A NEW ERA OF RESPONSIBILITY IN SPACE: ELIMINATING THE THREAT OF ORBITAL DEBRIS

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Program Overview

Man-made orbital debris poses the single greatest threat to the sustainable use of Earth's orbit and puts at risk the space-based infrastructure on which society has become ever more reliant for everything from communications and navigation to tourism and national security. A series of new developments suggests that the international community is taking bold new steps to eliminate this risk and usher in a new era of responsible behavior in outer space, most notably the April 2022 U.S. moratorium on kinetic anti-satellite tests which has now gained significant international support.

This online symposium will feature key figures from government, industry, and academia to brainstorm about these positive developments and discuss the way forward as we work to prevent orbital pollution from interfering with the peaceful use of outer space.

SPEAKER BIOGRAPHIES

Prof. Elena Carpanelli is an Assistant Professor in International Law at the University of Parma in Italy. She is a specialist in the field of space law and is a member of the International Institute of Space Law and an editor of *Air & Space Law*.

Prof. Emer. Joanne Gabrynowicz served as Research Professor and Director of the National Center for Remote Sensing, Air, and Space Law of the University of Mississippi School of Law (2001 – 2013) and Professor of Space Studies and Director of Graduate Studies at the Space Studies Department of the University of North Dakota (1987 – 2001. Prof. Gabrynowicz has advised the U.S. government at many levels and has also been a key figure in many international legal reform initiatives. She currently lectures at various universities and continues to serve as a long-time member of the *International Institute of Space Law*. In honor of her work, the International Astronomical Union named an asteroid, 'Asteroid (9002) Gabrynowicz'.

Carol Leslie Hamilton serves on the University of California College of Law Board of Governors, the Renewables 100 Policy Institute's Board of Advisors, and the Department of Homeland Security Los Angeles Area Community Engagement Roundtable. Nominated by President Obama as the U.S. Alternate Representative to the 69th Session of the United Nations General Assembly, she served as Senior Advisor to the U.S. Mission to the United Nations where she represented the United States on human rights, nuclear nonproliferation, disarmament, and international security issues.

Derek Hanson is an attorney-advisor at the U.S. National Oceanic and Atmospheric Administration (NOAA). Derek provides legal counsel relate to NOAA's environmental satellites and to the Office of Space Commerce, which regulates private remote sensing satellites and is developing the Traffic Coordination System for Space.

Justine M. Kasznica is a shareholder at Babst|Calland in Pittsburgh where she serves as the chair of the Firm's Emerging Technologies Group. As part of her high-tech practice, Ms. Kasznica advises commercial space companies and provides advice on payload launch services contracts, NASA Space Act Agreements, SBIRs, STTRs, BAAs, and other technology development agreements. She also advises on regulatory issues related to commercial space activities, including FAA approvals and certifications, payload review, and other regulatory compliance requirements. Perhaps most notably, Ms. Kasznica serves as outside general counsel to Astrobotic and oversaw the legal aspects of the recent Peregrine mission to the Moon.

Dr. Michael Mineiro serves as Senior Counsel in the Washington, D.C. office of Akin Gump Strauss Hauer & Feld LLP where he counsels launch, satellite, space-based service providers, software, communications and other technology companies and investors on a broad range of legal issues related to regulatory, disputes and compliance issues. Dr. Mineiro has had extensive experience advising the U.S. governments including previously servin in key roles on the House Science, Space and Technology committee and the White House Office of Science and Technology Policy. He holds a doctorate in Space Law and an LL.M. in Air and Space Law from McGill University's Faculty of Law. He earned his J.D. at the University of North Carolina.

Major Matthew Ormsbee is an Assistant Professor of Law at the United States Air Force Academy where he is the Director of Space Law in the Law, Technology & Warfare Research Cell. Maj. Ormsbee received a direct commission as an Air Force Judge Advocate in November 2016 and entered active duty in January 2017. He earned an LL.M. degree in air and space law at the Institute of Air and Space Law, McGill University. Before law school, Maj Ormsbee was a Fulbright Fellow in Germany, an AmeriCorps service member, and a New York City Teaching Fellow.

Randy Repcheck is the Deputy Director of the Office of Strategic Management in the Federal Aviation Administration's Office of Commercial Space Transportation (AST). His directorate is responsible for the development of new regulations and guidance, space policy, research and development, training, and the business operations of AST. Mr. Repcheck joined the Office of Commercial Space Transportation in 1989, and has been engaged in a variety of activities including the licensing or permitting of launch and reentry vehicles and the operation of launch and reentry sites, inspections, the development of new regulations and guidance, and the safety of amateur rockets. Mr. Repcheck holds a B.S. degree in Aerospace Engineering from the Pennsylvania State University, and a law degree from the College of William and Mary.

Dr. Antonino Salmeri serves as the Director of Lunar Policy Platform, an international forum for the development of best practices and principles to ensure the sustainability of both governmental and private lunar activity. Dr. Salmeri holds four advanced degrees in law: a Ph.D. in Space Law from the University of Luxembourg, an Advanced LL.M. in Air & Space Law from the University of Leiden, a 2nd level LL.M. in EU Law & Policy from the LUISS University of Rome and a Masters Degree in Law from the University of Catania.

Mallory Stewart is the Assistant Secretary for the Bureau of Arms Control, Deterrence, and Stability (ADS) at the U.S. Department of State. She joined the bureau in 2022, after serving as a Special Assistant to President Biden and Senior Director for Arms Control, Disarmament, and Nonproliferation at the National Security Council. Prior to joining the NSC, she was the Senior Manager for Global Nuclear Security and Nonproliferation at the Center for Global Security and Cooperation in Sandia National Laboratories.

Prof. Mark J. Sundahl is a Professor of Law and Director of the *Global Space Law Center* at Cleveland State University. He has served on the Commercial Space Transportation Advisory Committee (COMSTAC) which advises the Federal Aviation Administration regarding new regulations governing private space activity and has served as a member and advisor to the U.S. delegation to the UN Committee on the Peaceful Uses of Outer Space. most recently, he served as a member of NASA's Regulatory and Policy Committee. Prof. Sundahl is a member of the *International Institute of Space Law* and an editor of *Air & Space Law*.

Merissa Velez serves as Division Chief of the *Satellite Programs & Policy Division* of the Space Bureau of the Federal Communications Commission which licenses the use of radio frequencies and orbital slots used by private satellite operators.

Jeremy M. Weinberg has been an attorney in the Office of the Legal Adviser at the U.S. Department of State since 2006. He currently covers outer space security topics along with marine environmental protection, and previously specialized in European Union law. He earned his J.D. at the University of Virginia and before law school was a journalist in Russia and Texas and an equity research editor in London and New York.

APRIL 18, 2022

FACT SHEET: Vice President Harris Advances National Security Norms in Space

New U.S. Commitment on Destructive Direct-Ascent Anti-Satellite Missile Testing

Today at Vandenberg Space Force Base in California, Vice President Kamala Harris announced that the United States commits not to conduct destructive, direct-ascent anti-satellite (ASAT) missile testing, and that the United States seeks to establish this as a new international norm for responsible behavior in space. The Vice President also called on other nations to make similar commitments and to work together in establishing this as a norm, making the case that such efforts benefit all nations.

At the Biden-Harris Administration's first National Space Council meeting in December, Vice President Harris tasked the National Security Council staff to work with the Department of Defense, the Department of State, and other national security agencies to develop proposals for national security space norms that advance U.S. interests and preserve the security and sustainability of space. The commitment announced today is the first initiative under this effort. The United States is the first nation to make such a declaration.

This commitment addresses one of the most pressing threats to the security and sustainability of space, as demonstrated by Russia's November 2021 destructive direct ascent ASAT missile test. The People's Republic of China conducted a similar test in 2007. The destruction of space objects through direct-ascent ASAT missile testing is reckless and irresponsible. The long-lived debris created by these tests now threaten satellites and other space objects that are vital to all nations' security, economic, and scientific interests, and increases risk to astronauts in space. Overall, these tests jeopardize the long-term sustainability of outer space and imperil the exploration and use of space by all nations. Developing a shared understanding of what constitutes safe and responsible space activities contributes to a more stable space environment by reducing the risk of miscommunication and miscalculation. This is especially important as there is an ever-increasing number of states and nongovernmental entities that rely on space services and space assets which are vulnerable to debris.

This new commitment also protects U.S. interests in space. Meaningfully reducing ASAT testing and debris generation advances U.S. national security interests and protects long-term U.S. interests in space exploration, space science, and space-enabled economic development.

Conflict or confrontation in outer space is not inevitable, and the United States seeks to ensure outer space remains free from conflict. The Biden Harris Administration had made clear that the United States will engage the international community to uphold and strengthen a rules-based international order for space. The United States, working with commercial industry, allies, and partners, will lead in the development of new measures that contribute to the safety, stability, security, and long-term sustainability of space activities. Overall, through this new commitment and other actions, the United

States will demonstrate how space activities can be conducted in a responsible, peaceful, and sustainable manner.

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By Ching Wei Sooi

October 2023

Direct-Ascent Anti-Satellite Missile Tests: State Positions on the Moratorium, UNGA for the Future Resolution, and Lessons

About Secure World Foundation

The Secure World Foundation strives to be a trusted and objective source of leadership and information on space security, sustainability, and the use of space for the benefit of Earth. We use a global and pragmatic [illegible] to study and

SECURE WORLD FOUNDATION

SWISS EXISTENTIAL RISK INITIATIVE

evaluate proposed solutions to improve the governance of outer space. While recognizing the complexities of the international political environment, SWF works to encourage and build relationships with all willing stakeholders in space activities, including government, commercial, military, civil society, and academic actors. Central to this approach is increasing knowledge about the space environment and the need to maintain its stability, promoting international cooperation and dialogue, and helping all space actors realize the benefits that space technologies and capabilities can provide.

About Swiss Existential Risk Initiative

The Swiss Existential Risk Initiative is committed to reducing existential and global catastrophic risks, particularly those associated with emerging technologies. We mentor and support students and young professionals who share our passion for this important field. Since 2021, we've been offering an annual research fellowship to support the next generation of talent. Working with stakeholders from academia, industry, government, and NGOs, we are strengthening collaborative efforts to tackle these pressing challenges. By bringing minds together, we aim for a safer future for everyone.

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Executive Summary

The topic of destructive DA-ASAT testing has recently become highly salient. In April 2022, the United States announced a unilateral moratorium, pledging to stop testing destructive directascent anti-satellite missiles. The following month in May 2022, discussions on this and other related issues began within the United Nations Open-Ended Working Group on Reducing Space Threats through Norms, Rules, and Principles of Responsible Behaviours. To date, a series of other national pledges have followed, beginning with Canada in May 2022 and most recently Costa Rica and Norway in October 2023, bringing the total number of states up to 37.

October 2023

Direct-Ascent Anti-Satellite Missile Tests: State Positions on the Moratorium, UNGA Resolution, and Lessons for the Future

On 7 December 2022, the United Nations General Assembly overwhelmingly adopted resolution A/RES/77/41 in support of the destructive DA-ASAT testing moratorium. 155 States voted in favour, with 9 against and 9 abstentions. Notably, the United States, India, China, and Russia are the only states to have demonstrated destructive direct-ascent anti-satellite missile capability – and at the time of writing, neither India, China, nor Russia support the moratorium and resolution.

This report provides insight into key questions such as: what prompted the moratorium and resolution, reasons behind their widespread support, and why is it that more states have not pledged the moratorium despite 155 votes in favour of the resolution.

HIGH-LEVEL FINDINGS INCLUDE:

- A significant number of states are concerned by destructive DA-ASAT testing
- A heavy emphasis on orbital debris was present throughout this initiative
- The difference in prioritisation of concerns between developed (stricter security concerns) and developing space powers (debris, access to space, and due regard under Article 9 of the OST)
- The geopolitical factor behind votes cannot be discounted – in some cases, surpassing the substance of the resolution in importance
- States voting against the resolution cite strikingly similar reasons

- Similar aspects of the resolution are cited as reasons both for support and opposition
  - *Narrowness of the Resolution*
  - *Geopolitics*
  - *Previous Destructive Direct-Ascent Anti-Satellite Missile Testing*
  - *The Debate of Norms versus Legally binding Instruments*
- The US spearheaded this initiative, and the support of some NAM states was instrumental to the resolution's widespread endorsement
- Developing states' need for greater technical and legal expertise vis-à-vis the effects of destructive DA-ASAT testing and the implications of a commitment

REASONS STATES FAVOUR THE RESOLUTION CAN BE GROUPED AS FOLLOWS:

- Supportive of Norms as a Governing Mechanism and/or Building Block towards Legally binding Initiative(s)
- Supportive of a 'Capability Neutral Approach'
- Supports the Promotion of Transparency and Confidence Building Mechanisms
- Addresses the Concerns of Developing States
- Diplomacy from the United States
- Supportive Despite Narrowness of the Resolution
- Geopolitical Influences
- Concerned by Previous Destructive Direct-Ascent Anti-Satellite Missile Testing
- Resolution Positively Affects/Does Not Negatively Impact National Security

REASONS STATES ARE AGAINST THE RESOLUTION CAN BE GROUPED AS FOLLOWS:

- Believes that Legally binding Instruments must be the First Step
- 'Sword & Shield' Suspicions
- Moralizing Rhetoric
- Opposition Because of the Narrowness of the Resolution
- Geopolitical Influences
- Concern and Suspicion over Past Rhetoric
- Concerned by Previous Destructive Direct-Ascent Anti-Satellite Missile Testing
- Resolution Negatively Affects/Does Not Improve National Security

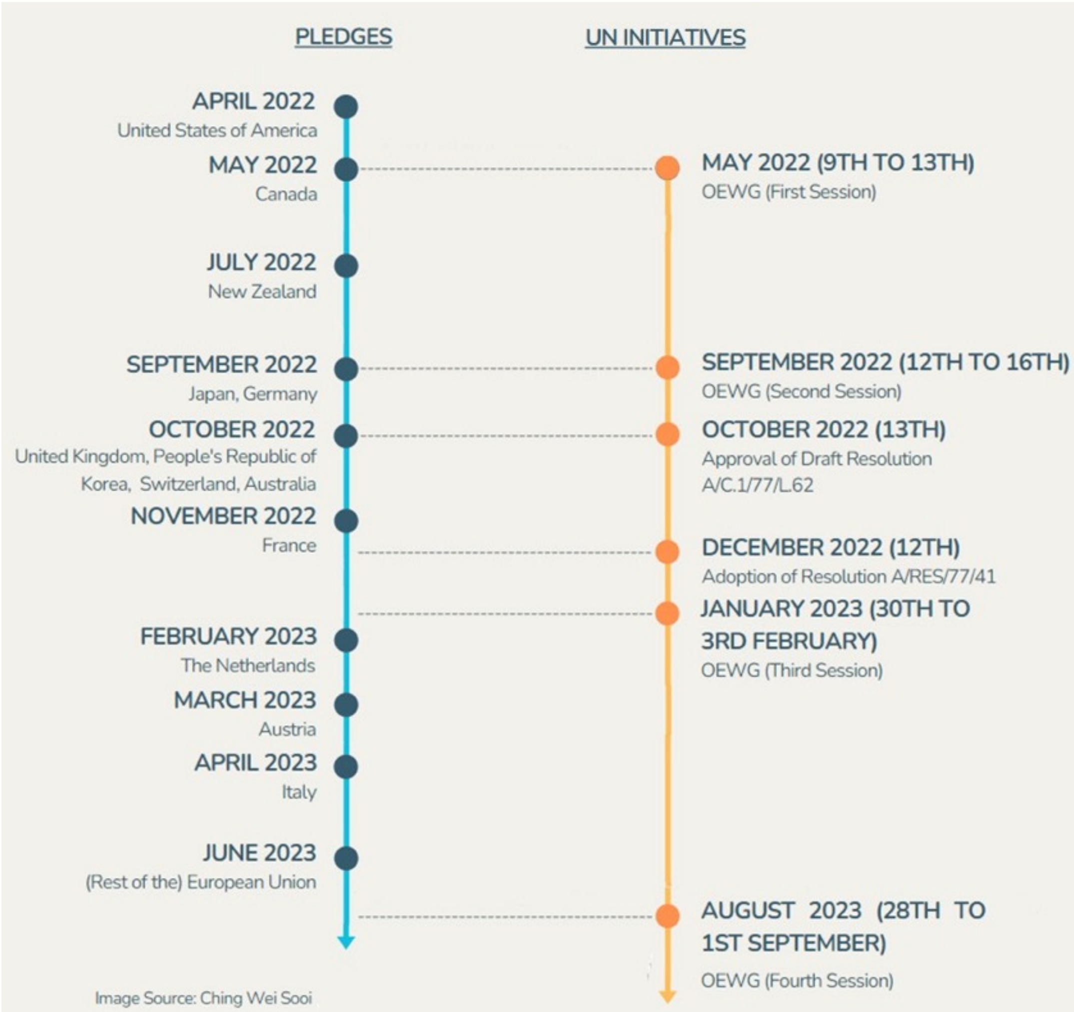
REASONS STATES ABSTAINED ON THE RESOLUTION CAN BE GROUPED AS FOLLOWS:

- Geopolitical Influences
- Strong Preference for Legally binding Instruments over Non-Legally Binding Measures
- Opposition Because of the Narrowness of the Resolution
- Others

The findings of this research indicate the emergence of a growing norm against destructive anti-satellite missile testing with noteworthy momentum behind this initiative. Additionally, taking into account the high number of states in favour of the resolution, there appears to be a softening dichotomy between the two approaches of norms versus legally binding instruments in addressing space security. Next, multiple interviewees expressed that the moratorium and resolution have become extremely politicized. More broadly, they are heavily concerned by the adverse geopolitical climate which exacerbates existing geopolitical deadlocks on preventing an arms race in outer space. Against that backdrop, this report notes however that the moratorium appears to be gaining significant support.

