

# NASA

National Aeronautics and Space Administration

**Office of Inspector General**

**Office of Audits**

**Testimony before the Senate Subcommittee on Space,  
Science, and Competitiveness**

# EXAMINING THE FUTURE OF THE INTERNATIONAL SPACE STATION

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Chairman Cruz, Ranking Member Markey, and Members of the Subcommittee:

The Office of Inspector General (OIG) is committed to providing independent, aggressive, and objective oversight of NASA, and we welcome this opportunity to discuss the Agency's utilization of the International Space Station (ISS or Station) and the challenges and opportunities related to its post-2024 future.<sup>1</sup>

The OIG has issued 13 reports related to the ISS over the past 5 years, including reviews on NASA's efforts to maximize research, extend its operations, manage contracts with private companies to fly cargo and eventually crew to the Station, and maintain international partnerships that fund close to one-quarter of the Station's annual expenses. My testimony today is informed by these past reports, but primarily draws on findings in a forthcoming audit assessing NASA's progress in maximizing utilization of the ISS to accomplish its human exploration objectives. This report – which we plan to release publicly in the next few weeks – will also examine the options and challenges associated with the Station's eventual retirement and deorbit.

For the past 20 years, the ISS has served as a platform for humans to learn about living and working in space. NASA's original vision was that astronauts living on the Station would conduct biological and materials research, demonstrate American leadership in space, forge international cooperation, and lead efforts to commercialize low Earth orbit. To date, the Agency has accomplished many of these goals. NASA has sponsored research aboard the ISS in the areas of life and physical sciences, human health, astrophysics, Earth sciences, space science, and commercial research and development for pharmaceuticals, materials, manufacturing, and consumer products. The ISS has also been used in disaster response on Earth by providing near-real time mapping support for recovery and humanitarian aid efforts. However, all of these achievements have come at a cost of \$3 – \$4 billion annually or about half of NASA's annual human space flight budget.<sup>2</sup>

Against this backdrop, the President's fiscal year (FY) 2019 budget request proposes ending direct Federal funding of the ISS beginning in 2025, and a congressionally mandated report prepared by NASA and submitted in late March provides a high-level outline of the Agency's plan to transition the Station to commercial operation. Our forthcoming report examines this plan as well as other options the Agency may consider, including extending ISS operations beyond the current retirement date and the necessity at some future point to safely dispose of the Station through a controlled destructive re-entry into the Earth's atmosphere.

### **Transition to Private Operations**

NASA's current plan for the future of the ISS past 2024 is to transition responsibility for its operation — in whole or in part — to a commercial entity or entities. The Agency expects this approach to offset some portion of its substantial annual investment in ISS operations while providing more cost-effective operation of the Station through increased private sector investment, ultimately spurring greater commercial development of low Earth orbit. Under this

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<sup>1</sup> The ISS is currently authorized to continue operations until October 1, 2024.

<sup>2</sup> In FY 2018, the ISS budget included approximately \$1.7 billion for crew and cargo transportation, \$1 billion for systems operations and maintenance, \$267 million for research, and \$225 million for labor and travel.

plan, NASA envisions itself as only one of many customers for the ISS or other privately-owned and operated low Earth orbit platforms.

As part of this vision, the Agency is considering a range of options including transitioning operations to private industry, augmenting the Station with privately developed modules, combining portions of the current platform with a new private platform, or deploying an entirely new free-flying platform and de-orbiting the ISS. NASA is also assessing whether its long-term research requirements, while similar to those of the current ISS Program, could be met with platforms or modules that do not require a vehicle as complex and expensive as the ISS.

NASA has taken several concrete steps over the past 10 years to meet its goal of increasing commercialization of the ISS and low Earth orbit. Most prominently, NASA pays commercial partners Orbital ATK and Space Exploration Technologies Corporation (SpaceX) to deliver cargo to the ISS with a third contractor, the Sierra Nevada Corporation, scheduled to begin resupply flights in 2020.<sup>3</sup> In addition, NASA is paying The Boeing Company (Boeing) and SpaceX to transport astronauts to the ISS as early as FY 2019. These activities represent NASA's most significant investment in the commercialization of low Earth orbit, given that cargo and crew transportation account for approximately \$1.7 billion or roughly 50 percent of the Station's annual costs.

NASA is also engaging private industry directly regarding potential future commercialization of the ISS. For example, in July 2016 NASA issued a Request for Information seeking industry ideas to stimulate economic development through the use of unique ISS capabilities. Last month, NASA released a Research Announcement soliciting industry concepts, business plans, and viability studies for development of commercial platforms in low Earth orbit, as well as industry input on the role Government should play in the commercialization of low Earth orbit. NASA also plans to coordinate with the Departments of Commerce and Transportation to create a multi-agency working group to identify specific actions or legislation that would enhance development of a commercial market in low Earth orbit.

