

HOUSTON CHRONICLE

What happens when NASA retires the International Space Station?

Andrea Leinfelder | Oct. 25, 2020 | Section A, Page 1

Michael Suffredini knows what he knows: how to build and operate space stations.

He also knows the U.S. government will never build another station for low-Earth orbit. So after two decades of working on the International Space Station, Suffredini left NASA in 2015 and co-founded Houston-based Axiom Space.

He's among those working on a succession plan for the beloved space station that, on Nov. 2, will celebrate 20 uninterrupted years of sheltering humans some 250 miles above the Earth.

"The International Space Station has been an amazing asset for the United States. It still is, and it will be for years to come," NASA Administrator Jim Bridenstine said during a recent Senate hearing. "But we all know a day is going to come when it comes to the end of its useful life."

Nov. 2 will be a global celebration for the engineers who overcame technical limitations, the researchers who saw potential in using microgravity to improve life on Earth, and the astronauts and cosmonauts who tested their bodies so humanity could push further, perhaps one day having sustainable programs on the moon and Mars.

In Houston, it marks two decades of mission control working all day, every day to ensure the continuous operation of this platform, which has been home to 241 people from 19 countries.

Yet this milestone is also a reminder to look toward the future. The space station is authorized for human habitation through 2024, and Congress is expected to extend that to 2030.

NASA believes the orbiting lab will survive at least another 10 years, and there's precedent for long-lasting space hardware. The Hubble Space Telescope recently celebrated 30 years in space. The Voyager 1 and Voyager 2 spacecraft, launched in 1977, are still sending information to Earth.

But eventually, the space station's parts will wear down and its technology will become outdated.

"The wear and tear on hardware is a real thing," said Brendan Curry, chief of Washington operations for the Planetary Society, "and space is an environment that is constantly trying to, one way or the other, kill you or kill your hardware."

That's why Bridenstine implored the Senate to invest in commercial space stations now. NASA has requested \$150 million for commercial low-Earth orbit development in each of fiscal years 2019, 2020 and 2021, but Congress gave the agency only \$40 million for 2019 and \$15 million for 2020. NASA has yet to receive its budget for 2021.

Without adequate funding, NASA fears history could repeat itself. There was a nine-year gap between when the space shuttle retired and when the U.S. resumed launching astronauts on American-made rockets. A similar gap in low-Earth orbit could hurt a commercial space sector that's finally getting its footing, and it could jeopardize NASA's ability to perform its required research in low-Earth orbit.

"If the International Space Station comes to the end of its life and we don't have commercial space stations," Bridenstine



Astronauts Bob Behnken and Chris Cassidy give a thumbs up during a July 2020 spacewalk to install hardware and upgrade International Space Station systems.

said, “there’s going to be a lot of rockets that aren’t going to get launched.”

How to build in space

The first module of the International Space Station was launched Nov. 20, 1998, from the Baikonur Cosmodrome in Kazakhstan. It took four uncrewed Russian launches and 37 space shuttle launches to largely complete assembly in 2011.

NASA’s mission control in Houston and Roscosmos’ mission control in Moscow are the leads for their different segments of the station. Houston manages activities across the station by coordinating with its international partners’ control centers. But if a serious emergency were to occur, Houston’s flight director has ultimate authority.

Astronauts’ schedules are made by separate U.S. and Russian teams. For the U.S. side, the operations planner receives input from the different areas that require crew time, such as scientific research, maintenance and exercise. The space station commander leads the crew members as they work to conduct operations directed by mission control. In emergency scenarios, however, he or she can make rapid decisions and report those to mission control once the situation allows.

The station’s early days were focused on assembling the station, developing technical expertise and curating strong international bonds. Then the station began to focus on research and helping companies develop markets in space.

“It wasn’t until the end of assembly that we really began talking about commercial,” said Suffredini, who was space station program manager at Johnson Space Center from 2005 to 2015.

Some companies built vehicles to deliver cargo and astronauts to the station. Jeffrey Manber co-founded Webster-based Nanoracks in 2009 to help universities and corporations get their experiments, such as biological tests or whiskey aging, into microgravity.

At that time, many people in Washington felt the space station program would end in six years. Manber disagreed.

“I gambled personally that the station would not be defunded in 2015,” Manber said.

Nanoracks has since expanded its services. Its Bishop Airlock will soon become the station’s first commercially owned airlock.

But still, Manber sees the challenges.

“How long can we operate an aging space station efficiently? That’s the question,” he said.

Next-gen stations

Many believe commercial space stations are the next step for creating a thriving commercial sector in low-Earth orbit. Nanoracks and Axiom Space, both in the Houston area, are working toward this goal.

Nanoracks is researching free flyers. Instead of a space station with multiple modules, Manber envisions a variety of solo bus-size stations (and smaller) orbiting the Earth.

Some might be used for medical research, others for astronaut training or filming movies. Nanoracks would like to create uncrewed free flyers where companies could work with materials, such as volatile gases, that might be dangerous with people onboard.