Further, developing states currently lack comprehensive technical and legal expertise on two fronts: the adverse effects of destructive DA-ASAT testing; and the technical and legal implications of making a commitment. The lack of thorough understanding respectively has been cited as a reason why more states have not announced their own moratoriums.

Timeline of Commitments vis-à-vis UN Processes:



Acronyms and Abbreviations

ASAT Anti-satellite

COPUOS Committee on the Peaceful Uses of Outer Space

DA Direct-ascent

EU European Union

OEWG Open-Ended Working Group

LBI Legally binding instrument

NAM Non-Aligned Movement

PAROS Prevention of an arms race in outer space

PPWT Prevention of the Placement of Weapons and Threat or Use of Force

TCBM Transparency and confidence building measures

UN United Nations

UNGA United Nations General Assembly

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Introduction

More states than ever before are pursuing spacepower: "the use and denial of thousands of machines in Earth orbit… for the purposes of war, development, and prestige."[1] Consequently, more states are developing counterspace capabilities. Counterspace capabilities "refers to capabilities, techniques, or assets that can be used against another space object or a component of a space system in order to deliberately deny, disrupt, degrade, damage or destroy it reversibly or irreversibly, so as to gain advantage over an adversary."[2] Anti-satellite (ASAT) weapons are "a subset of counterspace technology [which] focuses on targeting the satellite."[3] A further subset is kinetic, direct-ascent ASAT (DA-ASAT) weapons – the focus on this report.

DA-ASAT weapons are missiles launched from the Earth to destroy satellites, the destruction of which produces a massive amount of debris.[4] The debris generated cannot be understated. "Historical testing of these destructive weapons has contributed significantly to the amount of debris that exists in orbit, posing a threat to all objects in space… [representing] some of the most significant debris-generating events in history that are creating problems for operational satellites today."[5] At the time of writing, destructive DA-ASAT tests have been conducted by the United States, Russia, China, and India. For further reference, the Secure World Foundation has published an infographic on ASAT weapons, their history, and the debris generated.[6]

While the development and testing of destructive DA-ASAT tests goes back to 1959, significant developments have recently begun to play out in high-level international fora, providing the impetus for this timely report. Discussions on this and other related issues have been ongoing in the United Nations Open-Ended Working Group on Reducing Space Threats through Norms, Rules, and Principles of Responsible Behaviours (OEWG) since May 2022. Just prior to the OEWG in April 2022, the United States announced a unilateral moratorium, pledging to stop testing destructive direct-ascent anti-satellite missiles. A series of other pledges followed, beginning with Canada in May 2022 to the European Union in June 2023 (Figure 1). To date, the most recent pledge by Costa Rica and Norway brings the total number of states up to 37.

On 7 December 2022, the United Nations General Assembly overwhelmingly adopted resolution A/RES/77/41 in support of the destructive DA-ASAT testing moratorium. 155 States voted in favour, with 9 against and 9 abstentions (Figure 2). States that voted against are: *Belarus, Bolivia, Central African Republic, China, Cuba, Iran, Nicaragua, Russia, and Syria*. States that abstained are: *India, Laos, Madagascar, Pakistan, Serbia, Sri Lanka, Sudan, Togo, and Zimbabwe*. Curiously, Uganda abstained when voting on the draft resolution but voted in

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[1] Bleddyn E Bowen, Original Sin: Power, Technology and War in Outer Space (Oxford University Press, 2023) ('Original Sin').

[2] Almudena Azcárate Ortega and Victoria Samson, A Lexicon for Outer Space Security (UNIDIR) <https://doi.org/10.37559/WMD/23/Space/05>.

[3] Ibid.

[4] Secure World Foundation, 'Anti-Satellite Weapons' (2022) <https://swfound.org/media/207392/swf-asat-testinginfographic-may2022.pdf>.

[5] Ibid.

[6] Secure World Foundation, 'SWF Releases New Infographic on Anti-Satellite Weapons and Space Sustainability' (7 June 2022) <https://swfound.org/news/all-news/2022/06/swf-releases-new-infographic-on-anti-satellite-weapons-andspace-sustainability/>.

favour for its adoption; the Central African Republic voted in favour for the draft resolution but against in its adoption; and the Democratic People's Republic of Korea conspicuously did not register a vote which "was unusual as Pyongyang normally goes out of its way to vote 'no' on all United States-sponsored resolutions."[7] The moratorium and resolution are remarkably substantial developments, especially against the broader context of deadlock in space security negotiations over, for instance, the prevention of an arms race in outer space (PAROS). As Jessica West of Project Ploughshare explains:
Commitments not to engage in destructive ASAT testing are one of the most concrete initiatives to emerge from the ongoing [OEWG], and … one of the most tangible military [space] restrictions adopted to date. The working group has fundamentally changed the nature of the discussion on space security. New ideas are coming to the fore, and individual states are championing them far beyond the confines of the meeting room.[8]

[7] Theresa Hitchens, 'US Call for Halting Kinetic Anti-Satellite Tests Gets Boost from UN Vote', Breaking Defense (9 December 2022) <https://breakingdefense.sites.breakingmedia.com/2022/12/us-call-for-halting-kinetic-anti-satellitetests-gets-boost-from-un-vote/>.

[8] Theresa Hitchens, 'EU Embraces Biden Administration's Limited ASAT Test Ban as UN Meeting Looms', Breaking Defense (17 August 2023) <https://breakingdefense.sites.breakingmedia.com/2023/08/eu-embraces-bidenadministrations-limited-asat-test-ban-as-un-meeting-looms/>.

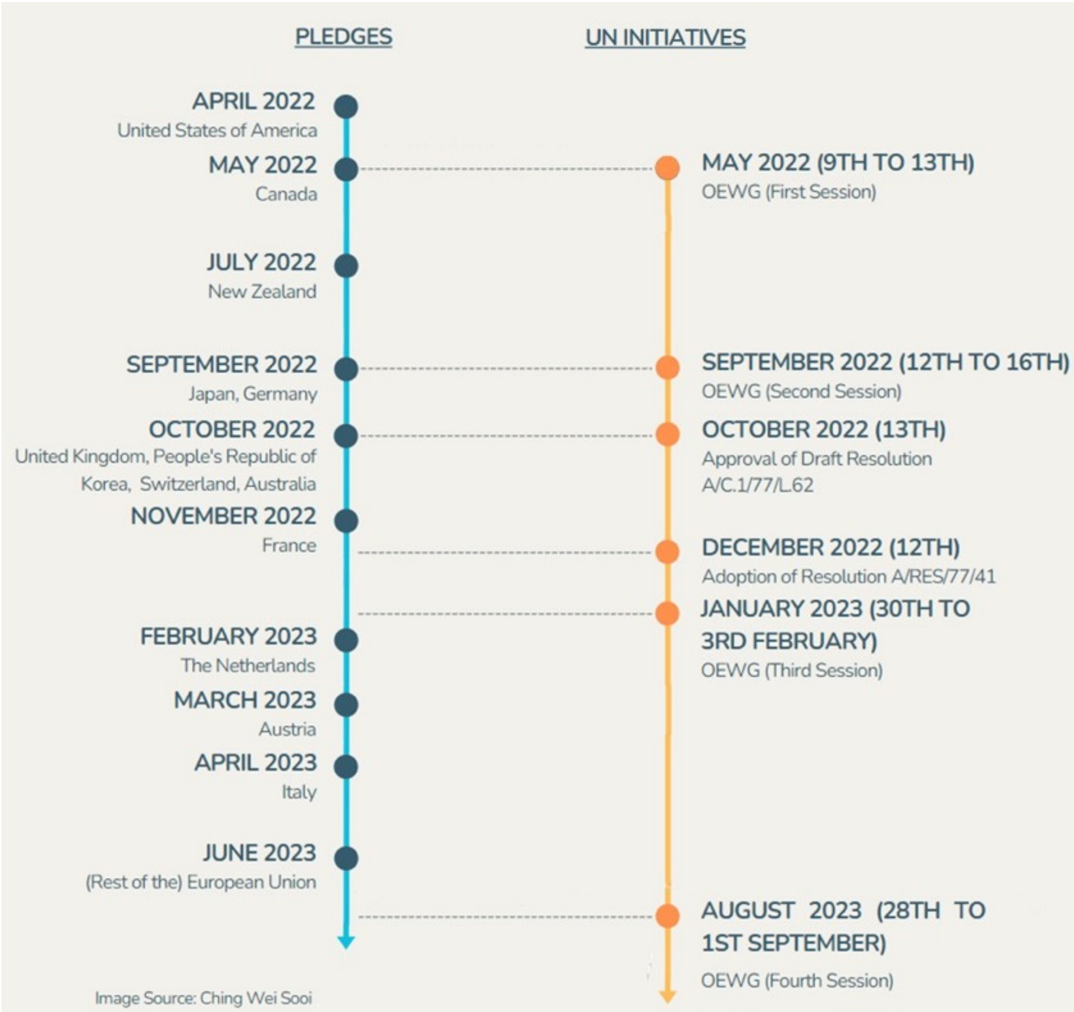

Figure 1: Timeline of Commitments vis-à-vis UN Processes

Accordingly, this report conducted research into state positions on the moratorium and the UNGA resolution on the destructive DA-ASAT testing moratorium. The overall goal is to better understand how states arrived at their positions, what factors influenced the decision, and how these insights might improve our understanding of the current space security landscape and provide lessons for the future. This report investigates why and how the commitment and resolution received such broad support, and concurrently, for what reason have more states not pledged the moratorium despite 155 votes in favour of the resolution.

Figure 2: Voting on the Destructive DA-ASAT Missle Testing Resolution [9]

Methodology

The data collected for this research included official state contributions at the OEWG and UNGA, other official public statements outside of those fora, and a series of interviews with several highlevel representatives from governments as well as independent state experts.

As this research was conducted over an eight-week summer research fellowship, a purposive and snowball sampling strategy was employed with a goal to interview around a half dozen states. Interviews were conducted with: Canada, China, the Philippines, the Russian Federation, and South Africa. Interviews were also conducted with a representative from a state in the Non-Aligned Movement (NAM) and two representatives from Western states, indicated as A Western State (1) and (2), all of whom requested anonymity.

Additionally, Nigeria's representative opted to respond to the questionnaire in writing.

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[9] 'General Assembly: 46th Plenary Meeting, 77th Session | UN Web TV' (7 December 2022) <https://media.un.org/en/asset/k1j/k1jwh0t953> ('General Assembly').

Unfortunately, representatives from states that abstained at the UNGA were not available to be interviewed in the time allotted for this research. In total, the interviews represent a diverse sample of states both geographically and in how they voted for the resolution.

The interviews were structured with five core questions and six additional questions. Due to time constraints on the part of the interviewees, some elected only to answer the five core questions, while others answered all eleven. The list of questions can be found in Table 1.

Table 1: List of Questions

Core Questions

1. Could you describe the process of coming to your country's stance on the DA-ASAT resolution (A/RES/77/41)?
2. What developments have shaped your country's stance on this?
3. How much of a priority is this issue for your country?
4. Why do you think your country voted the way it did?
5. Do you recall specific issues that were especially contentious?

Optional Questions

6. What do you make of the pledges to not commit destructive DA-ASATs by the United States and 13* other countries?
7. What do you think follows after the UNGA resolution and ongoing pledges?
8. How would you feel about a legally binding resolution regarding DA-ASATs?
9. What is your assessment of the strategic value of DA-ASATs?
10. What concerns you about space security more broadly
11. What is your assessment of the international space governance framework?

**At the time of conducting the interviews, EU Member States had not yet publicized their pledge of the moratorium.*

Following the data collection, a thematic analysis was conducted using a coding process. Codes were developed, grouped together, and their resulting themes provided the basis for answering this report's research questions.

The following section provides a summary of the findings, including tables of specific state positions as derived from the statements and interviews as well as the overall themes that were developed from the data. Interviews were also conducted with a representative from a state in the Non-Aligned Movement (NAM) and two representatives from Western states, indicated as A Western State (1) and (2), all of whom requested anonymity.

Findings

ON DA-ASAT WEAPONS

Numerous states explicitly consider destructive DA-ASAT tests to be among the most significant threats and top priorities in space. For example:

Table 2: National Positions Expressing Major Concern Over DA-ASAT Tests

STATE	NATIONAL POSITION

A Western State (1)	***Interviewee:*** The issue of destructive DA-ASAT tests is "a high priority." Their state has always been critical of these tests when they have occurred, concerned by the debris generated by and the destabilizing effects of destructive DA-ASAT tests. A major concern is the risk of misunderstanding and miscalculation escalating into conflict. To wit, because space systems are strategic assets and counterspace weapons have wide ranging effects, any interference by one state in another's space operations could provoke unpredictable responses, potentially escalating into conflict. They note that a test today would be worse than one 10 years ago due to the significant rise in satellite numbers. This congested environment exacerbates the destabilizing effects of any destructive DA-ASAT test. Measures to reduce destructive DA-ASAT testing benefit space sustainability along with a narrower security objective of reducing the risk of conflict in space.
Brazil	"One of the most pressing initiatives on [PAROS] is the ban on all destructive [ASAT] tests. The testing, development and use of destructive [ASAT] weapons stand as the most serious threat to the security and sustainability of outer space."[10]
Canada	In interviewing the ***Canadian representative***, they reiterated Canada's long-standing position on ASAT weapons which stretches back almost 40 years. "The destruction of objects and creation of debris is something Canada is vehemently against." This topic is a priority for Canada from a number of perspectives, especially from the civil side of long-term sustainability, access, and reliance on space.
Egypt	The ***Egyptian representative***, while unavailable to be interviewed, described this topic as "one of the most pressing issues pertinent to international peace and security."
Republic of Korea	The Republic of Korea representative, while unavailable to be interviewed, stated that their state is "paying great attention to this issue." Separately, in a presentation by an official from the Republic of Korea's Disarmament & Non-Proliferation Division on 'Why a moratorium on ASAT testing is important', it was said that "ultimately, we reached a whole of government common understanding that destructive DA-ASAT missile testing is one of the most evident and urgent threats to our space assets and activities."[11]

STATE	NATIONAL POSITION
United States of America	Described destructive DA-ASAT tests as: "the most pressing threat to all countries using outer space"[12] in their introduction to the OEWG of their unilateral moratorium; "one of the most pressing issues" and "greatest near-term threat" to space security in their

[10] Brazil, 'First Committee - Thematic Debate 3 Outer Space (Disarmament Aspects) Statement by the Delegation of Brazil' (2022) <https://unoda-documents-library.s3.amazonaws.com/General_Assembly_First_Committee_-_SeventySeventh_session_(2022)/Brazil-C3-26-Oct.pdf>.

[11] SPOTLIGHT Talk: Hyerin Kim - Why a Moratorium on Anti-Satellite Testing Is Important (Directed by Secure World Foundation, 16 June 2023) <https://www.youtube.com/watch?v=hoDffXa6zXU> ('SPOTLIGHT Talk').

[12] Ploughshares, The Open-Ended Working Group on Space Threats, Recap of the First Meeting (May 2022).

	statement to the first committee of the UNGA;[13] and as a "clear and pressing threat to space security and sustainability"[14] in a White House press statement.

Table 3: National Positions Expressing Lesser Concern Over DA-ASAT Tests

STATE	NATIONAL POSITION
People's Republic of China	In interviewing the ***China expert***, they mentioned that DA-ASAT tests are just one of China's concerns for arms control and in the space domain.
Russian Federation	In interviewing the ***Russia expert***, they stated that while DA-ASAT tests are probably not the top priority for Russia, space security is a major military security concern, wherein DA-ASAT capabilities feature as a prominent part of the issue. Also, DA-ASAT weapons "are very much interconnected with missile defense technologies both in terms of interceptors and sensors – and through that, it is a part of one of the major military security concerns of Russia that has been in place for decades, the issue of missile defense."

On the Destructive DA-ASAT Testing Moratorium

An open question is why 155 states have voted for A/RES/77/41, yet only 37 have pledged the moratorium. Views on this matter are provided in this section.

Table 4: National Positions on the DA-ASAT Testing Moratorium

STATE	NATIONAL POSITION	NOTES AND ADDITIONAL CONTEXT
A Western State (1)	***Interviewee:*** When the United States made their unilateral pledge, the ***interviewee***'s state welcomed the move. This led to their state making a similar commitment shortly after.	***Contd.:*** Internal consultations highlighted compelling reasons to back the moratorium (e.g., concerns over space debris and the destabilizing effects of destructive DA-ASAT tests). The moratorium and resolution are examples of responsible behaviour. Because these commitments are verifiable, they have the advantages of being both implementable and beneficial.
Brazil	"The commitment to end these tests would be a first but significant step towards an improved environment for	Interestingly, has not made the pledge themselves at the time of writing.

