



## Position Paper

# Disposal of the International Space Station and Future Large Space Objects

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January 2025

## *De-orbiting the ISS*

The International Space Station (ISS) has made significant contributions to humanity's understanding and use of humans in space since it went fully operational in 2000. But its life may be limited by economic and engineering considerations. Recently NASA awarded SpaceX the contract for a “deorbit tug” to push the ISS out of orbit and into the Pacific Ocean. This has been greeted with cries of alarm from some space advocates who decry the “waste” of simply junking the ISS. NASA has written a paper to buttress their decision<sup>1,2</sup>, which is to deorbit the ISS intact. NASA argues that the ISS was simply not designed to operate autonomously – it needs a busy crew to stay operational — and there are significant costs and risks associated with boosting the ISS to a “graveyard” orbit.

There is an understandable desire to keep this historic artifact, as we surely wish to preserve the Apollo landing sites. However, there are some key differences. Most importantly, the Moon is very good at preserving history — its billion-year-old pristine craters offer us insights into our early solar system, and the Apollo sites will last a very long time without expensive human intervention if we simply restrict access and operations nearby. The ISS will not.

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<sup>1</sup> <https://www.nasa.gov/wp-content/uploads/2024/06/iss-deorbit-analysis-summary.pdf>

<sup>2</sup> <https://www.nasa.gov/faqs-the-international-space-station-transition-plan/>

The NSS appreciates that NASA has made an effort to seek out entities interested in reusing parts of the ISS, but that work has been fruitless so far, in part due to the difficulties created by the orbit of the ISS. Considerable time remains before the ISS deorbit, hence the NSS recommends that NASA continue to solicit industry input for at least three more years, and possibly longer. The commercial space industry is rapidly growing, and more opportunities may develop over that period. The NSS takes note of a white paper by an industry group proposing a method of recycling the ISS.<sup>3</sup>

## ***Transition Away from the ISS***

As NASA plans the transition away from the International Space Station (ISS), the National Space Society (NSS) urges that the following principles guide its decisions:

**1. Ensuring Continuity of Operational Capability:**

The ISS must not be deorbited until at least one commercial low Earth orbit (LEO) station is in orbit and fully operational. Delays in the ISS deorbit schedule may be necessary to accommodate this requirement. NASA must prioritize adequate funding for Commercial LEO Destinations, as underfunding these efforts would be a misguided policy decision that jeopardizes the future of U.S. leadership in space.

**2. Preserving Critical Functions:**

Any commercial LEO station that replaces the ISS must replicate or accommodate its major functions. This does not mean each commercial station must serve as a one-to-one replacement for the ISS; instead, certain operations, such as cubesat launches, may be more effectively transitioned to other platforms or methods.

**3. Maintaining a Continuous Human Presence in Space:**

For scientific, operational, and geopolitical reasons, NSS supports the uninterrupted presence of Americans in space. NASA should ensure that at least two astronauts, funded by NASA, are stationed on commercial LEO platforms at all times. These astronauts could be distributed across multiple stations or based on a single station. Sporadic usage of commercial LEO stations by NASA undermines their viability, and NASA must act as a reliable anchor tenant to provide stability and support for these ventures. Beyond serving as a minimum commitment, this continuous presence would enable significant utilization of commercial LEO stations, including as training facilities for future missions.

**4. Operational Redundancy:**

To ensure resilience, NASA should fund and support the full operational capability

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of at least two commercial LEO stations. Each station must be capable of continuously supporting at least two NASA-funded astronauts. Uncrewed orbital elements, while valuable, do not meet this requirement. Operational flexibility could be achieved by stations that are crewed for six months of the year and operate autonomously for the remaining six months, as long as NASA maintains a permanent human presence in LEO.

**5. Maximizing Reuse of ISS Components:**

Efforts should be made to repurpose ISS components and scientific equipment. A promising approach could involve docking a Starship to the ISS to facilitate the transfer of valuable gear to a commercial station in a different orbit or using Starship as a foundation for a new commercial station. Such efforts would ensure the preservation and continuation of critical assets while minimizing waste.

## ***Disposition of Large Objects in Space in the Future***

An important issue lies behind this discussion — how, generally, should we dispose of end-of-life objects in space, particularly as they grow in size? Simply dumping large low orbiting objects into the atmosphere has real risks and costs<sup>4</sup>.

The most sustainable long-term direction may lie in the re-use or recycling of structures, components, and materials that make up objects in space like the ISS. Currently such objects are not designed to be readily re-purposed or recycled, but now seems like a good time to start this learning process and create a new space market sector.

In this direction, the NSS urges that NASA should formally publish a Request for Information (RFI) for plans to re-use future large space objects, with the following conditions for reuse and recycling:

- The entity making the proposal must take possession of the subject object and/or its parts and relocate them within 24 months of approval.
- The objects and parts would be offered as-is, at no cost to the entity if there is no competition or to the best qualified bidder if there is competition.
- To be accepted, the entity must provide a plan showing that their intended re-use or recycling is both safe, and within the capabilities of the entity.
- The entity must cover all the costs of removing the parts/materials from the object.
- In return for satisfying the above criteria, the entities will be provided a degree of liability insurance for a limited period of time.

Although NASA's original requirements and at least one proposal for Space Station (circa 1986) called for "indefinite life with maintenance," this was changed to "10 years after assembly complete" (circa 1992). However, the design philosophy remained to enable

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<sup>4</sup> <https://agupubs.onlinelibrary.wiley.com/doi/10.1029/2024GL109280>

indefinite life if desired via replacement of Orbital Replacement Units (ORUs) and in-situ repair. Multiple ISS elements were detached and re-positioned to different locations during the assembly sequence, demonstrating that even elements could be replaced if necessary, although support equipment and maintenance plans were not developed (and one key support equipment item, the Space Shuttle Remote Manipulator Arm, was retired). Development and validation of concepts for indefinite extension with repair is an absolutely vital step for space settlement.

Therefore, NASA should additionally, as part of this RFI, call on industry to submit proposals for the indefinite extension with repair for future in-space infrastructure, and consider demonstration of such techniques with the ISS prior to disposal, considering that it has an unprecedented time of exposure to the effects of aging in LEO, with humans in the loop, and would serve as a valuable “fleet leader” for future large space structures. These proposals may include any relevant engineering studies related to this topic. This RFI should cover the yet to be constructed Gateway, but also any proposed or envisioned future infrastructure in space. ***With such an RFI, NASA would jump-start an in-space repair/recycling industry in much the same way it initiated commercial orbital transportation services in 2005.*** The results of this RFI should help to avoid future situations such as the ISS deorbit in which a large and expensive facility in space is designed for either a finite lifespan or in such a fashion that component reuse is impossible.

This direction proposed by the NSS will inspire thought and discussion concerning the in-space reuse and recycling of vehicles, satellites, and stations. A sustainable human future in space can be strengthened by the salvage and reuse of in-space infrastructure, or by its indefinite use with maintenance.

**About the National Space Society (NSS):** NSS is an independent non-profit educational membership organization dedicated to the creation of a spacefaring civilization. NSS is widely acknowledged as the preeminent citizen’s voice on space, with over 50 chapters in the United States and around the world. The Society publishes *Ad Astra* magazine, an award-winning periodical chronicling the most important developments in space. To learn more, visit [www.nss.org](http://www.nss.org).