Astronauts Danny Olivas and Nicole Stott (right) during a space walk in 2009 in which they did construction and maintenance work on the International Space Station.



Two spacecraft are pictured docked to the International Space Station as the complex flew into an orbital sunset above the Tasman Sea in between Australia and New Zealand on Oct. 18, 2020.

And while some free flyers will be launched from the ground into space, Nanoracks envisions repurposing upper stages of rockets that are discarded in space. As the first step toward this goal, it's launching an experiment next year to demonstrate cutting metal in space without creating debris.

"Now is the time to help companies do the research into how you would develop efficient free flyers," Manber said. "America has invested billions in creating an extraordinary success story in the low-Earth orbit ecosystem, and I don't want that to go away."

Axiom Space plans to build on the modular approach where multiple segments are attached together. This is what NASA and other governments are comfortable with, Suffredini said, and they'll be more willing to transfer to a commercial station that is a new-and-improved version of the space station.

Axiom Space was selected by NASA in January to develop a commercial module that will attach to the station. It is set to launch in 2024. Through 2028, additional modules will be attached to that first module to provide areas for housing, research and manufacturing.

"I felt strongly that the right way to evolve from the International Space Station to a commercial space station in low-Earth orbit was to start off attached to the ISS," Suffredini said.

The station is expected to cost \$2 billion, which Axiom is funding through private investment and revenue from providing full-service human spaceflight missions as well as its research customers and brand partnerships.

Being attached to station also ensures there isn't a lull in commercial activity as companies wait for a new one to launch, Suffredini said. When the time comes to retire the station, projects can simply move to the Axiom Station before it's detached and become its own free-flying station.

Tom Marotta, co-founder of space policy think tank Beyond Earth Institute, hopes to see a wide variety of commercial space stations. He said these are the first step toward understanding the physiological, psychological and economic factors of creating permanent human communities beyond Earth.

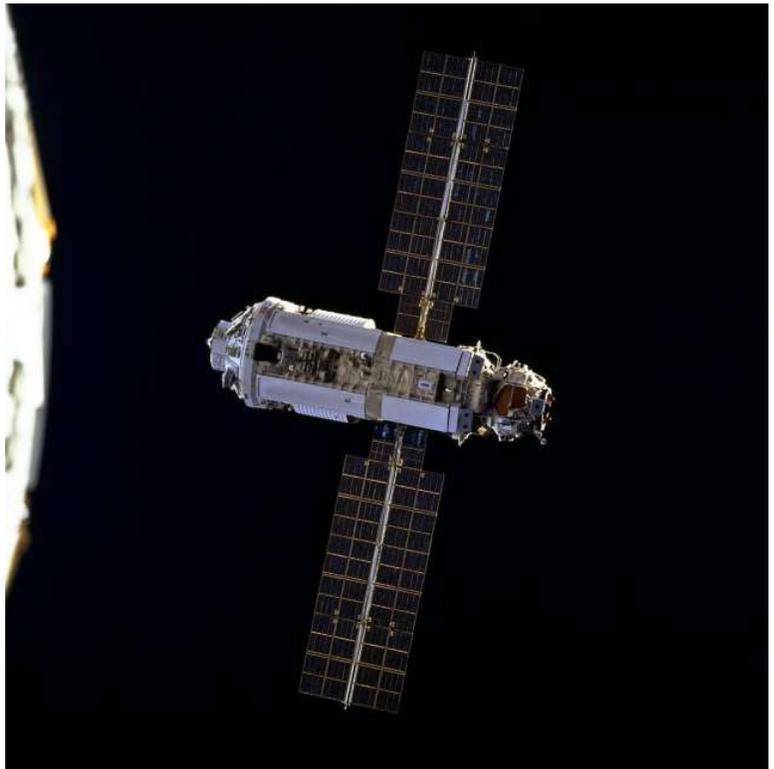
"It's part of an evolution toward larger and more complex facilities," Marotta said, "and also an economic and social system in space."

On the cusp

After giving Axiom a port to dock with the ISS, NASA planned to fund free-flyer research for space stations such as the one Nanoracks envisions. But that was put on hold as Congress didn't fully fund NASA's budget requests, said Robyn Gatens, acting director of the International Space Station at NASA headquarters.

Gatens said NASA spends \$3.5 billion a year on the International Space Station. Transitioning low-Earth orbit to the commercial sector is important for freeing up resources for the moon and Mars. But in the meantime, she emphasized that important work is being done on the station. It's a platform where NASA continues to evolve its capabilities for traveling deeper into space, such as learning how to recycle more water. The station is also being used to research health care techniques, including regenerative medicine to replace damaged tissue or organs, that will continue improving life on Earth.

"I feel like the best is yet to come," Gatens said. "I feel like we're just on the cusp of some really huge payoffs from this platform."



The Zarya Control Module was launched atop a Russian Proton rocket from Baikonur Cosmodrome, Kazakhstan, on Nov. 20, 1998. Zarya provides battery power, fuel storage and rendezvous and docking capability for Soyuz and Progress space vehicles.