[13] UN Web TV, 'First Committee, 27th Plenary Meeting - General Assembly, 77th Session' (1 November 2022) <https://media.un.org/en/asset/k10/k10d5896y9>.

[14] The White House, 'Vice President Harris Advances National Security Norms in Space', The White House (19 April 2022) <https://www.whitehouse.gov/briefing-room/statements-releases/2022/04/18/fact-sheet-vice-president-harrisadvances-national-security-norms-in-space/> ('FACT SHEET').

STATE	NATIONAL POSITION	NOTES AND ADDITIONAL CONTEXT
	the negotiations on outer space security, notably on PAROS."[15] Encouraged other states to make the pledge.[16]	
Canada	Stated that "this is a first step, but it represents the most significant progress we have achieved to date. It is from humble measures that momentum for greater ones are built."[17]	The Canadian representative describes the pledges as a good move. "One of the things Canada has wanted to do along with key allies is to come to a consensus on developing this body of norms of responsible behaviour in space." The unilateral pledges are the development of one such norm which could eventually lead to a legally binding instrument (LBI). The pledges will help dictate behaviour in space and, more importantly, enable the calling out of bad behaviour. It should be observed whether, over the next few years, there is momentum which could coalesce around a potential treaty – and if not, hopefully more states will continue to make the pledges nonetheless.
People's Republic of China	Welcomed any arms control initiative that contributed to PAROS but also expressed concern about the narrow scope of the declaration and suggested that it was a means of seeking advantage under the guise of arms control.[18] *Also see joint statement below.	The China expert questions whether states have a strong will to work on a LBI despite having made their pledges. Even if a LBI was agreed on, they expressed concern that "for a state whose survival is at stake, they will seriously consider the strategic option of using destructive DA-ASAT weapons even if they have signed up to any treaty, resolution, or pledge."

[15] Brazil (n 10).
[16] Ploughshares, 'The Open-Ended Working Group on Space Threats, Recap of the First Meeting' (n 12).
[17] Canada, 'Canadian Statement, Open-Ended Working Group on Reducing Space Threats First Session' (2022) <https://documents.unoda.org/wp-content/uploads/2022/05/Canada-General-Statement-for-Translators-OEWG-Space-ThreatsSession-bilingual.pdf>.
[18] Ploughshares, 'The Open-Ended Working Group on Space Threats, Recap of the First Meeting' (n 12).

Russian Federation	"Noted that the declaration was a positive response to practical initiatives on PAROS."[19] Views the decision of United States of America to undertake a political commitment to not carry out disruptive DA-ASAT missile testing, and the initiative to submit a resolution on that front as a purely declarative step (i.e., of no, or negative, value).[20] Described the moratorium as "a political ploy to deny states without such capability a 'shield' for their space assets."[21] *Also see joint statement below.	Described the pledge as too narrow, leaving open both the development of kinetic ASAT systems and non-destructive testing[22] and without a definition of ASAT test.[23] ***Interviewee:*** "[The pledges are] noted. There is always a concern that this is some kind of cunning plan to deprave Russia of capabilities while retaining their capability. Another important question whether there will be readiness to draw a line between what is DA-ASAT or missile defense test."
***Joint Statement:** Belarus Democratic People's Republic of Korea Nicaragua People's Republic of China Russian Federation Venezuela Syrian Arab Republic	"Consider the suggestion to undertake political commitment not to conduct destructive [DA-ASAT] tests to be a step in the right direction" but "insufficient" to guarantee the peaceful use of outer space and PAROS.[24]	N/A

19 Ibid.
20 UN Web TV (n 13).
21 Ploughshares, The Open-Ended Working Group on Space Threats, Recap of the Third Session (June 2023).
22 Ploughshares, 'The Open-Ended Working Group on Space Threats, Recap of the First Meeting' (n 12).
23 Ploughshares, The Open-Ended Working Group on Space Threats: Recap of the Second Meeting (September 2022).
24 Russian Federation, 'Joint Statement on the Initiative on Undertaking Political Commitment Not to Conduct Destructive Direct-Ascent Anti-Satellite Missile Tests' (26 October 2022) <https://unoda-documents-library. s3.amazonaws.com/General_Assembly_First_Committee_-_Seventy-Seventh_session_(2022)/Statement_by_Russian_ Federation.pdf>.

STATE	NATIONAL POSITION	NOTES AND ADDITIONAL CONTEXT

South Africa	***Interviewee*** stated that there is currently no South African stance on the destructive DA-ASAT testing moratorium. Pledging as such would be a high-level decision involving all relevant stakeholders and technical expertise. On the other hand, the resolution with only three operational paragraphs was easier to support, especially as it involved negotiations at a political level*	*Speaking in the ***interviewee***'s personal capacity, in answering why more states have not made the pledge, they stated that such a pledge would have to involve significant technical expertise and substantive discussions. They stressed the point that whereas developed states have teams of technical and legal experts to advice and aid in the decision-making process, developing states from the African region and elsewhere find it difficult to pledge the moratorium because of insufficient technical and legal expertise. For instance, to what exact extent will destructive DA-ASAT testing affect a state's space programme? What threats could emerge, and how do they affect this decision-making calculus? Diplomats must package, qualify, and justify such information when convincing Capital to do something (e.g., making the pledge). The lack of a thorough understanding makes it extremely difficult to make such a significant high-level commitment. "It is a very, very important factor." Additional emphasis was placed on the disparities in developmental milestones and technological progress between developed and developing states. There is a sense that developed states, having reached certain developmental milestones, are now telling developing states to not reach the same milestones (e.g., DA-ASAT capabilities). But "we are also developing, so we should not need be blocked from getting to a [similar] level." They call for developed states to "help us to get there as well" so that developing

		states can better understand the perspectives and concerns of developed states.
Sri Lanka	"Welcomes the recent commitment by several states not to conduct [DA-ASAT] missile testing which we believe is a positive initial step in the right direction."[25]	Note that Sri Lanka has not made the commitment.

25 Sri Lanka, 'Statement by Mr. Sugeeshwara Gunaratna Deputy Permanent Representative of Sri Lanka' (2022) <https://unoda-documents-library.s3.amazonaws.com/General_Assembly_First_Committee_-_Seventy-Seventh_session_(2022)/ Sri-Lanka-C3-26-Oct.pdf>.

STATE	NATIONAL POSITION	NOTES AND ADDITIONAL CONTEXT
Switzerland	"We welcome the announcements made by a number of States not to conduct destructive, direct-ascent ASAT missile tests in space… We hope that such commitments will contribute to the adoption of further measures to prevent an arms race in outer space and appropriate binding international norms."[26]	Notably, specifically called on states that have conducted destructive DA-ASAT tests to commit to the moratorium.[27]
The Philippines	***Interviewee:*** "The Philippines is considering suggestions to declare a moratorium on DA-ASAT. The Philippines does not have capabilities to conduct DA-ASAT."	***Contd.:*** "Those that have the capabilities should be the ones to declare such a moratorium. While building norms against DA-ASAT is important, they should not be politicized."
United States of America	"Commits not to conduct destructive, direct-ascent anti-satellite (ASAT) missile testing, and that the United States seeks to establish this as a new international norm for responsible behaviour in space."[28]	Multiple statements that the moratorium is just a first step "that could provide the basis for future arms control agreements [and] new norms of responsible behaviour, and not the only outcome desired or needed the OEWG."[29] Audrey Schaffer, Director for Space Policy at the National Security Council, highlights the distinction that the resolution doesn't commit states to the norm. Instead, it encourages states to make national commitments to the norm by pledging a moratorium. "It's not enough for 155 countries… to vote in support of the idea. To truly establish an internationally recognised norm banning destructive DA-ASAT tests, we need a critical mass of nations to actually make the commitment. We have to continue the drumbeat of nations making commitments to the emerging international norm."[30]

The European Union	"Concerned that the use of destructive ASAT systems might have widespread and irreversible impacts on the outer space environment, the Member States of the EU consider such commitment as an urgent and initial measure aimed at preventing damage to the outer space environment, while also contributing to the development of further measures for PAROS."[31]	"The EU welcomes this joint commitment," said an EU spokesperson, noting that it did not apply to the European Union itself: "However, this not a commitment by the EU as this potential behaviour would fall outside of the competences of the EU."[32]

26 Switzerland, 'Thematic Debate on Outer Space' (2022) <https://reachingcriticalwill.org/images/documents/Disarmament-fora/1com/1com22/statements/26Oct_Switzerland.pdf>.

27 Ploughshares, 'The Open-Ended Working Group on Space Threats: Recap of the Second Meeting' (n 23)."plainCitation":"Ploughshares, 'The Open-Ended Working Group on Space Threats: Recap of the Second Meeting' (n 23

28 The White House, 'FACT SHEET: Vice President Harris Advances National Security Norms in Space', The White House (19 April 2022) <https://www.whitehouse.gov/briefing-room/statements-releases/2022/04/18/fact-sheet-vicepresident-harris-advances-national-security-norms-in-space/>.

29 Ploughshares, 'The Open-Ended Working Group on Space Threats, Recap of the First Meeting' (n 12).

30 SPOTLIGHT Talk: Audrey Schaffer - Why a Moratorium on Anti Satellite Testing Is Important (Directed by Secure World Foundation, 16 June 2023) <https://www.youtube.com/watch?v=Te1CN8343rw>.

31 European Union, 'EU Joint Contribution on the Works of the Open-Ended Working Group on Reducing Space Threats through Norms, Rules and Principles of Responsible Behaviours. Fourth Part: Recommendations on Possible Norms, Rules and Principles of Responsible Behaviour Relating to Threats by States to Space Systems' (June 2023) <https:// docs-library.unoda.org/Open-Ended_Working_Group_on_Reducing_Space_Threats_-_(2022)/EU_joint_contribution_to_ OEWG_works_on_norms_of_responsible_behaviours.pdf>.

32 Jeff Foust, 'European Union Nations Join ASAT Testing Ban', SpaceNews (24 August 2023) <https://spacenews.com/european-union-nations-join-asat-testing-ban/>.

Reasons States Voted For the Resolution

REASONS GIVEN CAN BE GROUPED AS FOLLOWS:

Supportive of Norms as a Governing Mechanism and/or Building Block towards Legally binding Initiative(s)

- Resolution is effective despite being non-legally binding and could possibly mark progress towards a legally binding measure

Supportive of a 'Capability Neutral Approach'

- Resolution does not target technology, only the use thereof, thus allowing for the advancement of technical capability

Supports the Promotion of Transparency and Confidence Building Mechanisms

- Resolution meets the criteria as contained in the report of the Group of Governmental Experts on Transparency and Confidence-Building Measures in Outer Space Activities (A/68/189)

Addresses the Concerns of Developing States

- Resolution addresses and/or acknowledges concerns such as debris, access to space, equitable access, and due regard

Diplomacy from the United States

- Responses to efforts by the United States to garner support for the resolution

Supportive Despite Narrowness of the Resolution

- Recognises that the resolution focuses only on the testing of destructive, direct-ascent anti-satellite missiles; believes that it is still beneficial and could serve a stepping stone towards more comprehensive measures

Geopolitical Influences

- States voting 'yes' with like-minded states and allies; states voting in favour in spite of the resolution's heavily politicized nature

Concerned by Previous Destructive Direct-Ascent Anti-Satellite Missile Testing

- Resolution and votes in favour were prompted by alarm over previous destructive directascent anti-satellite missile tests

Resolution Positively Affects/Does Not Negatively Impact National Security

- Resolution benefits national security – or, at the very least, does not detract from it

Table 5: Reasons States Voted For the Resolution

STATE	NATIONAL POSITION	NOTES AND ADDITIONAL CONTEXT
GROUP 1: SUPPORTIVE OF NORMS AS A GOVERNING MECHANISM AND/OR BUILDING BLOCK TOWARDS LBI(S)		
A Western State (1)	***Interviewee:*** Notes that for their state, there is little practical difference between a LBI and a politically binding commitment; having made a pledge against destructive DA-ASAT testing, the commitment will be taken seriously and will be implemented.	N/A
Brazil	Supported both the No First Placement and the destructive DA-ASAT testing resolutions. "Noting that	Cites "erosion of mutual trust among major space powers" as a key ingredient to the failure of negotiating an LBI – and as a reason to support the a 'bottom-up' approach, believing that it will foster

	both efforts are insufficient, it argued that partial commitments can lead to more comprehensive measures."[19] Because efforts to achieve an LBI has "fallen well short… Brazil has decided to support a 'bottom-up' approach: the gradual development of voluntary norms, rules, and principles to strengthen the basis for a deeper conversation on normative elements" to "gradually pave the way for a future LBI."[34]	"much-needed mutual trust… to pave the way for a future [LBI]."[20] "Existing divisions in perception among members do recommend that we take a less direct approach… Without trust and compromise [such as transparency and displays of actual responsible behaviour] the PAROS agenda will hardly progress."[21]
Canada	***Interviewee:*** "One of the things Canada has wanted to do along with key allies is to come to a consensus on developing this body of norms of responsible behaviour in space." With regards to existing space treaties, lots of behaviour are not illegal, but not necessarily responsible. Canada wants to ensure that there are norms of behaviour which can govern what states can and can't do, reducing the risk of misperceptions and miscalculations."	***Contd.:*** "Getting [any] LBI in this day and age is very difficult. It would be a very long process." Usually, the development of treaties stems from consensus over norms. Therefore, the development of norms could eventually lead to an LBI. The unilateral pledges are the development of one such norm which could eventually lead to an LBI. The pledges will help dictate behaviour in space and, more importantly, enable the calling out of bad behaviour. It should be observed whether, over the next few years, there is momentum which could coalesce around a potential treaty – and if not, hopefully more states will continue to make the pledges nonetheless. The resolution could possibly form a part of a broader treaty in the future.
Egypt	Supports the resolution as a complement to existing initiatives with aims to elaborate on rules that could pave the way to LBIs.	"This initiative should be a first step towards elaborating legally binding rules that will that would not be limited to the direct ascent missiles but PAROS in all its aspects… [and] pave the way to the urgent

[19] Ploughshares, 'The Open-Ended Working Group on Space Threats, Recap of the Third Session' (n 21). 34 Brazil (n 10).

[20] Ibid.

[21] Ibid.

		commencement without further delay of [such] negotiations."[22]
STATE	NATIONAL POSITION	NOTES AND ADDITIONAL CONTEXT
France	Describes the resolution as: a first step towards a standard that must become universal; and proof that progress can be made to make space safe and conflict-free.[38]	Notes that the draft treaty on Prevention of the Placement of Weapons and Threat or Use of Force (PPWT) and related initiatives do not address all threats such as ground-to-space (e.g., destructive DA-ASAT testing).[39]
Germany	Called for a universal norm against destructive ASAT tests.[40]	N/A
Indonesia	Recognizes the value of various voluntary and practical measures such as this resolution.[41]	The resolution is a "stepping stone that could lead or contribute to the development of a LBI on PAROS." [42]
Israel	Holds a long-standing position that in outer space, continuous adaptations and a gradual approach must be taken. As such, it prefers norms and soft law over LBIs.[43]	Notably, Israel "dissociates itself from [Paragraph 3] and any reference to a LBI in this context."[44] Paragraph 3 of the resolution 'Calls upon all States to… establish and develop further practical steps that could… contribute to LBIs on PAROS.'
Japan	"The Government of Japan decided not to conduct destructive, direct-ascent anti-satellite (ASAT) missile testing in order to actively promote discussions in the international fora concerning the development of norms of responsible behaviour in outer space."[45]	"This decision is a result of the Government of Japan's considerations after the United States Government's announcement not to conduct destructive, directascent anti-satellite (ASAT) missile testing in April. "The Government of Japan will continue to play an active role to achieve secure, stable and sustainable outer space including the development of norms of responsible behaviour in outer space."[46]

[22] UN Web TV (n 13).

Mexico	Voted "in accordance with the search for general disarmament under international control" and supports "any measure aimed at preventing outer space from being militarized and used as a theatre for armed conflict."[47] In favour of creating new frameworks complementary to existing ones.[48]	Reiterates that the resolution is not a substitute to an LBI. [49]
New Zealand	"It seems to us that voluntary as well as LBIs can play a part in preventing an arms race in outer space. And we need to further discuss both types of approach."[50]	N/A

38 France, 'Intervention de Mme Camille PETIT Ambassadrice, Représentante Permanente de La France Auprès de La Conférence Du Désarmement' (2022) <https://unoda-documents-library.s3.amazonaws.com/General_Assembly_First_ Committee_-_Seventy-Seventh_session_(2022)/Statement_by_France.pdf>.

39 Ibid.

40 Ploughshares, 'The Open-Ended Working Group on Space Threats, Recap of the First Meeting' (n 12).

41 UN Web TV, 'First Committee, 28th Plenary Meeting - General Assembly, 77th Session | UN Web TV' (1 November 2022) <https://media.un.org/en/asset/k1s/k1sgl6jv3z>.

42 Ibid.

43 Ibid.44 Ibid.

45 'Decision Not to Conduct Destructive, Direct-Ascent Anti-Satellite Missile Testing' <https://www.mofa.go.jp/press/release/press3e_000451.html>.

