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Chairman Cruz, Ranking Member Nelson, Ranking Member Markey and members of the Subcommittee, on behalf of The Boeing Company, thank you for the opportunity to testify today to provide Boeing's perspective on the future of the International Space Station and pathways to increase commercial use of low Earth orbit (LEO). I appreciate your holding last month's hearing with NASA and today's hearing with industry and other stakeholders to understand the implications of important policy decisions before Congress and the Administration that will determine the future of American leadership in LEO.

Mr. Chairman, as you know Boeing is proud to work closely with the Johnson Space Center and Mission Operations in Houston where about 1,000 Boeing employees collaborate with NASA teams to support the astronauts, ISS operations and research on a daily basis. And Senator Nelson, our Boeing team of more than 400 employees in and around the Kennedy Space Center is preparing for launch of the CST-100 Starliner later this year and supporting ISS, Space Launch System and the X-37B spacecraft.

On November 2nd the world will celebrate 18 years of a continuous human presence in space. That means that students graduating high school this month with aspirations of one day being part of human exploration of deep space… will have lived their entire life on Earth while men and women continuously orbited above… living, working and expanding the realm of what's possible in space. In other words, they were helping to make those students' dreams a reality.

The question the subcommittee is considering today has profound implications for whether we will continue to have a continuous human presence in space for decades to come, if not indefinitely. If we as a country make strategic policy decisions at this juncture, future generations may celebrate November 2, 2000 as the beginning of humanity's permanent presence off Earth.

The men and women of Boeing are rightfully proud of our company's role as NASA's prime contractor for the International Space Station. In that capacity, we designed, developed, integrated, tested and delivered all U.S.-built elements of the station. We also ensured these elements integrated seamlessly with those built by our international partners, a tough task given these elements were developed half way across the world and only met for the first time on orbit.

Having created this unique home and laboratory in space, Boeing maintains this continued orbital presence as NASA's contractor for sustaining engineering for the ISS.

We are responsible for maintaining the station at peak performance levels to ensure that this invaluable and inspirational engineering marvel remains available to NASA, its international partners, other U.S. government agencies and private companies.

But today, I am pleased to be here with this distinguished panel to talk about ISS sustainment of a different sort. We ask you to use your authority to preserve the long-term viability of this vital national laboratory, this icon of aerospace engineering, this symbol of an international vision for space, for as long as the Station is able to operate safely and reliably; even as we work together to return to the moon and press beyond into deep space.

And we believe that ISS mission goes well beyond 2028, ensuring that the investment taxpayers and international partners made in building the station continue to provide value for many years ahead.

As you may know, at NASA's request, Boeing performed a study on the life of major space station hardware components. Our study shows the primary structure can reach 2028 and found no technical showstoppers to continued flight beyond 2028. The ISS was designed and built in Boeing's robust tradition which has seen spacecraft and aircraft far exceed their initial design life. Working with NASA we routinely upgrade systems and capabilities. The fact is, the ISS is far more capable now than it was even seven years ago. And with the NASA-Boeing team focused on operations 24-7-365 we are able to operate in a mindset of continuous improvement for safety and reliability.

It's important to add that Boeing continues to work with NASA to reduce the costs of sustaining the International Space Station. In fact, over the past 10 years, we have reduced the costs to our sustaining role by more than 30 percent.

Notice that I said "technical showstoppers." Unfortunately, we do see that this potential extended life could be compromised due to premature discussions about terminating the program or withdrawing U.S. funding and support.

Like you, we are concerned by consideration of ending direct government funding of ISS in 2025, creating an uncertain future for this valuable space asset. Uncertainty due to the risk of subjecting the station and all that it represents to the hope of a commercial space market that may not have a chance to take shape in seven years – risking reduction or elimination of research and science, and even America's leadership role in LEO should viable commercial alternatives not materialize.

Before considering this policy question, let's take a look at what the ISS represents…

The ISS is – by far – the largest spacecraft in history and represents the investment of hundreds of billions of dollars from 15 nations around the world. It operates 24/7.

ISS Provides a Unique Geopolitical Benefit

We believe that deep space exploration will only be possible through international cooperation, and ISS proved this is best done under American leadership. It will require

global investment and infusion of ideas from a coalition of space-faring nations. The International Space Station has proven and will continue to prove that it is possible, and it should be our model for our future in LEO as well as in deep space as we prepare to launch the Space Launch System with NASA and international astronauts on Exploration Missions to the Moon in the 2020s. In fact, through current intergovernmental agreements, our international partnerships on ISS are directly contributing to cost-sharing for exploration, and can be further leveraged as we build out the Lunar Orbiting Platform-Gateway and build systems for the Moon and Mars.

