International Space Station Satellite Deployment: Jettison Policy and Best Practices for Satellite Payload Developers

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The International Space Station Systems Engineering and Integration Office is responsible for the **Multilateral International Space Station (ISS) and ISS Visiting Vehicle Jettison Policy,** the Partner Program Directive on jettisoning objects from the ISS and Visiting Vehicles to/from the ISS.

Jettison candidate = any object released from the ISS or an ISS Visiting Vehicle while the vehicle is in free flight, as well as any deployables originating from those objects. ***The ISS deploys dozens of CubeSats and other small satellites into Low Earth Orbit (LEO) each year!***

In addition, other objects are jettisoned if they cannot be safely returned in a Visiting Vehicle if they:

*Pose a safety issue for the ISS or for return

*Negatively impact ISS utilization, return manifests, or on-orbit stowage manifests.

*Represent an Extravehicular Activity (EVA) timeline savings large enough to reduce the sum of the risks of EVA exposure time and the orbital environment's hazardous debris population, compared to the sum of such risks without a jettison.

Above: a set of four CubeSats - two from Japan, and one each from Uganda and Zimbabwe - are deployed into Earth orbit for a variety of scientific studies and technology demonstrations from a small satellite deployer on the outside of the Kibo laboratory module as the International Space Station orbited 264 miles above Namibia, Dec 2022

Jettison Policy Requirements

The ISS Jettison Policy intends to quantify and control the risks of deploying and operating small satellites, not only to ensure the safety of the humans flying in space, but also to preserve the orbital environment for world space activities and enable the significant benefits brought by such utilization.

***Trackability**: The jettison candidate(s) shall be trackable by the Space Surveillance Network (SSN).

***Limit Generation of Orbital Debris:** Candidates with stored energy systems shall be passivated by End of Mission (EOM) to prevent fragmentation or generation of additional orbital debris. If the jettison candidate cannot or will not be passivated, the payload developer (PD) will provide analysis that the risk of fragmentation is acceptably low. For EVA based jettisons, bundle multiple jettison candidates together when possible.

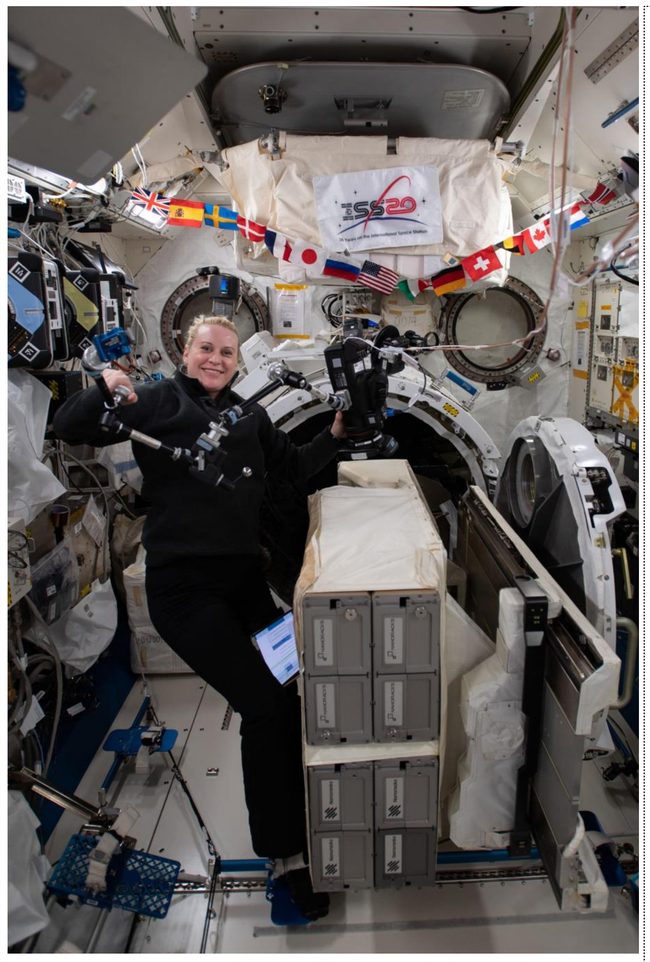
***Limit Risk of Collision with ISS**: All objects planned for jettison shall verify that they do not contact any ISS structure during jettison. For candidates to be jettisoned from the ISS via EVA, analysis shall verify that the planned velocity vector of the jettison candidate is the axis of an unobstructed cone of a 30° half-angle (minimum), and that the object is within acceptable EVA control (i.e.,"handle-able"). For candidates to be jettisoned robotically, the clearance cone must be larger than the worst case accuracy of the jettison mechanism, as defined by the robotics deploy mechanism system owner and implementing ISS robotics team and safety team.