While all of these actions are positive steps, NASA's current plan to privatize the ISS remains a controversial and highly debatable proposition, particularly with regard to the feasibility of fostering increased commercial activity in low Earth orbit. Specifically, it is questionable whether a sufficient business case exists under which private companies can create a self-sustaining and profit-making business independent of significant Government funding. In particular, it is unlikely that a private entity or entities would assume the Station's annual operating costs, currently projected at \$1.2 billion in 2024. Such a business case requires robust demand for commercial market activities such as space tourism, satellite servicing, manufacturing of goods, and research and development, all of which have yet to materialize.

Candidly, the scant commercial interest shown in the Station over its nearly 20 years of operation gives us pause about the Agency's current plan. This concern is illustrated by NASA's limited success in stimulating non-NASA activity aboard the Station through the Center for the Advancement of Science in Space, Inc. (CASIS). Established in 2011 to facilitate use of the ISS by commercial companies, academia, and other Government and non-Government actors for their

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<sup>3</sup> Through its first round of Commercial Resupply Services contracts (CRS-1), NASA awarded a total of 31 cargo resupply missions to Orbital ATK and SpaceX worth \$5.9 billion, or an average cost of \$191.3 million per mission. As a follow-on to CRS-1, in 2016 NASA awarded a second round of resupply contracts known as CRS-2 to Orbital ATK, SpaceX, and the Sierra Nevada Corporation.

research or commercial purposes, CASIS's efforts have fallen short of expectations. Apart from these privatization challenges, the amount of cost savings NASA may realize through commercialization of the ISS may be less than expected given that significant expenditures – particularly in crew and cargo transportation and civil servant costs – will likely continue even if many low Earth orbit activities transition to a privatized ISS or another commercial platform.

### **Extension and Continued Operations**

An obvious alternative to privatization is to extend current ISS operations. NASA originally targeted the Station's service life to end in 2015, approximately 15 years from the time its first elements were placed into orbit. Since that time, NASA has extended the Station's operational life on two occasions: the first in 2011 when ISS construction was nearing completion (an extension through 2020) and the second in 2014 that approved continuation of ISS operations through 2024.

NASA is currently evaluating the feasibility of extending the Station's service life through at least 2028. As of June 2017, Boeing, NASA's prime ISS contractor, had certified all major U.S. structural elements to 2028 with the exception of an external stowage platform and six truss segments that it expects to certify by 2019. In addition, Boeing has assessed and cleared to 2028 critical operational capabilities such as electrical power, environmental control and life support, and thermal control.

An extension to 2028 or beyond would enable NASA to continue critical on-orbit research into human health risks and to demonstrate the technologies that will be required for future missions to the Moon or Mars. In recent audit work we determined that, as of February 2018, NASA forecast that research for at least 6 of 20 human health risks requiring the ISS for testing and 4 of 40 technology gaps will not be completed by the Station's planned retirement in September 2024. In addition, research into 2 other human health risks and 17 additional technology gaps is not scheduled to be completed until sometime in 2024, meaning that even minor schedule slippage could push completion past the Station's planned retirement date.

While NASA may be able to find alternative, ground-based testing options for certain health risks and technology demonstrations, Agency officials have stressed that research into others will continue to require the Station's unique microgravity environment. If the remaining health risks and technology demonstrations cannot be fully tested on the ISS, NASA may have to accept higher levels of risk than planned for future exploration missions.

Extending the ISS past 2024 presents NASA with multiple challenges, most pointedly its \$3 – \$4 billion annual cost. Moreover, any extension could also increase the possibility of failure in the Station's aging systems and infrastructure. Finally, continued support from NASA's international partners – who currently pick up about 23 percent of the U.S. Segment's operating costs – remains an open question beyond 2024.

### *Funding Issues*

NASA currently spends about half of its Space Operations budget in support of ISS operations and will continue to do so with any extension of the ISS's service life beyond 2024. Unless the Agency receives a substantial increase in funding or can dramatically reduce the cost of ISS operation and maintenance, NASA will be hard pressed to continue supporting ISS operations under its current model while attempting to fund its other potential space exploration initiatives

such as the Lunar Orbital Platform-Gateway, a lunar orbit/landing mission, and preparations for a crewed Mars mission.

Even if the Agency ends direct funding of the ISS in 2025 as envisioned in the President's FY 2019 budget request, it is unlikely that the bulk of the funding currently devoted to the ISS Program could be immediately diverted to these and other exploration activities. Even with termination of most Station activities, NASA expects to retain a presence in low Earth orbit and therefore would need to fund related crew and cargo transportation costs. Furthermore, significant funding would be required to maintain offices and infrastructure currently funded by the ISS Program such as the Mission Operations office, which is expected to be needed by future exploration programs.