It is a model of geopolitical efficiency and tenacity that is far from finished in its work to demonstrate the benefits of cooperative space exploration. Abandoning the ISS at this time not only risks U.S. leadership in space, but also imperils our ability to forge essential collaborative political, engineering and scientific relationships around the world.

NASA currently leads the world's space agencies, and is positioned to lead a deep-space exploration campaign including international and industry partners. Those other space agencies, space-faring nations and emerging aspirants like Australia and the United Arab Emirates will not abandon their plans if we abdicate our responsibility to lead and inspire. Continued operations in low-Earth orbit will be essential for them to realize their aspirations in space and provide them the incentive and experience to make future contributions as we explore deep space.

If the ISS program is terminated in 2025, then our international partners and commercial businesses will look for alternative low Earth orbit opportunities. Russia has talked about separating from ISS and offering their capabilities to our international partners. China is currently building and plans to operate their own space station starting in 2022 and is engaging the international community to use it. Ending American government support for ISS will have significant impacts on our nation's standing in the world, and weaken U.S. influence of the international and commercial communities needed for deep space exploration.

No nation alone can sustainably return humans to the moon and send them to Mars – it will take the collective capacity and funding of our global partners. If we end our human presence in LEO prior to having a steady cadence of human spaceflight missions to deep space, we put at risk not only U.S. funding but the support of international partners. Also, if the U.S. is not the leader in human spaceflight, other nations will assume that leadership role.

ISS Provides Significant Scientific Benefit

The ISS provides a unique, micro-gravity research capability unlike anything else in the world. More than 2,000 experiments have been conducted on orbit with the participation of 103 countries. And this has contributed to significant breakthrough science. To cite just a few:

- The development of osteoporosis drugs available now to treat bone loss
- Clinical trials for treating Duchenne muscular dystrophy
- A vaccine for salmonella

And currently in work:

- Cancer therapy targeting tumor cells
- Fiber production
- Human organ and tissue manufacturing
- The development of robotic arms to treat inoperable tumors

If the research and science community sees the ISS future as uncertain, planning for future experiments could begin to slow or stop as early as this year. These are long cycle endeavors, and not commercial in nature. More than 300 experiments are performed every month aboard the ISS. These experiments not only contribute to down-to-earth scientific breakthroughs, but also develop understanding and human health and environmental support systems to support future deep space missions. It is for these reasons and more that with great wisdom and an eye to the long-term future, Congress enacted the 2005 NASA Authorization Act that designated the U.S segment of the ISS as a national laboratory. National Laboratories, like the ISS, are important to delivering world-class research and strengthening the overall contribution of the laboratories to the nation's research enterprise. The ISS provides significant benefits here on Earth, and holds the potential to expand our economic sphere beyond the Earth's surface.

It's also important to note that the work being done on ISS inspires the next generation of researchers and visionaries. Boeing is proud to sponsor the "Genes in Space" contest that offers an opportunity for middle-school and high school students – future researchers and explorers – in the U.S. and around the world, to propose actual, meaningful experiments to be performed on orbit, and then allows them to see their ideas in action.

Cutting short this government-supported research in 2025, or causing future researchers to wonder whether the ISS will be viable in its current science model, risks putting the brakes to much of the breakthrough discoveries that could be possible. Even the uncertainty of future government involvement puts new science at risk. With average lead-time of six to seven years to plan, propose, fund and initiate meaningful research projects, scientists and researchers will have little choice but to abandon their ideas and look elsewhere. We must ensure the science community that their future contributions to life on Earth – and in space – will find a lasting home on orbit.

ISS provides significant economic opportunity

Our advocacy for continued government support for operation of the Station does not dismiss the prospects of viable commercial utilization of the ISS. We believe there is opportunity on orbit, but that it is unlikely to happen with the turn of a switch on a certain date. Total ISS reliance on private funding is unlikely to be economically viable by 2025

absent significant, if not exclusive, NASA investment and anchor tenancy. There will simply not be enough of a space economy in place for market forces to drive robust commercial behavior in low-Earth orbit in that timeframe. There is a good chance that a premature termination of ISS could ultimately result in a U.S.-government funded LEO platform with less capability, fewer international partners and comparable costs. Such a plan could even inhibit the commercial development of LEO, without ISS as an anchor without which bigger business arrangements would not be viable.