46 Ibid.

47 UN Web TV (n 41).

48 Ibid.

49 Ibid.

50 Ibid.

STATE	NATIONAL POSITION	NOTES AND ADDITIONAL CONTEXT
Nigeria	***Interviewee:*** "A commitment by states not to conduct destructive direct-ascent ASAT testing; it is in this connection that Nigeria voted in favour of the resolution on ASAT testing. Though not binding, the resolution could pave the way for the promotion of more binding measures in the future. This is something Nigeria would be willing to fully support." Nigeria has and will continue to advocate for the establishment of more binding measures to regulate space-related activities. Advances space security through "norms, rules, and principles of responsible	N/A

	behaviours, predicated on the principle of equity and equality.”	
Republic of Korea	“We also looked at the voluntary nature of the commitment [against destructive DA-ASAT testing] and how this will affect the shaping of global norms” and “how this will affect our and our adversaries’ capabilities and behaviours,” facilitated by “Korea’s position towards a safe secure and sustainable space environment and our aspiration to develop norms of responsible behaviour in outer space.”[51]	The relevant Ministries formed “a common understanding of the dire necessity of developing space norms. South Korea believed that it is in our national interest to develop norms on destructive DAASAT missile testing to clarify that such behaviour will not be deemed acceptable within the international community.”[52]
South Africa	The ***interviewee*** stated that South Africa was very supportive of the resolution as it could be a valuable stepping stone. South Africa generally prefers LBIs, but it is not a hard rule. South Africa supports both LBIs and nonlegally binding measures that would ultimately lead to PAROS.	***Contd.:*** Destructive DA-ASAT tests are an important issue that is a part of the wider PAROS agenda. And in the context of the stalemate surrounding PAROS, working on DA-ASAT tests could spur wider progress. PAROS is South Africa’s top priority. Additionally, they noted that one contentious point during discussions was the divide between states ready to negotiate an LBI versus those that prefer alternatives such as a step-by-step process, a code of conduct, or a declaration; measures with less legally binding implications. Further, even for pro-LBI states, there was a divide between those in favour of a narrow LBI (e.g., only on ASAT weapons) versus a whole-encompassing LBI, According to the ***South African representative’s*** personal

		opinion, because of the stalemate around PAROS, the United States opted to tackle the problem of the problem of destructive DA-ASAT testing which is "a smaller part of the whole," and to run with it, to see how it would evolve.

51 SPOTLIGHT Talk: Hyerin Kim - Why a Moratorium on Anti-Satellite Testing Is Important (n 11).52 Ibid.

STATE	NATIONAL POSITION	NOTES AND ADDITIONAL CONTEXT
The Philippines	Emphasized that norms are one way to ensure the secure functioning of space programs which are essential for sustainable development.[53] ***Interviewee:*** "The Philippines believes that the absence of agreed norms heightens the risks and threats to outer space security."	***Contd.:*** "The debate on the commencement of negotiations for legally binding instruments on the prevention of outer space (PAROS) must not hinder progress on practical consensus measures that will enhance outer space security. "It is in this context that President Ferdinand R. Marcos, Jr. has called on this General Assembly last month to define the norms of responsible behavior in outer space."
United Kingdom	"We acknowledge that many States are in favour of a legally binding instrument to prevent an arms race in outer space. We also recognise that an increasing number of States see value in first establishing norms, rules and principles of responsible behaviours which complement existing international law, and, whilst they might be non-legally binding, can act as practical	"Such an approach allows us to build trust and confidence in the ability and willingness of States to comply with these norms, rules and principles before considering whether they could be enshrined in new legally binding instruments."[55]

	and pragmatic steps towards legally binding measures in the future."[54]	
United States of America	"In order to encourage restraint and develop a norm against such tests, the United States will submit a resolution calling upon all countries to commit not to conduct destructive direct-ascent anti-satellite missile tests."[56]	"We recognize that many nations have no intentions of developing testing or deploying DA-ASAT capabilities, but regardless of whether or not a particular state has this kind of capability or the intention to develop one, it's nonetheless valuable for as many states as possible to publicly commit to this norm of responsible behaviour because that is how we establish international norms. It's not enough for just one state or two countries or even 13 countries to make a commitment and then say okay we're done we have an international norm."[57]
Vietnam	This resolution "achieves the general goal of PAROS [and] should be complemented by other various measures that address the issue in a comprehensive manner."[58]	N/A
Association of Southeast Asian States	Reiterates "the urgent need for the commencement of substantive negotiations in the Conference on Disarmament on a [LBI on PAROS].[59]	Note that 9 out of 10 ASEAN states voted in favour of the resolution; Laos abstained.

53 Ploughshares, 'The Open-Ended Working Group on Space Threats: Recap of the Second Meeting' (n 23).

54 United Kingdom, 'Thematic Debate on Outer Space (Disarmament Aspects) Statement by the United Kingdom' (2022) <https://unoda-documents-library.s3.amazonaws.com/General_Assembly_First_Committee_-_Seventy-Seventh_ session_(2022)/United-Kingdom-C3-26-Oct.pdf>.

55 Ibid.

56 The White House (n 28).

57 SPOTLIGHT Talk: Audrey Schaffer - Why a Moratorium on Anti Satellite Testing Is Important (n 30).

58 UN Web TV (n 41).

59 Malaysia, 'Statement by H.E. Mr. Syed Mohd Hasrin Aidid, Permanent Representative of Malaysia to the UN, on Behalf of the Association of Southeast Asian Nations' (2022) <https://unoda-documents-library.s3.amazonaws.com/General_ Assembly_First_Committee_-_Seventy-Seventh_session_(2022)/Statement_by_Malaysia.pdf>.

STATE	NATIONAL POSITION	NOTES AND ADDITIONAL CONTEXT

The European Union	Czechia, on behalf of member states of the EU "The following states also align themselves with this statement, North Macedonia, Montenegro, Albania, Ukraine, the Republic of Moldova, Iceland, Norway, as well as Canada. "The EU and its member states welcome and support the new US resolution on destructive DA-ASAT missile testing... Without exploring the possibility of new legally binding instruments in the future, the EU and its member states believe that an approach based on behaviours is the most pragmatic and immediate way forward to improve space security today."[60]	"The EU and its Member States are committed to reduce space threats and preserve the peaceful use of outer space using a step by step approach towards possible legally binding instruments in the future. "They believe that, given the dual-use nature of many space systems, an approach based on responsible behaviours, supported by relevant monitoring capabilities, is the most pragmatic and immediate way forward to improve space security today."[61]
The Non-Aligned Movement	Underscores that "while voluntary TCBMs may partially contribute to reducing mistrust and enhancing the safety of outer space operations in the short-term" they "cannot represent a substitute for... an [LBI]."[62]	"In describing the position of the Non-Aligned Movement, to which it belongs, Venezuela labelled the OEWG approach as complementary to, but not replacing, law."[63]
GROUP 2: SUPPORTIVE OF A 'CAPABILITY NEUTRAL APPROACH'		
Australia **Canada** **Israel*** **Japan** **The Philippines** **United States of America**	Capability neutral can be understood as measures to mitigate threats that do not focus on technology, but on the uses of technology. The argument goes that due to the constant technological developments and changes in space activities in the new space era, the development of technology should not be constrained.	"States [that] support the pursuit of norms of responsible behaviour in outer space [insist] that a focus on norms rather than an agreement that would restrict access to, or the development of, technology is preferable precisely because it does not constrain the development of technical capabilities."[64] *"Israel's long standing position holds that due to the constant technological developments in outer space, and the changes in space activities in the new space era, continual adaptations are required and the gradual approach, preferring norms and soft law over the

		legally binding instruments, must be taken."[65]

60 UN Web TV (n 13).

61 European Union (n 31).

62 Indonesia, 'Draft Statement by the Republic of Indonesia on Behalf of the Non-Aligned Movement' (2022) <https://unoda-documents-library.s3.amazonaws.com/General_Assembly_First_Committee_-_Seventy-Seventh_session_(2022)/ Statement_by_Indonesia.pdf>.

63 Ploughshares, 'The Open-Ended Working Group on Space Threats: Recap of the Second Meeting' (n 23).

64 Ibid.

65 UN Web TV (n 41).

STATE	NATIONAL POSITION	NOTES AND ADDITIONAL CONTEXT
GROUP 3: SUPPORTS THE PROMOTION OF TRANSPARENCY AND CONFIDENCE BUILDING MECHANISMS		
France* **Israel** **United States of America**	Some states stated beliefs that the argues that the voluntary valid as a commitment meets the requirements for a Mechanism (TCBM).[66] Transparency and They argue that TCBMs can reduce risks and the UNGA as misunderstanding and because it is clear and precise, enhancing stability in space.can easily be	resolution is a The United States Transparency and Confidence Building Confidence Building Mechanism such (TCBM) in fora such as the OEWG[67] misinterpretations, First Committee[68] confirmed by others, and eliminates a source of mistrust or misunderstanding.[69] *Convinced that the most concrete and immediately pragmatic and applicable method to strengthen trust is to distinguish responsible behaviour from that which threatens or undermines space safety and security."[70]
GROUP 4: ADDRESSES THE CONCERNS OF DEVELOPING STATES		
Brazil	Argued that the risk of harm from debris was greater for developing states with more modest space activities and assets	The Philippines echoes the concern over increased vulnerability to space debris.

	and less capabilities to monitor the space environment or manoeuvre their assets.[71]	
Nigeria	***Interviewee:*** "The abolishment of ASAT testing would certainly promote the reduction of space debris capable of causing harm to space assets of other countries such as Nigeria." Stated that because it takes a huge number of resources to have a functioning satellite in orbit, it is important that there should be a reduction of space debris that could pose a threat to such space assets. "The fact that such damages… could also disrupt the public-oriented services they support in the country is equally a major problem for Nigeria." Majorly concerned by the issue of a possible arms race in outer space.	***Contd.:*** "As a developing country whose space-related activities is largely predicated on the use of space systems for strictly peaceful uses such as: economic development, commercial services as well as defence systems; it is important to highlight that, investments into space assets to serve the aforementioned purposes must be safeguarded."

66 Ibid.

67 Ploughshares, 'The Open-Ended Working Group on Space Threats: Recap of the Second Meeting' (n 23).

68 UN Web TV (n 13).

69 United States of America, 'Aide-Memoire on Proposed UN General Assembly Resolution on Destructive Direct-Ascent Anti-Satellite Missile Testing' (2022) <https://documents.unoda.org/wp-content/uploads/2022/09/A_AC294_2022_ WP21_USA-ae.pdf>.

70 France (n 38).

71 Ploughshares, 'The Open-Ended Working Group on Space Threats, Recap of the Third Session' (n 21).

The Philippines	Argued that the risk of harm from debris was greater for developing states with more modest space activities and assets and less capabilities to monitor the space environment or manoeuvre their assets.[72] ***Interviewee:*** "The Philippines is particularly concerned about any deliberate debris-creating behaviors, including kinetic direct-ascent antisatellite tests and uncoordinated launches and uncoordinated and uncontrolled re-entry. It is in this context that the Philippines supported the DAASAT resolution as one of the many measures the international community can take on space debris."	Brazil echoes the concern over increased vulnerability to space debris. Vietnam echoes the argument for equitable access to space. ***Contd.:*** "Like many developing countries, the Philippines is becoming increasingly reliant on spacebased infrastructure. The Philippines has a modest space program that we intend to expand. Access to outer space as an inalienable right of developing countries. The Philippines has a direct interest in outer space security, a topic that should never be an exclusive preserve of a few major spacefaring states. "The Philippines views outer space not only as a global common, but as a common heritage of humankind. All nations have the right to the peaceful uses of outer space, but this right must be exercised with due regard to the rights and interests of others, and to the preservation of outer space for future generations. Spacefaring nations are mere stewards for future generations."
Vietnam	The resolution supports a consistent policy to "support and promote the right of all states to explore and use outer space for peaceful purposes in accordance with international law."[73]	The Philippines echoes the argument for equitable access to space.
Association of Southeast Asian States	Reiterates importance of access to, non-appropriation of, capacity-building for, and ensuring that humanity collectively benefit from space.[74]	Note that Laos was the only ASEAN state that did not vote in favour of the resolution, having abstained instead.
GROUP 5: DIPLOMACY FROM THE UNITED STATES		
Canada	***Interviewee:*** "The United States did a lot of work in shoring up support for it."	N/A

South Africa	***Interviewee:*** "There was a process of building up to the resolution which involved informal sessions where the United States would explain the impact and effects of debris. Other informal meetings were organised by the United States (along with the Secure World Foundation) to share relevant research on destructive DA-ASAT missile testing."	***Contd.:*** "Through these processes, the United States sought to get other countries to pledge the moratorium. South Africa's Capital was briefed on these informals and was convinced of the issue of space debris. "These processes were a key driver behind South Africa's support for the resolution. South Africa was also motivated to support the resolution because of the existing stalemate surrounding the PAROS agenda."

72 Ibid.
73 UN Web TV (n 41).74 Malaysia (n 59).

STATE	NATIONAL POSITION	NOTES AND ADDITIONAL CONTEXT
GROUP 6: SUPPORTIVE DESPITE THE NARROWNESS OF THE RESOLUTION		
Austria **Brazil*** **Germany†** **Japan** **New Zealand** **The Philippines** **The United Kingdom**	Advocated for an extension to no destructive tests of any counterspace capabilities, and no engagement in destructive activities (e.g., deliberate collisions or using non-kinetic capabilities such as lasers) that cause debris.[75]	*Argued for a ban on all destructive ASAT tests.[76] †Germany also suggested banning not just the use of kinetic co-orbital counterspace capabilities but the threat of their use.[77]
Japan **The United States of America***	"Proposed to limit all destructive or otherwise intentional actions that cause debris."[78]	*Recognizes that the resolution is "limited to one threat… and that the commitment is not contained in a proposed legally binding treaty text."[79]
Mexico	"Concerned that there is no explicit prohibition in the text."[80]	N/A

Switzerland	"Proposed that all use of ASAT capabilities, terrestrial and space-based, that produce debris should be banned."[81]	N/A
Association of Southeast Asian States	"Reaffirms the need for [addressing] the issue of missiles in all its aspects, negotiated multilaterally within the UN."[82]	Note that Laos was the only ASEAN state that did not vote in favour of the resolution, having abstained instead.

75 Ploughshares, 'The Open-Ended Working Group on Space Threats, Recap of the Third Session' (n 21). 76 Ibid.
77 Ibid.
78 Ibid.
79 UN Web TV (n 13).
80 UN Web TV (n 41).
81 Ploughshares, 'The Open-Ended Working Group on Space Threats, Recap of the Third Session' (n 21).82 Malaysia (n 59).

STATE	NATIONAL POSITION	NOTES AND ADDITIONAL CONTEXT
GROUP 7: GEOPOLITICAL INFLUENCES		
Canada	***Interviewee:*** "Canada is keen to maintain strong, friendly relations with its allies, which is always a factor when co-signing resolutions."	***Contd.:*** "[The] geopolitical situation on Earth plays out in space – any tensions on the ground bleed into other domains. Space is no exception to that. [The] Ukraine conflict and broader geopolitical standoff prevents consensus on important issues." Political deadlock plays out in consensus-based multilateral forums, which prevents the achieving of lots of worthwhile objectives that should not be affected by other situations. Currently, this is the ***interviewee***'s biggest concern.
South Africa	***Interviewee:*** "Geopolitics at the moment [means] that it's very difficult to reach consensus in any negotiation. It's not only space, it's nuclear and so many other things within the disarmament fora that has taken a backseat for a number of years." They note that while the problem of reaching consensus has existed for years, current geopolitics exacerbates this issue	***Contd.:*** "Because of these difficulties, South Africa takes a pragmatic approach towards space security. While their priority is an LBI on PAROS, "let's try and look at other shapes that could fit into the square."
GROUP 8: CONCERNED BY PREVIOUS DESTRUCTIVE DA-ASAT TESTS		

A Western State (1)	***Interviewee:*** noted that Russia's 2021 destructive DA-ASAT test had a very significant impact on the operations of other satellites and has reinforced the notion that destructive DA-ASAT tests are a bad idea.	N/A
Republic of Korea	Previous destructive DA-ASAT tests are "a direct threat to space assets and the long-lived space debris created during the testing poses a great risk and threat… this is why we expressed or concern regarding [Russia's] ASAT missile testing in November 2021" and "explains our national position towards destructive [DA-ASAT] testing."[83]	N/A
United States of America	"When we learned on November 15, 2021, that Russia had deliberately carried out destructive DA-ASAT missile tests… I think that moment really spurred us to action. "And so that's why just a few months later… the United States announced it would take a leadership role on this issue, committing to refrain from this kind of testing and encouraging other nations to follow suit."[84]	N/A

83 SPOTLIGHT Talk: Hyerin Kim - Why a Moratorium on Anti-Satellite Testing Is Important (n 11).
84 SPOTLIGHT Talk: Audrey Schaffer - Why a Moratorium on Anti Satellite Testing Is Important (n 30).

