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Strengthening Verification of the Outer Space Treaty

Connecting Science and Diplomacy

Overview

On October 21, 2026, the Council on Strategic Risks, the Geneva Centre for Security Policy, and Secure World Foundation hosted our second roundtable discussion in New York on "Strengthening Verification of the Outer Space Treaty" and deterring the placement of nuclear weapons in space. The roundtable included diplomats, scientists, academics, policy experts, and commercial operators. To encourage creative discussion, the event was held on a not-for-attribution basis. The discussions explored how technical capabilities and diplomatic arrangements could strengthen verification of the Outer Space Treaty (OST), particularly its Article IV prohibition on the placement of nuclear weapons in orbit.

This was the second of a series by the organizers on this topic. Hence, the conversation began with a description of the conclusions from the first roundtable in Geneva in May 2026, which pointed towards a layered approach combining research, transparency, consultation, and international cooperation to bulwark verification of the OST. Verification remains technically challenging and politically sensitive, but participants identified a few practical, actionable initiatives that could begin before negotiations on a more comprehensive and collective approach to verification start.

The most developed concept brought up at the New York dialogue was the suggestion of an international partnership modeled on the International Partnership for Nuclear Disarmament Verification (IPNDV), tailored to the OST verification challenge. Such an initiative could bring together interested countries and technical experts to examine cooperative and noncooperative verification scenarios, develop technologies, and address the legal and political conditions for their use. Another strong idea was to conduct cooperative prelaunch inspections to verify the presence of permitted nuclear power or propulsion systems, including commercial ones. These and other proposals were presented as pragmatic and practical paths forward, rather than legally-binding treaty implementation decisions or commitments.

The diplomatic and technical starting point

The discussion described a difficult political and security environment marked by geopolitical competition and counterspace capabilities, concerns about "dual-use" and uncoordinated proximity operations, and the growing reliance on commercial systems. Nevertheless, several participants pointed out that diplomatic exchanges are honing in on what should be observed, notified, or verified. The ongoing Open-Ended Working Group on the Prevention of an Arms Race in Outer Space in All its

Aspects (OEWG) was identified as a helpful venue for connecting technical questions with wider security concerns before its mandate expires in 2028; however, questions were raised about whether it could be sufficient in developing practical paths forward, given its requirement for consensus to make progress. There was therefore a desire to understand and identify other multilateral organizations or processes that could specifically advance OST verification practices, especially if it is not realistic to hold a meeting of OST States Parties in the near term (given that one has never been convened).

Article IV was seen as the most useful starting point for verification discussions because it is an almost universally agreed-upon, clear-cut legal restriction, and the inquiry concerns both physical hardware and observable behavior. Participants emphasized that verification must address both observable activity and the strategic reasoning that could lead a state to consider violating or withdrawing from treaty obligations. Technical detection cannot prevent every violation, but the prospect of detection and attribution can change a state's calculus. Strengthening the treaty would largely depend on the credibility of detection capabilities as well as sustained transparency and dialogue, especially before and after potentially contentious exchanges.

A central unresolved question was whether the absence of a nuclear weapon aboard an orbiting satellite could be reliably verified. Prelaunch inspection was considered technically easier, but access to sensitive facilities cannot be assumed. On-orbit inspection has to overcome weak signals, possible shielding, background radiation, and the possibility that civilian nuclear power systems would complicate interpretation (beyond merely providing an argument to defy any positive attribution). Recent and ongoing studies at MIT, Stanford, and elsewhere indicate that on-orbit inspection could be feasible within certain constraints.

A proposed international verification partnership modeled on the IPNDV

An interested group of countries could establish a space verification partnership without waiting for agreement among all major space powers. Participation and leadership by countries beyond the United States was recommended in order to reinforce the initiative's international credibility and the global norm it aims to uphold. The minimal costs could be shared among governments, with possible philanthropic support for an initial proof of concept before longer-term public or governmental funding.

The proposed structure included four connected working groups. One would examine uncooperative verification scenarios as a more near-term priority, while another would explore cooperative verification arrangements over a longer horizon. A complementary technical group would assess and align technical tools with the needs of the uncooperative and cooperative scenario working groups, including analyzing the trade-offs between passive and active inspection. Finally, a legal and political group would examine the measures needed to support those activities and keep institutional proposals aligned with technical developments.