We don't lack capacity for commercial opportunities with the ISS, but the likelihood that those opportunities can fund the entire ISS by 2025 is very low. Currently NASA funds the US Operating segment of the ISS at ~$3B annually. Commercial revenue is $100M or less. This is a big gap. The problem we really need to solve is growing the private sector demand for services in space. We are already seeing signs of what could be possible where commercialization and investment in the ISS capability can seed and foster a sustainable economy in LEO. From our vantage point, the Boeing/Nanoracks commercial airlock will enable Cubesat and other small satellite deployment from ISS by way of the national laboratory. Boeing investment in innovation targets an untapped user community of start-ups through business accelerators like MassChallenge.

But the fundamental fact remains and has been pointed out as recently as last month's Science and Technology Policy Institute study, "it is unlikely that a commercially owned and operated space station will be economically viable by 2025." Today's commercial LEO destination business case relies on continued government funding while other markets around non-US governments, manufacturing, and private spaceflight participants continue to develop. This is unlikely to evolve much more toward a viable commercial market by 2025.

Furthermore, uncertainty about that near-term future discourages venture capitalists from substantial investment that leverages the ISS as a platform. The U.S. government must continue serve as the anchor customer in LEO and, to the greatest extent possible, maintain our current international partners to drive global investment to U.S. commercial providers serving and using the ISS. With continued government support the Station can serve as an incubator to define these future commercial opportunities, but the government must still be able to rely on the Station for basic scientific research and more understanding of what is needed to support deep space missions.

ISS continues to provide significant down-to-Earth economic opportunity

If economic opportunity is to be the driver of the Space Station's future, let's not dismiss the real economic opportunity that has been at the heart of development, assembly and operation of the Station for over two decades. It's opportunity that continues well into the future.

Over the past 18 years of human presence on orbit, approximately 400 suppliers from at least 35 states have supported the Station. Last year alone, 227 suppliers have been part of robust economic activity of approximately $165 million. With approximately $300

million in annual contract expenditures, at least $50 million has been awarded to small businesses.

The ISS program, along with its crew and cargo transportation programs, help ensure that NASA maintains critical leadership in mission operations, human spaceflight and other competencies that will be necessary as we launch upcoming Exploration Missions to the Moon and beyond.

Long-term viability of the Station is essential to sustaining that earthbound economic vitality.

All of these arguments – international collaboration, breakthrough science and research, a nascent yet promising commercial space economy, earthbound economic vitality, and deep space exploration needs – point to a compelling rationale to keep the International Space Station operating in a government-funded model through 2025 and on into the future.

Recommendation

While it is very important for the Administration and Congress to consider the future of ISS beyond 2024 and how to make greater commercial use of this unprecedented platform, we believe that proposing a termination date at this time will result in confusion, missed opportunities and potentially compromise our permanent human presence in space – just at a time when the commercial space ecosystem in LEO is starting to develop. It also may compromise planned scientific research and result in international partners losing confidence in America's commitment to LEO.

Some have argued that the rationale for ending direct funding of the ISS is that the United States cannot afford both continued ISS operations and deep space exploration at the same time. We disagree that this is an "either-or" decision, and Congress has demonstrated its commitment to NASA and our human spaceflight programs through significant increases in appropriations over the last several fiscal years to ensure both a healthy LEO and deep space exploration program.

The retirement of the world-recognized Space Shuttle created a misperception in some quarters that NASA was going out of business and America was ceding space leadership. It is easy to see how that perception could arise. Premature retirement of the Shuttle created a seven-year gap in U.S. spaceflight and brought about a $3 billion reliance on Russia to carry our astronauts to the ISS, effectively leaving control of this vital asset in their hands. At the same time, NASA only saw about $500 million shifted to exploration.

The ISS remains as the foundation for U.S. leadership in the international space community, and premature retirement before we have established follow-on capabilities and platforms could be even more problematic than the void left after Shuttle retirement. As such, NASA should develop a plan founded on transition criteria and objectives as guidelines rather than an arbitrary decommission date to avoid future

unintended consequences which could undermine U.S. leadership and recent investments in low-Earth orbit. Elements of the plan should include, but not be limited to:

- Continued U.S. human presence in LEO to sustain crew and cargo transportation
- Completion of exploration-related research and technology development requiring ISS
- Availability of alternate capability to conduct NASA microgravity research
- Establishment of a human exploration habitation capability in deep space.
- Considerations of “industrialization” vs pure commercialization.

To ensure U.S. leadership in space we need a criteria-based approach to the future of the International Space Station, not an arbitrary end date. ISS serves an important role for deeper space exploration, as a test bed and example of cooperation. The science community needs to know ISS will be viable outside a pure commercial model, or the science pipeline could begin to dry up soon. Moving toward a more efficient industrial model on ISS makes sense if these risks can be managed on a criteria based timeline.

Our generation – soon to include those high-school graduates (Generation ISS, if you will) – are demonstrating how we will be able to live in space for a half-century.

Thank you.