STATE	NATIONAL POSITION	NOTES AND ADDITIONAL CONTEXT
GROUP 9: RESOLUTION POSITIVELY AFFECTS/DOES NOT NEGATIVELY IMPACT NATIONAL SECURITY		
A Western State (2)	According to a high-ranking official from an allied US state who requested anonymity, "the United States is quite keen to preserve a certain flexibility to operate in space", and this was taken into account in the construction of the resolution's specific wording of destructive, direct-ascent.	N/A

Canada	***Interviewee:*** When it came to the decision to join the resolution, Canada undertook internal consultations, which were held to ensure that everyone was on the same page, and for due diligence purposes.	N/A
South Africa	***Interviewee:*** Multilateral discussions on space are critical, timely, and relevant because of the rapid pace of technological development. It is important to develop technological expertise and raise awareness of these issues that are important to and threaten the international community.	***Contd.:*** Describes space disarmament as "an emerging new kid on the block that really needs attention… in terms of data, discussions, technical expertise… it really needs to be nurtured; the discussions should continue."
United States of America	According to Audrey Schaffer, Director for Space Policy at the National Security Council, the United States "is leading the way on this issue because we believe it's in our [national security and economic] interests."[85] Accordingly, the Department of Defense was "one of the earliest and biggest proponents of [the moratorium]."[86]	N/A

85 Ibid.

86 KEYNOTE: Fireside Chat with Lt Gen John Shaw on the Future of Military Space Activities (Directed by Secure World Foundation, 16 June 2023) <https://www.youtube.com/watch?v=gUd6lmupyhI> ('KEYNOTE').

Reasons States Voted Against the Resolution

In a joint statement, Belarus, China, the Democratic People's Republic of Korea, Nicaragua, Syria, Venezuela, and Russia "consider the suggestion to undertake political commitment not to conduct destructive [DA-ASAT] tests to be a step in the right direction" before referring to it as "insufficient" to guarantee the peaceful use of outer space and PAROS.[23] **REASONS FOR THEIR OBJECTION CAN BE GROUPED AS FOLLOWS:**

Believes that Legally binding Instruments must be the First Step

- Extremely opposed to any space security measure that is not a legally binding instrument

'Sword & Shield' Suspicions

[23] Russian Federation, Joint Statement on the Initiative on Undertaking Political Commitment Not to Conduct Destructive Direct-Ascent Anti-Satellite Missile Tests (n 24).

- Resolution provides the United States, having already tested direct-ascent anti-satellite missile technology, both an offensive 'sword' and a deterring 'shield', while preventing other states from gaining the defensive benefits of developing this capability

Moralizing Rhetoric

- Resolution's framing of responsible versus irresponsible behaviour is a disagreeable rhetoric

Opposition Because of the Narrowness of the Resolution

- Resolution is ineffective–and may worsen space security–due to its focus on anti-satellite missiles only of a destructive and direct-ascent nature

Geopolitical Influences

- States voting 'against' with like-minded states and allies; states abstaining because of the resolution's heavily politicized nature

Concern and Suspicion over Past Rhetoric

- Distrust over the reasons behind and merits of the resolution due to previous statements made by the United States

Concerned by Previous Destructive Direct-Ascent Anti-Satellite Missile Testing

- Resolution is hypocritical and its merits suffer due to previous testing by the United States

Resolution Negatively Affects/Does Not Improve National Security

- Resolution worsens national security – or, at the very least, does not improve it

Table 6: Reasons States Voted Against the Resolution

STATE	NATIONAL POSITION	NOTES AND ADDITIONAL CONTEXT
GROUP 1: BELIEVES THAT LBIS MUST BE THE FIRST STEP		
Cuba	"This text simply calls on states to commit to not engage in destructive testing using these DA-ASAT missiles. This is a commitment that has no legal value or standing whatsoever… There's also the issue of a lack of binding norms [and] specific instrument"[24] which is detrimental to promoting the adoption of LBIs.[25]	N/A

[24] UN Web TV (n 41).

[25] Cuba, 'EXPLICACIÓN DE VOTO DE LA DELEGACIÓN DE LA REPÚBLICA DE CUBA' (2022) <https://reachingcriticalwill.org/images/documents/Disarmament-fora/1com/1com22/statements/26Oct_Switzerland.pdf>.

STATE	NATIONAL POSITION	NOTES AND ADDITIONAL CONTEXT
	Believes that voluntary TCBMs are relevant but do not substitute the adoption of an LBI.[26]	
People's Republic of China	Expressed that while soft law such as TCBMs "could play a positive role… they are not legally binding and unable to fundamentally prevent weaponization and an arms race in outer space… The only solution to space security threats is to negotiate and conclude a [LBI] on outer space arms control as soon as possible."[27] Argued that a moratorium has much less practical value than a comprehensive agreement such as the draft PPWT.[28] Urged a legal approach which incorporates new law such as the PPWT.[93] Emphasized the need for full implementation of international law… and a legally binding arms control agreement.[29]	Argues that the "U.S.… persistently evades a comprehensive non-discriminatory and legally binding solution… [Therefore] the motives and sincerity of this initiative are dubious."[95] ***Interviewee:*** "The Chinese government believes that it cannot support this resolution given that China and Russia have their draft PPWT… which addresses the issue more comprehensively." On a related point, the ***interviewee*** questions whether states have a strong will to work on any LBI.
Iran (Islamic Republic of)	"We attach great importance to the commencement of negotiations on a comprehensive LBI for the purposes of PAROS."[96]	N/A

[26] Cuba, 'Intervención de La Delegación de Cuba En El Debate Temático Sobre "Espacio Ultraterrestre (Aspectos de Desarme)".' (2022) <https://unoda-documents-library.s3.amazonaws.com/General_Assembly_First_Committee_-_ Seventy-Seventh_session_(2022)/Cuba-C3-26-Oct.pdf>.

[27] China, 'Working Paper Submitted by China to the Third Session of the UN Open-Ended Working Group on Reducing Space Threats Through Norms, Rules and Principles of Responsible Behaviours' (2022) <https://docs-library.unoda.org/Open-Ended_Working_Group_on_Reducing_Space_Threats_(2022)/202301~1.PDF>.

[28] Ploughshares, 'The Open-Ended Working Group on Space Threats: Recap of the Second Meeting' (n 23). 93 Ploughshares, 'The Open-Ended Working Group on Space Threats, Recap of the First Meeting' (n 12).

[29] Ploughshares, 'The Open-Ended Working Group on Space Threats: Recap of the Second Meeting' (n 23). 95 UN Web TV (n 13). 96 Ibid.

Russian Federation	Asserted that “only a legally binding agreement on PAROS” can maintain peace in space and calls on the United States to demonstrate their dedication to peace and security in space through an LBI.[97] Also asserted the necessity of a “purely legal approach” that strictly complies with existing laws.[98] “Without reliable guarantees for keeping outer space free of weapons, enshrined in an international legally binding agreement on PAROS, solutions to the issues related to peaceful use of outer space and ensuring security of space activities is unpromising.”[99]	***Interviewee:*** Russia continuously puts forward the idea of a legally binding regime which prohibits all kinds of space weapons. However, the DA-ASAT resolution is contrary to the Russian approach of LBIs. The resolution “is a part of another approach focused on developing a normative framework for specific areas of space security. This is also why Russia can’t support this.” Additionally, “before the hot phase of the [Ukraine] crisis started… there were signs that we might have moved somewhere in the direction of agreeing to start from norms to eventually reach a legally binding document. But for now, the overall competition between great powers and actual confrontation makes it very hard to reach consensus.” On the topic of norms versus LBIs, Russia is involved in the development of norms through signing joint statements with different states on no first placement of weapons in space. “This is another sign that if there was enough political will, both Russia and US and China and UK can come up with some sort of joint solution that will make the two approaches to space security work together.”
GROUP 2: ‘SWORD & SHIELD’ SUSPICIONS		
Iran (Islamic Republic of)	Argues that this resolution is discriminatory. “If this initiative becomes universal, advantages for certain groups of states that are already in possession of such means will emerge, while others, primarily the developing states, will find themselves in a discriminated position.”[100]	“We believe that… the United States Army is obviously seeking military supremacy in outer space. It’s hard to believe that there are good intentions behind this hypocritical proposal.” [101]

97 Ploughshares, ‘The Open-Ended Working Group on Space Threats: Recap of the Second Meeting’ (n 23).

98 Ibid.

99 Russian Federation, ‘Statement by Mr. Konstantin VORONTSOV, Deputy Head of the Delegation of the Russian Federation’ (2022) <https://unoda-documents-library.s3.amazonaws.com/General_Assembly_First_Committee_-_ Seventy-Seventh_session_(2022)/Russia-C3-26-Oct-EN.pdf>.

100 UN Web TV (n 13).101 Ibid.

STATE	NATIONAL POSITION	NOTES AND ADDITIONAL CONTEXT
People's Republic of China	At the OEWG, China suggested that the moratorium (and resolution) "was a means of seeking advantage under the guise of arms control."[102] To wit, China suggested that the development of norms "will result in the domination of outer space by one state;"[103] "the subjective and selective 'norms' may well be used as a political tool by the superpower to serve its own interests;"[104] that "discrimination would result from the voluntary restraints on the destructive testing of DA-ASAT weapons."[105] Calls the resolution hypocritical as it does not constrain or limit the "US led" strategy to develop and advance military capabilities in outer space. Describes it as "a very parochial arms control initiative that is meaningless for self-restraint and repeats the same old path of military protection first, arms control later, during the Cold War. Therefore, China "is opposed to the practice of expanding unilateral military superiority under the pretext of arms control. The motives and sincerity of this initiative are dubious… The US initiative is a cheat move."[106]	***Interviewee:*** This initiative affects states without such capabilities more than those that already have it. For states without DA-ASAT capabilities, taking pre-2019 India as an example, their 2019 DA-ASAT test was to signal to other spacepowers that they belonged to the club, rather than for deterrence against any single state. However, for states with DA-ASAT capabilities, they have no reason to test a DA-ASAT again simply for technological demonstration purposes. Even without this initiative, factors such as international pressure and legal liability are high costs that prevent states from conducting DA-ASAT tests which could cause damages to others. For such states, DA-ASAT tests might be conducted for other reasons. If their national security was under severe threat, a DA-ASAT test could signal their determination against external threats. Therefore, one of the objectives of this initiative is to eliminate the strategic options of other states when they suffer a severe security threat. "We are getting very close to the truth here." There is a concern that, for a state whose survival is at stake, they will seriously consider the strategic option of using DA-ASATs – even if they have signed up to any treaty, resolution, or pledge. In other words, such an 'exception' might be proposed by certain states as reserved options in the relevant treaty or at least it might be justified under modern international law in particular circumstances. "For countries with DA-ASAT capabilities, for example the United States, [they] could still conduct DA-ASAT under many other reasons."

They won't call it a test, like what was done in 2008. "The United States never admitted that it was an ASAT test, they called it a contingency manner to save people on the ground – so, in theory, this could happen again in a similar way."

Past demonstrates of destructive DA-ASAT tests highlight the significance of this capability.

So, one the reasons behind this resolution "is a game [by the United States], a tool to limit the strategic options for deterrence of other countries."

But, a lot of UN delegations see this resolution as contributing towards the protection of the space environment. That's why this resolution has garnered so much support. Some of them do not realise how "this resolution is a dangerous political game between powers." Therefore, the ***interviewee*** stresses that the military and security perspective behind this resolution must be understood.

102 Ploughshares, 'The Open-Ended Working Group on Space Threats, Recap of the First Meeting' (n 12).

103 Ploughshares, 'The Open-Ended Working Group on Space Threats: Recap of the Second Meeting' (n 23).104 China (n 91).

105 Ploughshares, 'The Open-Ended Working Group on Space Threats: Recap of the Second Meeting' (n 23). 106 UN Web TV (n 13).

STATE	NATIONAL POSITION	NOTES AND ADDITIONAL CONTEXT
Russian Federation	Concerned that "discrimination would result from the voluntary restraints on the destructive testing of DA-ASAT weapons… arguing that 'certain states won't have a shield while others still have a sword'."[107] "The possible universalization or universal utilization of this initiative would create an advantage for a certain selection of states that already have these means at their disposal. All of the other states, primarily the developing states, would be discriminated against."[108] "This decision by Washington seems to be nothing more but some sort of an attempt to divert the attention of the international community from its actual strivings, which are clearly and unambiguously set out in the policy documents of the United States on outer space."[109]	***Interviewee:*** "There is always a concern that this is some kind of cunning plan to deprave Russia of capabilities while retaining their capability."
GROUP 3: MORALIZING RHETORIC		
People's Republic of China	"Several countries claim… that even if an action is lawful under international law, in some contexts, such an action may not be viewed as responsible. Such an argument is trying to judge 'hard law' by 'soft law', which creates a critical logic loophole."[110] The ***interviewee*** stated that China has procedural and political concerns over the resolution's strong moral rhetoric of responsible versus irresponsible behaviour. Any state is sensitive to being chastised and judged from a moral perspective.	The ***interviewee*** is concerned because for the space domain, this is "the first time that the responsible versus irresponsible dichotomy is being put to such a high level." They explained that rather than using such moral rhetoric to justify the creation of new measures, the source of morality should come from what is legal and illegal rather than the other way around.
GROUP 4: OPPOSITION BECAUSE OF THE NARROWNESS OF THE RESOLUTION		

Cuba	The resolution does not endorse a ban on the use or threat of use of force in outer space. Additionally, stated that it only discourages destructive DA-ASAT missile testing that would generate debris.[111]	N/A
Iran (Islamic Republic of)	Considers the resolution insufficient as it does not renounce the development and manufacturing of ASAT systems, their use, non-destructive ASAT tests, nor the elimination of existing destructive ASAT weapons. Additionally criticizes the lack of a definition for ASAT weapons and the testing of such weapons. Further points out the lack of a verification mechanism.[112]	N/A

107 Ploughshares, 'The Open-Ended Working Group on Space Threats: Recap of the Second Meeting' (n 23). 108 UN Web TV (n 13).
109 Ibid.
110 China (n 91).
111 Cuba, EXPLICACIÓN DE VOTO DE LA DELEGACIÓN DE LA REPÚBLICA DE CUBA (n 89).112 UN Web TV (n 13).

STATE	NATIONAL POSITION	NOTES AND ADDITIONAL CONTEXT
People's Republic of China	Noted that the proposed moratorium on testing failed to mention development, production, deployment, and the actual use of ASAT weapons.[113]	Additionally, the ***interviewee*** noted that the resolution "does not mention other activities that could threaten or disrupt the normal operations of space activities of other states."
Russian Federation	Described the resolution as "completely insufficient" as it does not renounce the development and production of ASAT systems, their use, non-destructive ASAT tests, nor the elimination of existing destructive ASAT weapons.[114]	Desires a comprehensive ban "against creating, testing, or deployment of weapons in space, including for ABM defence or ASAT purposes, and called for destruction of any such systems that already exist."[115] ***Interviewee:*** Russia has major concerns regarding space weapons, weaponization, the positioning of strike weapons in space that are capable of hitting objects on Earth or be part of the intercepting layer of missile defense, and the intelligence, surveillance and reconnaissance, and even targeting layers of space systems. "That's why focusing on only one issue seems inappropriate. This is why Russia is concerned with a ban that

		addresses only destructive direct-ascent ASATs without taking into consideration everything else." There are very real concerns that space capabilities can undermine overall strategic stability.
GROUP 5: GEOPOLITICAL INFLUENCES		
People's Republic of China	***Interviewee:*** No matter what topics are being discussed, it's always about competition, leadership, influence, and superiority – these power games that play out in space. So, this resolution is understood as a form of competition between the two states. "Considering the general state of geopolitics, it's very hard for China to support a United States initiative and vice-versa." Contested tensions between powers in space affects the Chinese position – and the position of other states.	***Contd.:*** "Solely highlighting DA-ASATs brings about more uncertainty that this simply a game between great powers. From a political perspective, it reveals broader tensions between the two camps." The fragile nature of outer space concerns the ***interviewee***, but they believe that the bigger challenge is the fragile relationship between powers in space: "the lacking of mutual trust or strategic understanding among the powers. They don't like and don't trust each other, and don't believe that they can achieve strategic understandings in the short term." The ***interviewee*** is disappointed that among the powers, "no one would like… show a truly friendly attitude towards solving problems in space. I see no process there." According to a non-Chinese representative who requested anonymity: Although China has spoken on the merits of the resolution, "obviously, they haven't joined for political reasons more than anything [else].

113 Ploughshares, 'The Open-Ended Working Group on Space Threats, Recap of the Third Session' (n 21).
114 UN Web TV (n 13).
115 Ploughshares, 'The Open-Ended Working Group on Space Threats: Recap of the Second Meeting' (n 23).

STATE	NATIONAL POSITION	NOTES AND ADDITIONAL CONTEXT
Russian Federation	Concerned "about the realisation of the policy by Western countries headed by the United States [to use] outer space for military purposes in order to ensure their dominance and supremacy."[116] ***Interviewee:*** One of the reasons Russia voted the way it did was because the resolution is "promoted by Russia's adversaries." "For now, the overall competition between great powers and actual confrontation makes it very hard to reach consensus."	***Contd.:*** "As in other areas of international governance, space governance suffers from developing new norms and rules of the road" (i.e., rising geopolitical tensions). But it is not as bad as other domains; there is still cooperation aboard the ISS between NASA and ROSCOSMOS, but it could have been better. The expert is worried about the "Balkanization of international governance", citing the Artemis Accords as an example whereby the US leads and, afterwards, attempts to bring other states on board. According to a non-Russian representative who requested anonymity: Although Russia has spoken on the merits of the resolution, "obviously, they haven't joined for political reasons more than anything [else].
GROUP 6: CONCERN AND SUSPICION OVER PAST RHETORIC		
People's Republic of China	Regrets that space was "declared as a 'war-fighting domain' by a certain country."[117] ***Interviewee:*** Highlights statements from the United States which gives a "very clear message that China, Russia, are the biggest challenges, or enemies" as an example of what the "essence of the challenge is."	N/A
Russian Federation	"This decision by Washington seems to be nothing more but some sort of a manoeuvre, an attempt to divert the attention of the international community from its actual strivings, which are clearly and unambiguously set out in the policy documents of the United States on outer space. "The defence strategy and the US Space Force doctrines clearly set out these aims.	***Interviewee:*** "It is crucial for Russia to feel and to see that Russian concerns are also being addressed, [that it's] not just a one-way street. [It is most irritating] when people ask Russia to do or support something without even trying to talk or address things that Russia is concerned about. There must always be some kind of give and take."