Inclusive participation was central to this proposal. Countries lacking independent verification capabilities would need access to information-collection and transmission processes, technical workshops, and exchanges that explain both the capabilities and limits of available technologies. Nuclear verification experience, including that of the IPNDV participants, the International Atomic Energy Agency, and the Comprehensive Nuclear Test Ban Treaty Organization, could offer institutional lessons to explore. Still, these organizations lack sufficient expertise to provide ready-made advice in the outer space arena.

Connecting technical work to diplomatic institutions

The PAROS OEWG could provide a venue for discussing verification proposals and their relationship to broader space security concerns. A Group of Governmental Experts on verification in outer space was also suggested, alongside relevant engagement with the United Nations Committee on the Peaceful Uses of Outer Space (COPUOS). The COPUOS itself has a Working Group on Nuclear Power in Outer Space, which could also be a suitable forum for discussing these technologies. These avenues were viewed as potentially complementary; an expert partnership could explore practical options while United Nations processes considered their wider acceptance and political implications. A complicating factor, however, is that the COPUOS mandate does not include security issues, so there would need to be some framing of how this affects spaceflight safety to make it palatable for that organization.

The discussion at the NY Dialogue also drew on experience from the Intermediate-Range Nuclear Forces Treaty, Comprehensive Nuclear Test Ban Treaty, strategic arms reduction agreements, the Chemical Weapons Convention, and the Hague Code of Conduct. The aim was to identify useful approaches to compliance, notification, and confidence-building while avoiding past mistakes. Treaty review in a meeting of OST States Parties was also raised as a possible response to technological developments. Still, there is no agreed-upon scope or mechanism for such a review, and hence it seemed an unlikely option at this point.

Developing and testing inspection options

There was general agreement that a technical path forward would involve comparing sensing techniques and developing demonstrations to validate capabilities. Technical discussions of inspections focused on the value of architecting a sensing approach that extends beyond simply identifying nuclear material to differentiating a nuclear weapon from a permitted space nuclear system (such as radioisotope power and heating systems, fission power reactors, or nuclear propulsion systems). At a high level, there are several possible approaches to in-space inspection.

Passive sensing has more precedent in space, but may require proximity and long observation periods; even then, shielding and background radiation could still prevent reliable conclusions (though few non-military satellites are shielded).

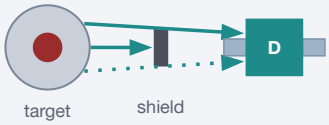
Active systems could operate faster or at greater distances, but require an interrogating source and detector. Such systems might expose sensitive information or raise escalation concerns, if not the perception of a direct threat.

Finally, a pseudo-active approach that uses the naturally occurring high-energy particles in the space environment as the interrogating source is applicable only in certain, high-radiation orbital regimes.

Inspection geometries

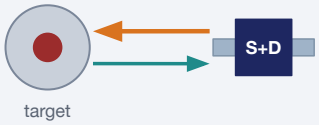
How the inspector, the target and the measured signal are arranged

Passive



The detector measures the target's own gamma and neutron emission. It needs close range and long dwell, and shielding attenuates the signal.

Active, colocated



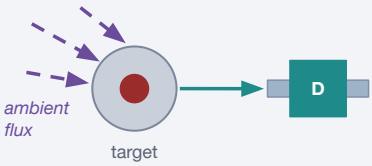
One spacecraft carries both source and detector. The induced signal weakens on the way to the target and again on the way back.

Active, transmission



Source and detector bracket the target, as in radiography. This requires two spacecraft in coordinated proximity operations.

Pseudo active



Cosmic rays and trapped protons supply the interrogating flux. The approach is viable only in some orbital regimes.

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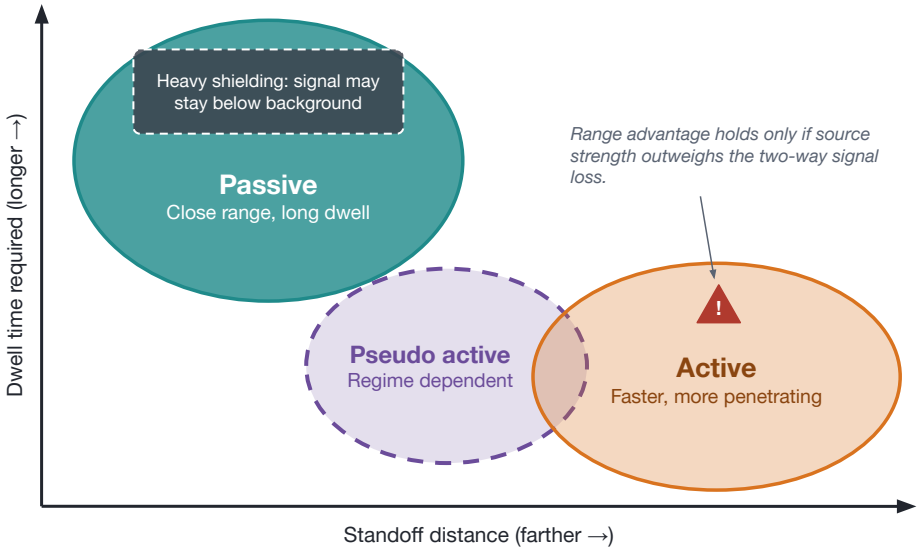
Operating envelope