Over the past 10 years, NASA has worked to reduce the costs of supporting the ISS, particularly crew and cargo services – the Program's most expensive element. In addition, NASA has saved more than \$172 million annually since 2007 through de-scoping, renegotiating, and combining Station-related contracts. For example, NASA renegotiated the Program's largest contract for engineering support with Boeing in 2010, reducing requirements and saving an estimated \$67 million per year. In addition, by combining its mission support, program integration, and infrastructure operations contracts, NASA estimates it has saved an average \$59 million per year since 2013. NASA also awarded a new contract in 2015 to support spaceflight operations, thereby reducing costs by an average \$46 million per year. While these are positive cost reductions, taken together they represent a small portion of the ISS Program's overall budget.

#### *Managing Risks of Hardware Failures*

By 2028, the original elements of the Station will be 30 years old and will have operated for 3 decades in a harsh microgravity environment, exposed to ionizing radiation, extreme temperature changes, and micrometeoroids and orbital debris. While many systems have been replaced or upgraded and the Agency has not identified any structural issues that would preclude an extension through 2028, risks related to hardware degradation, system failure, and technological obsolescence may increase with continued operation beyond 2024. These issues have significant implications on NASA's ability to repair or replace components because transportation of relatively large items is more difficult since retirement of the Space Shuttle, an issue NASA is taking steps to address.

According to NASA, micrometeoroids and orbital debris strikes are the primary threat to the Station's integrity because a direct strike can cause catastrophic and irreversible depressurization or other significant damage with immediate life-threatening risks to the crew. To mitigate this risk, the U.S. Government currently tracks more than 500,000 pieces of man-made, orbital debris, which consists of nonfunctional spacecraft, abandoned launch vehicle stages, and other mission-related debris.

#### *Continued Support of International Partners*

Lastly, any discussion of whether to extend ISS operations past 2024 needs to consider the level of support from NASA's current international partners – Russia, the European Space Agency (ESA), Canada, and Japan – whose continued participation hinges on issues ranging from international politics to differing space exploration goals. For example, the outlook for Russia's continued involvement with the ISS is uncertain given the current state of relations between the two countries. Russia's role is critical to sustaining Station operations because it controls the

Station's propulsion system and propellant and is currently the only partner capable of providing crew transportation to and from the ISS. The participation of NASA's other current international partners is also unsettled at this time given their desire to consider exploration missions beyond the ISS. For example, ESA has announced its intent to partner with NASA on the Lunar Orbital Platform-Gateway and other lunar activities. ESA is also working with the Chinese Space Agency to fly European astronauts on the Chinese space station planned for operation in 2022. Given that NASA's current international partners cover 23 percent of the Station's shared annual costs, the loss of one or more of these space agencies could have a significant impact on NASA's cost to extend ISS operations beyond 2024.

### **Decommission and Deorbit**

At some point, whether in an emergency or because its useful life has ended, NASA will need to decommission and deorbit the Station. Ideally, this will occur via a controlled, destructive re-entry into the Earth's atmosphere. NASA estimates a controlled reentry of the ISS will take up to 3 years to execute and cost approximately \$950 million. However, the Agency has not completed the necessary tasks to execute such a deorbit. In January 2017, NASA completed a draft plan to address various deorbit scenarios; however, the plan has not been finalized and is pending review by the Russia Space Agency. And, while NASA engineers continue to work on the technical details of deorbit scenarios, the Agency presently does not have the capability to ensure a controlled deorbit of the ISS in the event of an emergency.

### **Conclusion**

For the past 20 years, NASA has used the ISS as a research platform in low Earth orbit essential for advancing its deep space ambitions. But such celestial research comes at a steep cost: each year the Station remains in orbit, NASA allocates roughly half of its total human space flight budget to ISS operations – an expenditure that limits the Agency's ability to fund development of systems needed to visit the moon and other destinations beyond low Earth orbit.

Each of the options for extending, transitioning, or retiring the ISS presents NASA with significant challenges that will require it to balance cost, feasibility, and risk. The President's FY 2019 budget request proposes ending direct Federal funding of the ISS by 2025, at which time NASA proposes transitioning the Station to commercial operations. While this proposal faces an uncertain future in Congress, we question whether a sufficient business case will exist by that time to make such an option feasible.

Similarly, NASA's other options present challenges. Extension of the ISS past 2024 will require significant ongoing funding, which would eat into the money available for NASA to pursue its other exploration goals. In addition, extending the ISS to 2028 or beyond would increase safety risks due to aging hardware and equipment. Moreover, it is unclear whether NASA can count on funding from its existing international partners if it seeks to extend the Station's operations beyond 2024. Finally, NASA needs to finalize a plan to decommission and safely deorbit all or part of the ISS at the end of its useful life.

Regardless of the outcome, NASA must redouble its efforts to maximize the potential of whatever time remains on the Station. Important work on several human health risks and technology demonstrations will not be completed by 2024, leaving NASA with the choice of extending Station operations, relying on alternate testing methods, or accepting higher levels of risk. The sooner Congress and the Administration decide on a path forward for the future of the ISS, the better NASA will be able to plan.