	They are aimed at the military domination and its supremacy in outer space. Outer space itself is viewed as an arena for competition."[118]	
Non-Aligned Movement	"Rejects the declaration by the United States in 2018 that 'Space is a warfighting domain' or 'the next battle field'."[119]	N/A

116 Russian Federation, Statement by Mr. Konstantin VORONTSOV, Deputy Head of the Delegation of the Russian Federation (n 99).
117 China (n 91).
118 UN Web TV (n 13).119 Indonesia (n 62).

STATE	NATIONAL POSITION	NOTES AND ADDITIONAL CONTEXT
GROUP 7: CONCERNED BY PREVIOUS DESTRUCTIVE DA-ASAT TESTS		
People's Republic of China	***Interviewee:*** "For countries with DA-ASAT capabilities, for example the United States, [they] could still conduct DA-ASAT under many other reasons." They won't call it a test, like what was done in 2008. "The US never admitted that it was an ASAT test, they called it a contingency manner to save people on the ground – so, in theory, this could happen again in the similar way." Past demonstrations of destructive DA-ASAT tests highlight the significance of this capability.	Relevant to the Sword & Shield argument (Group 2) against this resolution.
Russian Federation	Questions the merits of and intentions behind this resolution, arguing that this resolution was only introduced after the United States had already tested and achieved successful destructive DA-ASAT capabilities.[120]	Relevant to the Sword & Shield argument (Group 2) against this resolution.
GROUP 8: RESOLUTION NEGATIVELY AFFECTS/DOES NOT IMPROVE NATIONAL SECURITY		

People's Republic of China	In addition to the Sword & Shield argument (Group 2), the ***interviewee*** explained that "the possibility to do [a DA-ASAT test] also has strategic value." The ***interviewee*** notes that a state objecting to the resolution does not mean that the state seeks to commit another test. "People always combine these two matters together. It is not correct. Whenever we are talking about objection to this resolution… it's just a preference to retain the possibility of doing so in the future. It is a strategic concern, its value as deterrence."	***Contd.:*** From a military perspective, this resolution will spur an arms race and security dilemma between space powers. In the event that DA-ASAT weapons are banned or prohibited, states will simply seek alternative approaches to achieve the same strategic value that was lost. Facing all these challenges, arms control should not be a tool that one state uses to achieve military or strategic advantages over another state.
Russian Federation	In addition to the Sword & Shield argument (Group 2), the ***interviewee*** stated that the active use of military and commercial space capabilities to enable ground operations by the Ukrainian military is why Russian officials have made public comments that commercial satellites might become legitimate targets of Russia's counterspace capabilities. "With such messaging, supporting a resolution banning DA-ASAT [missiles] would seem illogical", even though they doubt that Russia has any real interest in using DA-ASATs in the ongoing conflict.	***Contd.:*** Stressed that the development of counterspace capability in Russia is not driven by malign ideas. Rather, it stems from a very real concern that space capabilities can undermine overall strategic stability. Additionally, "for the moment, there are enough tasty targets in space that can make DA-ASAT missiles useful." Also see Table 2 on how this issue is inextricably linked to Russia's major security concern over missile defense.

120 Russian Federation, 'И Контроля Над Вооружениями МИД России К.В.Воронцова с Разъяснением Позиции По Проекту Резолюции «Испытания Противоспутниковых Ракет Прямого Перехвата» в Первом Комитете 77-й Сессии ГА ООН' (2022) <https://reachingcriticalwill.org/images/documents/Disarmament-fora/1com/1com22/eov/ L62_Russia.pdf>.

Reasons States Abstained on the Resolution

REASONS GIVEN CAN BE GROUPED AS FOLLOWS:

Geopolitical Influences

- States abstaining because of the resolution's heavily politicized nature

Strong Preference for Legally binding Instruments over Non-Legally Binding Measures

- Strongly opposed to any space security measure that is not a legally binding instrument

Opposition Because of the Narrowness of the Resolution

- Resolution is ineffective–and may worsen space security–as it focuses only on the testing of destructive, direct-ascent anti-satellite missiles

Others

- Resolution's focus on space debris puts it under the purview of the United Nations Committee for the Peaceful Uses of Outer Space (COPUOS); and a reference to rhetoric

Table 7: Reasons States Abstained on the Resolution

STATE	NATIONAL POSITION	NOTES AND ADDITIONAL CONTEXT
	GROUP 1: STRONG PREFERENCE FOR LBIS OVER NON-LEGALLY BINDING MEASURES	
India	"India, which indicated a preference for a legally binding instrument that provides a 'stronger guarantee of compliance with obligations,' remains open to new non-binding outcomes, including norms and other transparency and confidence-building measures."[30]	N/A
Pakistan	"We are not averse to the idea of more than one LBI as a part of this comprehensive approach, but each measure should clearly be seen to be contributing to the larger goal of PAROS."[122]	N/A
Sri Lanka	It is their "firm conviction" that PAROS could only be achieved through an LBI.[31] Welcomes "deliberations relating to norms, rules and principles of responsible behaviours" as a useful measure. States that is imperative that such deliberates are an interim step towards an LBI on PAROS.[32]	N/A
STATE	NATIONAL POSITION	NOTES AND ADDITIONAL CONTEXT

[30] Ploughshares, 'The Open-Ended Working Group on Space Threats: Recap of the Second Meeting' (n 23). 122 UN Web TV (n 13).

[31] Ibid.

[32] Sri Lanka (n 25).

GROUP 2: OPPOSITION BECAUSE OF THE NARROWNESS OF THE RESOLUTION		
India	"This resolution does not address the key issue of preventing an arms race in outer space through a universally acceptable, verifiable, and multilaterally negotiated legally binding instrument on PAROS. India believes that such an instrument should focus on all space threats in a comprehensive manner. "We are, accordingly, constrained to abstain on L.62."[125]	N/A
Pakistan	Notes positive elements in the resolution* but has decided to abstain due to "a few gaps in the current draft." First, the text "shies away from [expressing] concern over the growing arms race in outer space, urgent threats to and from space, including its weaponization, and how these developments impede progress towards negotiating an LBI on PAROS." Second, the Conference on Disarmament "has been prevented from commencing negotiations" on a LBI on PAROS. Third, the resolution focuses only on direct-ascent ASAT systems – and only prevents its testing. It does not address its development, production, deployment. Fourth, space security should be addressed in a holistic manner because "the commitment to not test just one type of ASAT [weapon] would neither prevent the development or deployment of other weapons and ASAT system, nor their nondestructive testing." Fifth, desires that Article One of the Outer Space Treaty is "spelled out clearly in the text."	* Reaffirmation of preventing an arms race in outer space; the need to maintain space as a peaceful and sustainable environment for the benefit of all; promoting and strengthening international cooperation; and a reference to Article Nine of the Outer Space Treaty. "We also agree with the generous spirit of [Paragraph 3], and its call on all states to take further steps, which could contribute to legally binding instruments on PAROS in all its aspects."[127]

	Lastly, objects to "suggestions on the applicability of international law of armed conflict to outer space."[126]	
Sri Lanka	Resolution focuses only on direct-ascent, destructive ASAT missiles; does not refer to production, research, and development, and their use; and that "the text lacks sufficient transparency with regard to the ultimate objective to be achieved."[128]	N/A

125 UN Web TV (n 13).
126 UN Web TV (n 41).127 Ibid.
128 UN Web TV (n 13).

STATE	NATIONAL POSITION	NOTES AND ADDITIONAL CONTEXT
GROUP 3: OTHERS		
India	"We share the concerns about the potential dangers arising from space debris to the safety and long term sustainability of outer space… India believes, however, that	N/A

	matters relating to debris fall within the purview of [COPUOS].” [129]	
Sri Lanka	“Rejects any doctrine that seeks to categorize space as a ‘war fighting domain’ or ‘the next battlefield’” and describes space debris as a significant risk.[130]	N/A

129 Ibid.
130 Sri Lanka (n 25).

The Future of Destructive DA-ASAT Testing and the Broader International Space Governance Framework

Some interviewees provided their personal thoughts on what will come after the moratorium and resolution. Their views are reflected in the table below and should not necessarily be taken as reflecting national position.

Table 8: Thoughts on the Future

STATE	DESTRUCTIVE DA-ASAT TESTING	INT. SPACE GOVERNANCE FRAMEWORK
Canada	***Interviewee:*** The anti-DA-ASAT pledges and resolution will feed into ongoing processes such as the OEWG and the GGE on Prevention of an Arms Race in Outer Space. The resolution was quite promising and could possibly form a part of a broader treaty in the future. The unilateral pledges are the development of one such norm which could eventually lead to a legally binding instrument. The pledges will help dictate behaviour in space and, more importantly, enable the calling out of bad behaviour. It should be observed whether, over the next few years, there is momentum which could coalesce around a potential treaty – and if not, hopefully more	***Contd.:*** The international space governance framework is outdated and needs an upgrade. First, there is an increasingly false dichotomy between Vienna and Geneva. A lot of civil and security aspects cannot be separated (e.g., how space debris affects both sustainability and security). There needs to be better coordination between the two bodies. However, there is a lot of resistance to this. Some states continue to insist that ‘Geneva issues should stay in Geneva’ and likewise for Vienna. Pleased with the progress of the OEWG and thinks that the work has been invaluable.

	states will continue to make the pledges nonetheless. "In principle, [a legally binding resolution] is something Canada could probably support." But, the devil's in the details.	
Nigeria	N/A	***Interviewee:*** Certain elements embedded in the work of the OEWG that could present an initial set of principles which if clearly specified and gains consensus, could form the pillar of such a future LBI.

STATE	DESTRUCTIVE DA-ASAT TESTING	INT. SPACE GOVERNANCE FRAMEWORK
People's Republic of China	***Interviewee:*** Believes that the Chinese government, rather than just rejecting the resolution, will provide a more, in their view, practical, balanced, and comprehensive proposal as a contribution to the international community. Questions whether states have a strong will to work on any LBI. On a potential LBI on destructive DA-ASAT testing, they question, at the procedural level, where and how would such a treaty be proposed in light of the difficulty of consensus. Additionally, the international community should consider the UN's limited resources. In the ***interviewee***s' view, a less	***Contd.:*** Moving forward, "we must be pragmatic, even if we can hardly get consensus about strategy and geopolitical in space." Pragmatic mechanisms should be built up to avoid misunderstandings and misperceptions in space. Alike Canada, points to procedural challenges from the lack of connection between different UN bodies. For instance, Geneva and New York are very stressful environments that lack legal support from Vienna.

	comprehensive treaty following decades of work would not be worthwhile.	
Russian Federation	***Interviewee:*** Expects the work on the DA-ASATs challenge to continue. It will probably be on the agenda for the next UNGA and for other UN working bodies on space security. Predicts that Western states will reach out to those states who voted against or abstained, and that India might vote in favour next time as they're interested in joining US space projects. "Russia will, with Chinese support, try to develop an alternative resolution." There is a good chance that "Russia can find a language that will bring in a lot of countries in support of Russia's version of a resolution that will deal with this or other aspects of space security." The expert is "confident that Russia is interested in keeping space safe" because "there is a very real understanding that Russia also needs space for civil and military needs." Russia would not be interested in a legally binding resolution focused only on DA-ASAT weapons, but would be interested if it addresses broader issues of space security.	***Contd.:*** "As in other areas of international governance, space governance suffers from developing new norms and rules of the road" (i.e., rising geopolitical tensions). But it is not as bad as other domains; there is still cooperation aboard the International Space Station between NASA and ROSCOSMOS, but it could have been better. They are worried about the "Balkanization of international governance", citing the Artemis Accords as an example whereby the US leads and, afterwards, attempts to bring other states on board.

STATE	DESTRUCTIVE DA-ASAT TESTING	INT. SPACE GOVERNANCE FRAMEWORK
South Africa	***Interviewee:*** At the time of writing, they do not know if there would be a follow-up resolution on the topic of DA-ASAT weapons. This topic will feature in ongoing processes such as the OEWG and a new GGE on PAROS. If the resolution gets tabled again, the votes might be similar or slightly different. This will depend on how negotiations unfold in informals, depending on what substantial amendments to the resolution are proposed. Notes that "going forward, there will still be gray areas in this issue." "In terms of an LBI on ASATs, that's a discussion that has not come up yet… but we do support discussions on it."	***Contd.:*** South Africa is concerned by the emergence of parallel processes (e.g., in the First Committee, the creation of an OEWG, a GGE, and separate discussions on specific elements of these processes – all before the first OEWG has been allowed to conclude; processes can and have also been killed by those in opposition). This makes discussions more difficult to follow. The ***interviewee*** states that other states are also concerned about the politics surrounding these processes. Draws attention to the multi-generational significance of space security and governance. Multilateral discussions on space are critical, timely, and relevant because of the rapid pace of technological development. It is important to develop technological expertise and raise awareness of these issues that are important to and threaten the international community. The ***interviewee*** describes space disarmament as "an emerging new kid on the block that really needs attention… in terms of data, discussions, technical expertise… it really needs to be nurtured; the discussions should continue."

Concluding Analysis: Convergence and Divergence in State Positions

This report reveals a mix of convergence and divergence between states on the issue of destructive DA-ASAT testing.

HIGH-LEVEL TAKEAWAYS INCLUDE:

- A significant number of states are concerned by destructive DA-ASAT testing
- A heavy emphasis on debris was present throughout this initiative
- The difference in prioritisation of concerns between developed (stricter security concerns) and developing space powers (debris, access to space, and due regard under Article 9 of the OST)
- The geopolitical factor behind votes cannot be discounted – in some cases, surpassing the substance of the resolution in importance
- States voting against the resolution cite strikingly similar reasons
- Similar aspects of the resolution are cited both as reasons for support and opposition
  - *Narrowness of the resolution*
  - *Geopolitics*
  - *Previous destructive DA-ASAT testing*
  - *The debate over norms versus LBIs*
- The United States spearheaded this initiative, and the support of some NAM states was instrumental to the resolution's widespread endorsement
- Developing states' need for greater technical and legal expertise vis-à-vis the effects of destructive DA-ASAT testing and the implications of a commitment

One reason for the resolution's success appears to be how it links the issue of destructive DA-ASAT testing to two distinct yet important concerns: space debris and the weaponization of outer space (i.e., generally referring to the "proliferation, testing, deployment and use of weapons or counterspace capabilities", although it is not a universally accepted concept[33]). The significant growth in space debris affects all states, and developing states make the case that their space assets are at greater risk due to their more rudimentary capabilities in, for instance, manoeuvrability (*Table 5, Group 4*). Therefore, the framing of resolution A/RES/77/41 as a positive step to reducing space debris seems to be key in securing the support of developing states and developing space powers.

All interviewees except for the Russia expert expressed concern over space debris, and the issue of debris featured in many statements by delegates in reference to the topic of destructive DAASAT

[33] Ortega and Samson (n 2).

testing. This reflects the "interest that was also converging on… avoiding the deliberate or intentional creation of space debris" in the OEWG.[34]

On the other hand, national security implications are mainly a priority for developed space powers. While space affects the national security of developing states as well, it tends to be much more important for developed states who tend to be more dependent on space, with the United States being at the extreme end of the spectrum: "I don't think it's an overstatement to say that we [the United States] are more dependent on space than any country in the world."[35] Indeed, national security concerns are prominent drivers for China and Russia as well, given their status as space powers.

An indication of a potential shift in traditional positions on this issue can be seen in a joint statement by Belarus, China, the Democratic People's Republic of Korea, Nicaragua, Syria, Venezuela, and Russia who "consider the suggestion to undertake political commitment not to conduct destructive [DA-ASAT] tests to be a step in the right direction."[36] China "welcomed any arms control initiative that contributed to PAROS"[37] and Russia "noted that the declaration was a positive response to practical initiatives on PAROS."[38]

That said, China and Russia's ultimate votes against the resolution, and India's abstention, are likely explained by other factors. Similar reasons cited by all three states are the narrowness of the resolution, a strong preference towards LBIs, and geopolitics. The resolution covers, specifically, *the testing of destructive, direct-ascent* ASAT missiles. It does not cover development, production, deployment, and use of this capability, nor non-DA capabilities such as co-orbital and space-to-earth counterspace weapons (*Table 6, Group 4; Table 7, Group 2*). While states in support of this resolution describe the narrowness as a feature of an initial stepping stone towards more expansive measures, China, Russia, and India object to this approach. (Narrowness was also cited as a reason for Pakistan's and Sri Lanka's abstentions.)