Conceptual comparison, not to scale



Key Attributes

- Solid fill: higher technical maturity
- Light fill: lower technical maturity
- Dashed outline: conditional on orbit
- Escalation and disclosure risk

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Technical experts described the possibility of taking a multi-pronged approach to identifying treaty violations in orbit by probing for the presence of nuclear material, in combination with deuterium. Some argued that all three of these criteria, in combination, would indicate the presence of a nuclear weapon and rule out the possibility that the subject under inspection was a nuclear reactor or a radioisotope thermoelectric generator. Others questioned whether deuterium would necessarily be present in all nuclear weapons. This approach would require further assessment, as there was no consensus on which indicators would constitute conclusive evidence of a weapon's presence. There was agreement that inspecting the characteristic emissions or qualities of permitted nuclear systems would be a useful starting point for developing a technical baseline for comparison and differentiation.

On-orbit inspection requires operational safeguards. In an uncooperative scenario, the target operator does not share position information and may maneuver away to avoid inspection, creating collision risks and the possibility of escalation. Advance notification, an observable approach, passively safe trajectories, and sharing of the inspecting satellite's exact orbital parameters were suggested as ways to reduce those risks. Acceptable proximity, observation duration, preventing the energy directed at a target from being perceived as escalatory, and confidence in the inspecting spacecraft's own capabilities remain open questions requiring further work.

One proposed, achievable near-term step is cooperative prelaunch inspection and radiation characterization of nuclear power or propulsion systems, including commercial systems, while they are on Earth. Such work could help establish reference information for interpreting legitimate nuclear payloads. It would also set a precedent for independent inspectors' access to launch sites or integration facilities. The approach would depend on access arrangements and protection of sensitive information, but there was broad agreement that this could be an initial step in establishing a future transparency regime.

Ensuring credible evidence

Participants discussed the lack of diplomatic infrastructure for evaluating evidence and handling disagreements. Further work could define how data should be assessed, how uncertainty should be expressed, and how states could raise concerns or request clarification without triggering escalation dynamics. There were several questions regarding whether we can actually utilize and catalog diplomatic use of the OST Art. IX's consultation mechanisms, as well as its call for acting with "due regard" for other actors in space. Fair, transparent, accessible procedures would be especially important for states dependent on information supplied by others.

Space situational awareness (SSA) data would need to be broadly available, and users and providers would need to address allegations of bias or uneven coverage. Proposed measures included comparing commercial data with national catalogs, testing whether predictive algorithms perform consistently across SSA databases, and encouraging states to collect and contribute information from private and academic space observations. Maneuver histories, plans, and information on maneuverability capabilities could improve interpretation. Greater data availability would need to be accompanied by attention to what is omitted from or inconsistent with satellite operators' public declarations. SSA is well suited for identifying patterns of life and anomalous activities but not determining intent. As such, it would be a key part but not the whole solution to strengthening the OST.

Priorities for next steps

The proposals support several connected lines of work: convening interested countries around a verification partnership; defining cooperative and uncooperative verification scenarios; comparing sensing options and testing their limits; and developing procedures for consultations, data sharing, clarification, and disputed evidence. These activities could inform parallel discussions in the PAROS OEWG and other relevant institutions. Building broader political support for public attribution of violations was also suggested, with recognition that such an approach would require a credible evidentiary basis and sufficient diplomatic backing for accountability measures.

The overall conclusion is that progress may be incremental. Technical research and development, inclusive capacity building, and diplomatic procedures could proceed together, with each informing the others. The central challenge is to make compliance assessments more reliable and actionable while ensuring that verification activities themselves do not create additional risks of miscalculation. But verification of the OST is now feasible and, given political priority, should be undertaken. Even incremental progress would make outer space more stable, predictable, and secure for all. ■

- *CSR briefed the findings of the Geneva and New York dialogues to a side event of the UN First Committee on October 26, 2026.*

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