth. The United States must lead. We must act quickly, decisively, and purposefully to maintain that leadership.

Again, thank you for the opportunity to address the National Space Council. I look forward to answering any questions you may have for me in this regard.