China, Russia, and India strongly prefer to address space security matters through a comprehensive LBI (*Table 6, Group 1; Table 7, Group 1*). Russia and China continue to support their draft treaty on PPWT. This appears to be a strong red line for the former two states, while India appears to be less strict about this rule, having noted before that they remain open to non-binding measures.[39] It follows that India may support this resolution if it gets reintroduced in the future, a sentiment also echoed by the Russia expert. (A strong preference for LBIs was also cited as a reason for Pakistan's and Sri Lanka's abstentions.)

This report observes the continuation of a geopolitical divide between, broadly, China, Russia, and the West, and how geopolitics take precedence over any substantial considerations on the merits of the resolution (*Table 6, Group 5*). Multiple interviewees cited this as the reason for China and Russia's objection. Many respondents highlighted a major concern over how terrestrial geopolitical tensions are mirrored in and obstruct space diplomacy. As the Russia expert put it:

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[34] Ploughshares, Recommendations by States from the Third Session of the United Nations Open-Ended Working Group on Reducing Space Threats (July 2023).

[35] SPOTLIGHT Talk: Audrey Schaffer - Why a Moratorium on Anti Satellite Testing Is Important (n 30).

[36] Russian Federation, Joint Statement on the Initiative on Undertaking Political Commitment Not to Conduct Destructive Direct-Ascent Anti-Satellite Missile Tests (n 24).

[37] Ploughshares, 'The Open-Ended Working Group on Space Threats, Recap of the First Meeting' (n 12).

[38] Ibid.

[39] Ploughshares, 'The Open-Ended Working Group on Space Threats: Recap of the Second Meeting' (n 23).

Before the hot phase of the [Ukraine] crisis started… there were signs that we might have moved somewhere in the direction of agreeing to start from norms to eventually reach a legally binding document. But for now, the overall competition between great powers and actual confrontation makes it very hard to reach consensus.

As the representative from a NAM state explained, the NAM appreciates this issue through a geopolitical lens. Some NAM states see this resolution as a ploy to incur India, China, and Russia significant political cost for their previous destructive DA-ASAT tests; "those who abstained are afraid of offending Russia, China, or India." If states favouring the moratorium and resolution are closely associated with the United States, their actions might be perceived as just a 'United States vote'. Therefore, the default position of many NAM delegations had been to not vote in favour – and if they did, they would calculate a need to also vote for China and Russia's draft PPWT treaty. The interviewee also noted the context that the NAM is strongly influenced by a few states with grudges against the West (e.g., Iran, Cuba, Venezuela), who are sometimes more aligned with China and Russia.

Focusing now on the group of states that voted against the resolution, strikingly similar reasons are cited between them. Similarly to China and Russia, Cuba and Iran expressed concern over the lack of an LBI and the narrowness of the resolution (*Table 6, Group 4*). Further, China, Russia, Cuba, and Iran highlighted a "Sword & Shield" dilemma posed by this resolution (*Table 6, Group 2*). Their contention is that the resolution gives the United States, having already successfully tested its destructive DA-ASAT missile capability (*Table 6, Group 7*), a 'sword' with which to potentially strike. According to the logic of deterrence, having such a capability also serves as a 'shield', discouraging adversaries from launching attacks for fear of retaliation. However, by seeking to halt further testing through this resolution, states that haven't reached the United States' level of capability are denied the defensive benefits of having a shield (i.e., the successful testing of destructive DA-ASAT missiles).

It is a matter of judgement to what degree the Sword & Shield argument holds up to the United States and other states describing the resolution as a capability neutral approach that does not constrain the development of technology. The resolution allows for non-destructive DA-ASAT testing (e.g., flight tests and deliberate near-miss 'fly-bys') which could provide deterrence as robust as their destructive counterparts. In fact, this has been China's approach after their destructive DA-ASAT test in 2007; Russia has also conducted non-destructive tests of its ASAT missile system prior to its destructive test in 2021.[40] A high-ranking official from an allied US state who requested anonymity stated "the United States is quite keen to preserve a certain flexibility to operate in space" which was taken into account in the construction of the resolution's specific wording of destructive, direct-ascent. The open possibility to further development of DA-ASAT capabilities goes both ways.

The suspicion of those states who voted against the resolution was, in their view, justified by the aggressive rhetoric found in some United States space strategy documents (*Table 6, Group* 6). Additionally, the China interviewee stated that China has procedural and political concerns over the resolution's strong moral rhetoric of responsible versus irresponsible behaviour; that any state is sensitive to being chastised and judged from a moral perspective (*Table 6, Group 3*).

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[40] Brian G Chow and Brandon W Kelley, 'U.S. Antisatellite Test Ban Reveals a New Approach for Security and Sustainability in Space', SpaceNews (12 May 2022) <https://spacenews.com/op-ed-u-s-antisatellite-test-ban-reveals-anew-approach-for-security-and-sustainability-in-space/>.

Interestingly, aspects of the reasons cited above for objection were also present in the reasoning of states that favoured this resolution. First, the narrowness of the measure is undisputed – but it is broadly understood to be a suitable stepping stone towards further normative TCBMs and/or the greater objective of a LBI on PAROS. Indeed, its framing as a stepping stone helped get NAM states on-side. Because the default NAM position is for LBIs, the significant number of NAM states voting in favour is possibly a sign of a softening dichotomy – to the extent that such a divide existed in the first place. As Ploughshare reports, "while most states supported the objective of a [LBI] on PAROS, norms were overwhelmingly viewed as a step toward such an agreement."[41]

Second, regarding previous destructive DA-ASAT tests, while China and Russia explicitly cite previous United States tests as a reason for their scepticisms and objection, the United States, Republic of Korea, and an interviewee from a Western state who requested anonymity cited Russia's November 2021 test as one impetus behind the moratorium and resolution.

Third, because this resolution has a politicised bent, it is extremely likely that Western states felt a geopolitical pull to vote in favour. For instance, Canada voted in favour because of its near-four-decade opposition to the destruction of space objects and creation of debris, and also because "Canada is keen to maintain strong, friendly relations with its allies, which is always a factor when co-signing resolutions."

As to the process leading up to the resolution, it is understood that there was intense effort by the United States in spearheading and obtaining support for the moratorium and resolution. The United States provided informative briefings about why space debris was a threat to all states, and an interviewee revealed that the United States was highly receptive to feedback during negotiations, implementing many suggestions into the final text of the resolution. A different interviewee stated that "the Americans had a single-minded determination to get the vote… [they] just took everybody's suggestion – so that's hard for countries to say no to."

Altogether, these efforts were highly appreciated by other states. But the resolution would not have been as successful if the United States and a few key NAM states did not also expend effort into promoting it as non-geopolitical. Following on from that, the moment one NAM state spoke in favour, the NAM stopped having a default position against it. It could no longer be painted as 'West versus NAM'. Additionally, as aforementioned, the resolution's success is also attributed to how it accounted for the concerns of developing states.

Next, there seems to be a challenge in securing widespread support for the moratorium relative to the success of the resolution. While the resolution received 155 votes in favour, only 37 states have made the formal pledge. Notably absent from this commitment are India, China, and Russia – the only other states to have tested destructive DA-ASAT missiles, and as such, crucial to the success of this initiative against destructive DA-ASAT testing. The China expert expressed doubts over whether these commitments represent an appetite to negotiate an LBI as well as broader concerns over security and arms-race dynamics; the Russia expert stated that the commitments are "noted."

It is also noteworthy that, at the time of writing, all 37 formal commitments have been exclusively made by Western states and allies. Geopolitics is undoubtedly a factor. As previously mentioned, one of the reasons preventing NAM states from committing to the pledge is the risk of being judged as voting

[41] Ploughshares, 'The Open-Ended Working Group on Space Threats: Recap of the Second Meeting' (n 23).

with and for the United States. An alternative reason was offered by the South African representative. In their personal opinion, it is difficult for developing states to comprehensively understand the technical and legal implications of the moratorium. As such, it is difficult for delegates to advocate for Capital to make the commitment, with decision-making being equally difficult for Capital (*Table 4*).

Corroborating this point, the representative of a NAM state who requested anonymity revealed that most delegates to the UN, including those from Southeast Asia, have a limited appreciation of this issue. Space is seen as an esoteric field in which their states "do not have skin in the game." Diplomats do not fully appreciate their states' interest in limiting the danger that space debris pose to space-based infrastructure. Technical experts in their respective space agencies might be concerned by this issue, but there is usually limited coordination between them and officials of the foreign ministry. Thus, diplomats in New York or Geneva do not usually get sufficient technical guidance for them to participate actively in negotiations. As a result, more often than not, diplomats in Geneva or New York end up looking to the default NAM approach for guidance. In other words, this is often not the stance from capital; it is simply diplomats defaulting to the NAM position.

Furthermore, the South African representative emphasised the disparities in technological and developmental milestones between developed and developing states. They stated that, against this backdrop, the moratorium could be construed as curtailing development. "[Because] we are also developing, we should not need be blocked from getting to a [similar] level… help us get there as well." The interviewee expressed that, once closer to parity, developing states will better be able to understand the perspectives and concerns of developed states.

In conclusion, the report observes the emergence of a growing norm against destructive anti-satellite missile testing with noteworthy momentum behind this initiative. Additionally, taking into account the high number of states in favour of the resolution, there appears to be a softening dichotomy between the two approaches of norms versus legally binding instruments in addressing space security. Next, multiple interviewees expressed that the moratorium and resolution have become extremely politicized. More broadly, they are heavily concerned by the adverse geopolitical climate which exacerbates existing geopolitical deadlocks on preventing an arms race in outer space. Against that backdrop, this report notes however that the moratorium appears to be gaining significant support. Further, developing states currently lack comprehensive technical and legal expertise on two fronts: the adverse effects of destructive DA-ASAT testing; and the technical and legal implications of making a commitment. The lack of thorough understanding respectively has been cited as a reason why more states have not pledged the moratorium.

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Recent NPRMS for FAA and FCC Rule Changes Regarding Debris

FCC NEWS from the Federal Communications Commission

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For Immediate Release

FCC ADOPTS NEW '5-YEAR RULE' FOR DEORBITING SATELLITES TO ADDRESS GROWING RISK OF ORBITAL DEBRIS

WASHINGTON, September 29, 2022—The Federal Communications Commission today adopted new rules requiring satellite operators in low-Earth orbit to dispose of their satellites within 5 years of completing their missions. The new rules shorten the decades-old 25-year guideline for deorbiting satellites post-mission, taking an important step in a new era for space safety and orbital debris policy.

The FCC takes seriously the short- and long-term challenges of orbital debris. Defunct satellites, discarded rocket cores, and other debris now fill the space environment, creating challenges for current and future missions. There are more than 4,800 satellites operating in orbit as of the end of last year, and the vast majority of those are commercial low-Earth orbit (LEO) satellites. The new 5-year rule for deorbiting satellites will mean more accountability and less risk of costly collisions that increase debris.

The Report and Order adopted today requires satellites ending their mission in or passing through the low-Earth orbit region (below 2,000 kilometers altitude) to deorbit as soon as practicable but no later than five years after mission completion. This is the first concrete rule on this topic, replacing a long-standing guideline. These new rules will also afford satellite companies a transition period of two years. The mission length and deorbit timeline for any given satellite are established through its application process with the FCC's International Bureau.

The FCC's Space Innovation docket is addressing the new space age with modernized regulations to match the new realities, support for technological innovation in this burgeoning economic sector, and taking seriously the space sustainability questions that come with rapidly growing and changing public and private space endeavors. The FCC recently launched a new proceeding for in-space servicing, assembly, and manufacturing (ISAM) capabilities. The agency is making more spectrum available to fuel the nation's space ambitions, including identifying spectrum for the first time to support commercial launches and proposing new spectrum sharing rules to increase competition. The satellite and launch industry is now an estimated $279 billion-a-year sector.

Action by the Commission September 29, 2022 by Second Report and Order (FCC 22-74).
Chairwoman Rosenworcel, Commissioners Carr, Starks, and Simington approving.

Chairwoman Rosenworcel, Commissioners Starks and Simington issuing separate statements. IB

Docket Nos. 22-271, 18-313

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[4910-13]

DEPARTMENT OF TRANSPORTATION

Federal Aviation Administration

14 CFR Parts 401, 404, 415, 417, 431, 435, 437, 450, and 453

[Docket No.: FAA-2023-1858; Notice No. 23-13]

RIN 2120-AK81

Mitigation Methods for Launch Vehicle Upper Stages on the Creationof Orbital Debris

AGENCY: Federal Aviation Administration (FAA), Department of Transportation (DOT)

ACTION: Notice of proposed rulemaking (NPRM)

SUMMARY: To limit the growth of orbital debris, the FAA proposes to require that upper stages of commercial launch vehicles and other components resulting from launch or reentry be removed from orbit within 25 years after launch, either through atmospheric disposal or maneuver to an acceptable disposal orbit. Any artificial object left in orbit around the Earth which no longer serves auseful purpose can become a debris hazard in space. Orbital debris is all such human-generated debris in Earth orbit that is greater than 5 millimeters (mm) in any dimension. Collisions between and with orbital debris are a growing concern because prior to the establishment of theInter-Agency Space Debris Coordination Committee (IADC) practices allowed these objects to accumulate in Earth orbit. Additionally, an increasing number of launch operators are launching assets into space at greater rates.If left unchecked, this accumulation can clutter useful orbits and present a hazard to operations on-orbit. This proposed rule would reduce the amount of additional debris created, aswell aslimit potential collisionswith functional spacecraftand other debris already on-orbit.

DATES: Send comments on or before [INSERT DATE 90 DAYS AFTER DATE OF

PUBLICATION IN THE FEDERAL REGISTER].

ADDRESSES: Send comments identified by docket number FAA-2023-1858 using any of the following methods:

- Federal eRulemaking Portal: Go to www.regulations.gov and follow the online instructions for sending your comments electronically.
- Mail: Send comments to Docket Operations, M-30; U.S. Department of Transportation, 1200 New Jersey Avenue, SE, Room W12-140, West Building Ground Floor, Washington, DC 20590-0001.
- Hand Delivery or Courier: Take comments to Docket Operations in Room W12-140 of the West Building Ground Floor at 1200 New Jersey Avenue, SE, Washington, DC 20590-0001 between 9 a.m. and 5 p.m., Monday through Friday, except Federal holidays.
- Fax: Fax comments to Docket Operations at (202) 493-2251.

Privacy: In accordance with 5 USC 533(c), DOT solicits comments from the public to better inform its rulemaking process. DOT posts these comments, without edit, including any personal information the commenter provides, to www.regulations.gov, as described in the system of records notice (DOT/ALL-14 FDMS), which can be viewed at www.dot.gov/privacy. *Docket*: Background documents or comments received may be read at www.regulations.gov at any time. Follow the online instructions for accessing the docket or go to the Docket Operations in Room W12-140 of the West Building Ground Floor at 1200 New Jersey Avenue, SE, Washington, DC 20590-0001, between 9 a.m. and 5 p.m., Monday through

Friday, except Federal holidays.

FOR FURTHER INFORMATION CONTACT: Brenda Robeson, Office of Commercial Space Transportation, Federal Aviation Administration, 800 Independence Avenue SW, Washington, DC 20591; (202) 267-4712; brenda.robeson@faa.gov.

SUPPLEMENTARY INFORMATION:

Authority for this Rulemaking

The Commercial Space Launch Act of 1984, as codified and amended at 51 U.S.C.— Commercial Space Transportation, ch. 509, Commercial Space Launch Activities, 51 U.S.C. 50901-50923 (the Act), authorizes the Department of Transportation and thus the FAA, through delegations, to oversee, license, and regulate commercial launch and reentry activities, and the operation of launch and reentry sites as carried out by United States (U.S.) citizens or within the United States. Section 50905 directs the FAA to exercise this responsibility consistent with public health and safety, safety of property, and the national security and foreign policy interests of the United States. Pursuant to § 50903, the FAA is also responsible for encouraging, facilitating, and promoting commercial space launches by the private sector.

List of Definitions and Acronyms Frequently Used In This Document

Disposal (storage) orbit—an orbit intended for post-mission long-term storage where atmospheric effects and solar radiation will not move the disposed object into a protected orbit for at least 100 years.

ISS—International Space Station.

NASA—National Aeronautics and Space Administration.

Spacecraft—vehicles, payloads, and other manmade objects that are designed to for placement or operation in outer space. For example, spacecraft include satellites, inhabitable space stations, inhabitable capsules, and cargo vehicles.

Transfer orbit—a temporary orbit on which an object travels to move from one orbit to another.

Upper stage—a segment of a launch vehicle that reaches orbit.

I. Overview of Proposed Rule

This proposed rule would require an operator licensed or permitted under this chapter to perform a launch or reentry with a planned altitude greater than 150 kilometers (km) to limit or dispose of debris at the end of a launch or reentry to maintain a sustainable space environment.

The FAA proposes to require that operators licensed or permitted under parts 415, 417, 431, 435, 437, or 450, to perform a launch or reentry with a planned altitude greater than 150 km submit an Orbital Debris Assessment Plan (ODAP)—including physical evidence, test results, and analyses to demonstrate removal activities—prior to each operation. This notice proposes that if debris—including spent upper stages and other components—is released during launch or reentry, during on-orbit aspects of launch or reentry, or during disposal operations, any pieces greater than 5 mm in size must be removed from highly-used regions within 25 years. The FAA proposes to allow operators to meet this criterion by performing one of five disposal options. Operators may choose to dispose of the debris within 30 days of mission completion through (1) controlled disposal; (2)

maneuver to a disposal orbit; or (3) Earth-escape orbit. Alternatively, an operator could elect to (4) retrieve the debris within 5 years of mission completion; or (5) perform atmospheric uncontrolled disposal or natural decay within 25 years, if the debris disposal meets the risk criteria.