Limit Risk of Re-Contact with the ISS: All objects planned for jettison shall verify safe relative motion with the ISS. The jettison candidate shall clear the 200 meter ISS Keep Out Sphere (KOS) within 1 orbit and maintain a positive departing rate while in the KOS. Nominal return time to the vicinity of ISS shall be no less than 30 days from the jettison date; in the worst-case contingency jettison scenario, the jettisoned object's return time to the vicinity of ISS shall be no less than 10 days. ISS reboosts or avoidance maneuvers will not be considered in these analyses.

***Limit Risk of Collision with ISS Visiting Vehicles**: All objects planned for jettison from ISS Visiting Vehicles or their associated launch vehicles shall verify that they do not pose an immediate collision risk with ISS. Candidates jettisoned lower than ISS shall have an invariant apogee at least 5 km below ISS invariant perigee. Candidates jettisoned higher than ISS shall have a Semi-Major Axis (SMA) of at least 45 km above the ISS SMA.

***Propulsive Jettison Candidate Criteria**: Establish the proper flow of trajectory data between the US Space Force, NASA, and the propulsive candidate's mission operations team.

a. Establish data sharing process with 18th Space Defense Squadron & ISS Trajectory Operations Officers (TOPO)
b. Demonstrate that the satellite operators are Responsible and Safe Space Operators (RSSO)
c. Operate the satellite such that it cannot interfere with ISS operations.



NASA astronaut and Expedition 64 Flight Engineer Kate Rubins works in Japan's Kibo laboratory module to set up a small satellite deployer that will release a set of CubeSats into Earth orbit for governmental and educational research, Nov 2020

Assessment Process

The ISS Program's analysis and approval process for jettison candidates typically takes roughly 3-6 months, depending on the complexity of the jettison candidate.

Data Gathering (*Launch-7 months to Launch-6 months*): mass, dimensions, materials details, propulsive systems, attitude control, power systems, deployable subcomponents, deploy method, deploy location, ops concept, End of Mission (EOM) safing plan, etc.

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Initial Assessment (*Launch-6 months through Launch-5 months*): ballistic assessment, trackability, jettison location & vector, ground population risk, etc.

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ISS Safety Review Panel Vetting & Detailed Analyses (*Launch-5 months through Launch-2 months*)

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Multi-lateral Systems Engineering and Integration Control Board (MSEICB): Jettison Authorization (*Launch-2 months to Launch-1 month*)

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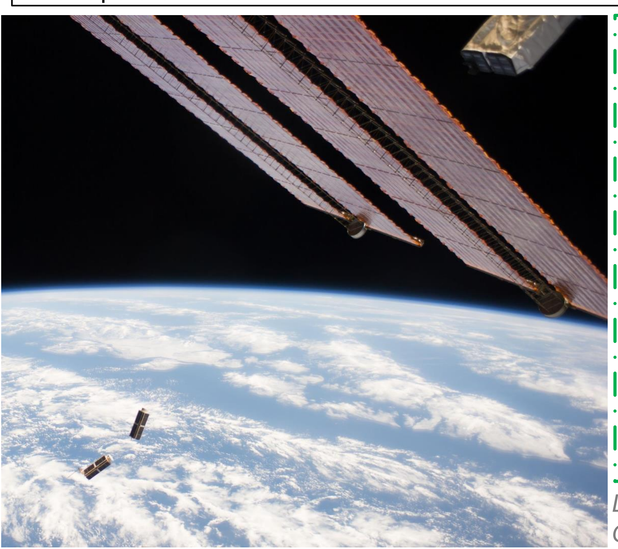
Space Station Control Board or ISS Mission Management Team: Final Jettison Authorization (*Launch-1 month to Launch*)



Adaptability and Innovation

The ISS Program is committed to working with smallsat providers to address their challenges and enable safe, accessible, innovative missions. The Policy has grown with the industry, with each deploy yielding hard-earned lessons learned that improve our process – not only for the next deploy campaign, but with applicability and adaptability for future applications in LEO and beyond.

- "Expedited Approval Criteria" are included to simplify and expedite the analysis and approval process for candidates that pose a low risk to the ISS and ISS Visiting Vehicles.
- Introduced in Rev C (2021), RSSO requirements provide developers of propulsive or complex satellites an opportunity to demonstrate that they can operate independent of NASA guidance without impacting ISS safety.

Left: two 3U "Dove" Cubesats being deployed from the NanoRacks Cubesat Deployer (NRCSD), Aug 2014

Left: Cyclops deployer with SpinSat preparing for release, Nov 2014
Right: Deployment of the NanoRacks-Remove Debris Satellite using the NanoRacks Kaber MicroSat Deployer, Jun 2018

To see the complete ISS Jettison Policy and Best Practices for Satellite Payload Developers, scan this QR code!