The FAA notes that many launches, as they are currently conducted, would already be in compliance with the operational requirements of the proposed regulation. The FAA also proposes to amend the reporting requirements governing debris creation. The FAA would require the reporting of a non-nominal launch or a debris-creating anomaly to the FAA.

II. Background

A. Statement of the Problem

Orbital debris is made up of fragmented material (resulting from anti-satellite tests, upper stage explosions, accidental collisions, etc.), nonfunctional spacecraft, rocket bodies, and mission-related items (explosive bolts, vehicle shrouds, etc.),[42] but excludes naturally-occurring debris such as meteoroids. As more and more spacefaring nations launch objects into Earth orbit, space is becoming increasingly crowded with orbital debris.[43] If left unchecked, orbital debris can diminish the usefulness of certain orbits and present a hazard to operations on-orbit. Current international modeling indicates that even if there were no further space launches, collisions between objects already in space will eventually become the major source of debris.[44] This threat could soon escalate dramatically with the deployment of large constellations of small satellites in the already-congested Low Earth Orbit (LEO) region.

As of 2021, the number of orbital objects sized 10 centimeters (cm) or greater is estimated to be over 23,000. Recent debris projections estimate a total of half a million objects sized between 1 and 10 cm on orbit, and over 100 million objects larger than 1 mm.[45]

Each Earth orbit has a specific usefulness and needs to be protected from accumulated orbital debris. LEO is commonly used for Earth observation, communications, and scientific experiments. LEO is also the region where most human spaceflight activities take place. Medium Earth Orbit (MEO) contains space navigation satellites and some communications missions covering the North and South poles. Space objects in Geostationary Earth Orbit (GEO) typically

[42] Belk, C.A., J.H. Robinson, M.B. Alexander, W.J. Cooke, and S.D. Pavelitz. (1997). Meteoroids and Orbital Debris: Effects on Spacecraft. *NASA Reference Publication 1408, Marshall Space Flight Center, AL.*

[43] Inter-Agency Space Debris Coordination Committee. (April 2013). *Space Debris IADC Assessment Report for 2010.*

[44] Inter-Agency Space Debris Coordination Committee. (January 2013). *Stability of the Future LEO Environment.*

[45] The NASA Orbital Debris Program Office. (Retrieved April 28, 2020). *Frequently Asked Questions.* orbitaldebris.jsc.nasa.gov/faq/#

support communications and weather missions. A transfer orbit is a temporary orbit that a launch vehicle uses to move from one orbit into another. A common transfer orbit is the GEO transfer orbit used to place spacecraft into GEO. The upper stage often remains in the GEO transfer orbit with an apogee near the GEO region and the perigee in LEO. Spacecraft typically occupy LEO, MEO, or GEO, but can operate in other less congested orbits. The areas outside LEO, MEO, and GEO have been known as acceptable disposal orbits for upper stages and discarded satellites because they are not frequently used by active satellites. Figure 1 illustrates the various levels of Earth orbit including disposal orbit regions.

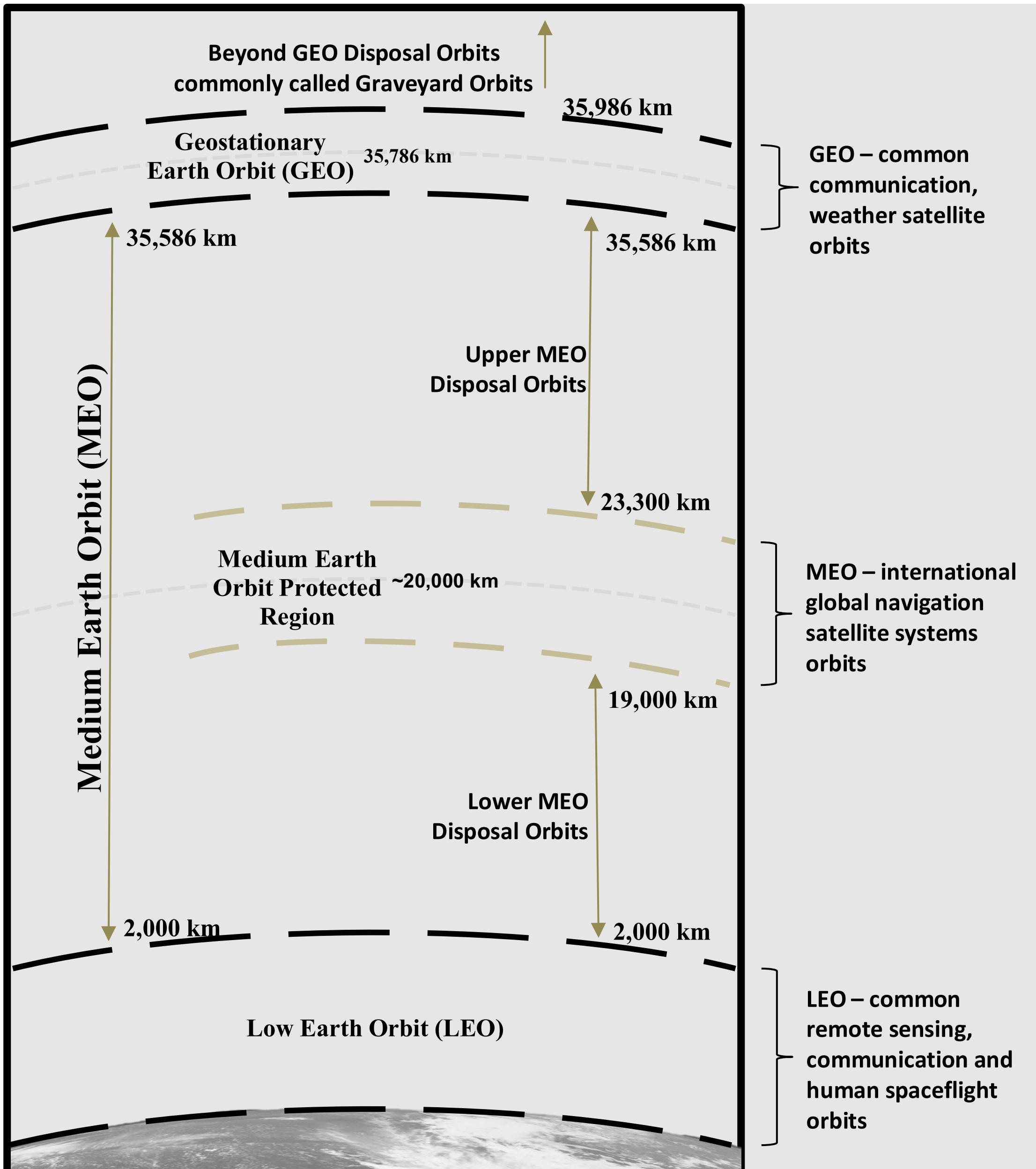

Figure 1: Operating and Disposal Orbits

Debris in space travels at hypervelocities. On average, collisions in LEO occur at a closure rate, or combined velocity at impact, over 10 km per second.[5] This is more than 11 times faster than a bullet. At those speeds, an impact to a typical operational spacecraft by debris 5 mm and larger will most likely cause damage to critical systems that ends the mission of the

[5] Portree, D.S.F. and Loftus, J.P. (January 1999.) Orbital Debris: A Chronology. NASA/TP-1999-208856.

spacecraft.[6] As seen in Figure 2, the main threat to operational spacecraft (abbreviated to "S/C" in Figure 2) in LEO is the debris in the range of 5 mm to 1 cm, primarily due to the sheer number of objects in this range. However, large objects greater than 1 meter, including discarded upper stages, are the main driver for debris growth.

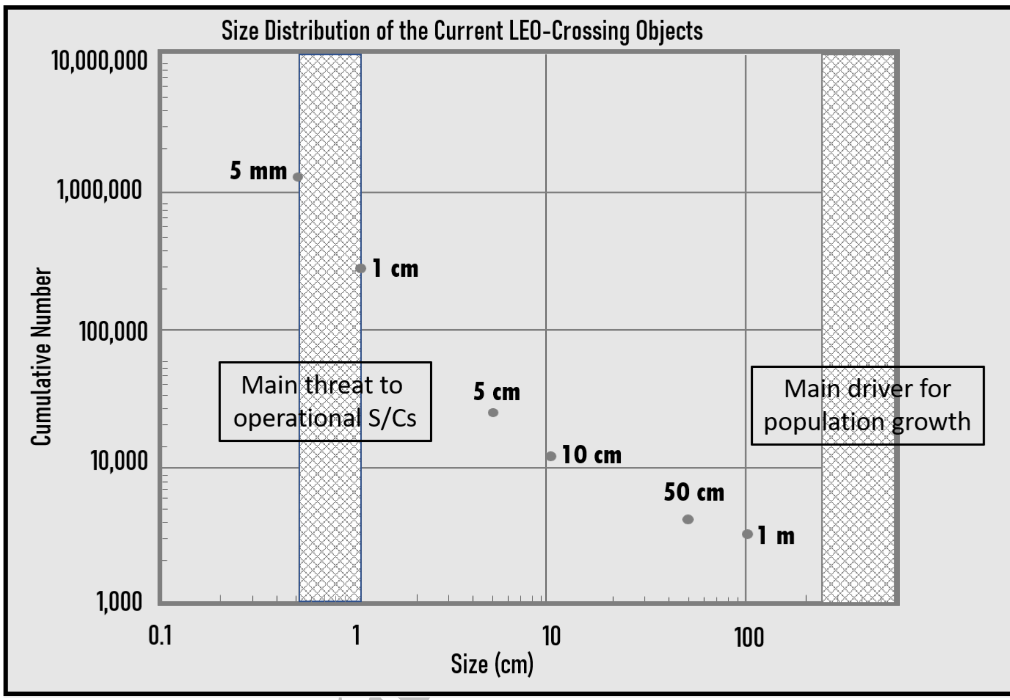

Figure 2: Notional cumulative size distribution of LEO-crossing objects [7]

In addition to causing catastrophic breakups, orbital debris impacts on functioning satellites or spacecraft can also degrade performance, pit or crack windows, mar surfaces of solar panels, damage optics, and degrade surface coatings. [8, 9] In 1984, a piece of orbital debris

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[6] Squire, M., et al. (2015). Joint Polar Satellite System (JPSS) Micrometeoroid and Orbital Debris (MMOD) Assessment, NASA/TM-2015-218780.

[7] Liou, J. C. (2011). Engineering and Technology Challenges for Active Debris Removal. Figure 4, page 8. Presented at the 4th European Conference for Aerospace Sciences. *Ibid*.

[8] Williamson, M. (2006). Space: The Fragile Frontier, American Institute of Aeronautics and Astronautics, Inc.
[9] The NASA Orbital Debris Program Office. (April 2009). Satellite Collision Leaves Significant Debris Clouds. NASA JSC Orbital Debris Quarterly News, 13(2), page 1-2.

damaged the windshield of the Space Shuttle Challenger. A 4 mm diameter crater was made by a fleck of white paint approximately 0.2 mm in diameter, traveling 3-6 km/sec.[46]

As of 2021, approximately 95 percent of the total mass of human-generated objects in orbit is rocket bodies (i.e. upper stages)[47] and spacecraft. The remainder is mission-related debris and fragmentation debris.[48] The more mass an object has, the more debris it will create in the event of an explosion or collision.

The U.S. Government, for launches it conducts, has taken steps to mitigate orbital debris generation. Similarly, other countries are taking steps to mitigate debris generation during operations they oversee. This proposed rule would align U.S. commercial orbital debris mitigation practices for U.S. commercial launch operations with orbital debris mitigation practices accepted by the U.S. Government and certain other countries. For example, the European Space Agency (ESA) is implementing a Zero Debris Approach to stop the growth of orbital debris from their operations by 2030. ESA's policy acknowledges that if the status quo of orbital debris generation continues, future on-orbit operations will be hindered unless actions like remediation (active debris removal) are enacted.[49]

If no mitigation measures are implemented, the projected growth of orbital debris is expected to rapidly increase, as Figure 3 shows. The growth rate, as estimated in 2011, assumed a steady launch rate based on annual launch rates and did not address the increase in satellite constellations. SpaceX alone has launched over 1,500 satellites in its Starlink constellation as of August 2021. Several more companies have launched their own small satellite constellations.

These small satellites are expected to have relatively short lifetimes, on the order of 5 years.

[46] Center for Orbital and Reentry Debris Studies, Aerospace Corporation. (December 2004). *Space Debris Basics: What Are the Risks?*
[47] Only some of the upper stages on-orbit result from U.S. commercially licensed launches.
[48] The NASA Orbital Debris Program Office. (May 2019). Monthly Mass of Objects in Earth Orbit by Object Type. *NASA JSC Orbital Debris Quarterly News*, *23*(1 & 2), page 13.
[49] European Space Agency. (Accessed on April 4, 2023). Short Introduction to ESA's Zero Debris Approach, blogs.esa.int/cleanspace/2023/01/12/short-introduction-to-esas-zero-debris-approach/#:~:text=The%20ESA%20Zero%20Debris%20Approach%20is%20the%20Agency%E2%80%99s,the%20catastrophic%20degradation%20of%20the%20Low-Earth%20Orbit%20environment

Even though many operators are following current best practices, those practices allow multiple generations of spent satellites to co-exist on-orbit. The graph in Figure 3 is based on trackable debris. Current technology tracks objects 10 cm and larger, though debris between 5 mm and 10 cm pose risks. The shaded areas around the solid lines are the 1-sigma uncertainty from 100 Monte Carlo runs of the growth model.

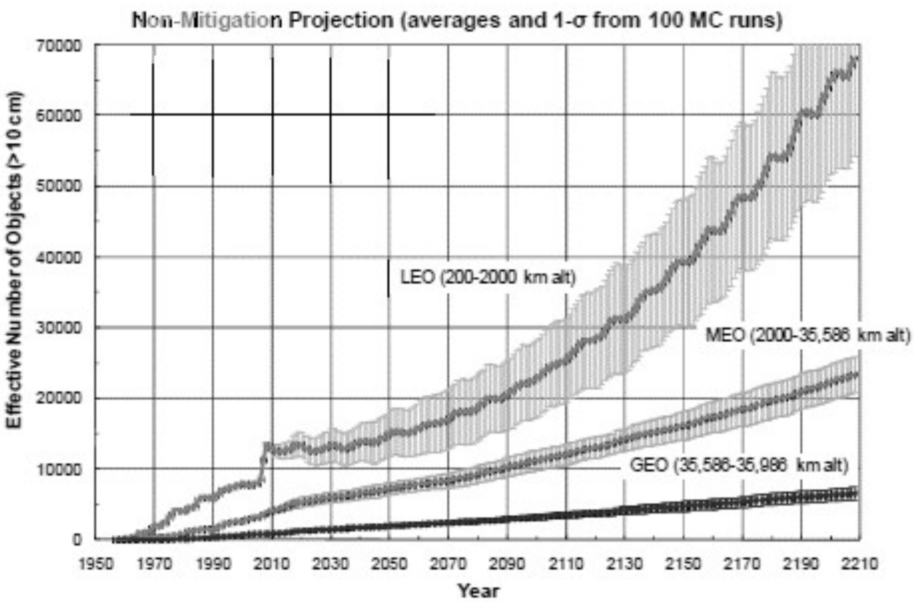

Figure 3 : Projected growth of the trackable ≥ 10 cm debris population in LEO, MEO, and GEO for the next 200 years. [14]

A launch vehicle is made up of a first stage and usually one or more upper stages. When a vehicle is launched into space, the first stage typically propels the vehicle through the bulk of the atmosphere, but does not reach orbit. The first stage falls back to Earth shortly after launch. The upper stage then ignites to put the payload into LEO or a transfer orbit. Typically, the upper

[14] Liou, J.-C. (2011). Engineering and Technology Challenges for Active Debris Removal. Presented at the 4th European Conference for Aerospace Sciences.

stage deploys the payload in LEO, if that is the final payload destination; otherwise, it usually deploys the payload in the transfer orbit for payload destinations higher than LEO.

Historically, the largest contributor to orbital debris was the explosion of upper stages.[50] Defunct upper stages with charged batteries or partially fueled tanks would often experience catastrophic failures attributed to stored energy. Current regulations adequately address this issue by requiring launch operators to ensure that stored energy is removed from all launch vehicle stages or components.[51] However, now the greatest risk regarding the growth of orbital debris population is collision between objects including upper stages on orbit. The strength of upper stage structures, along with their mass and size, pose a risk of catastrophic collisions that would create substantial amounts of orbital debris. The threat of fracturing such a large object can be mitigated by removing it from populated orbits. With this proposed rule, the FAA intends to ensure upper stages are properly disposed of at the end of launch to limit the growing orbital debris population.

The impact of even one collision has a significant effect on the growth of orbital debris. Figure 4, generated by the NASA Orbital Debris Program Office,[52] shows the predicted growth rate of orbital debris in LEO, as estimated in 2022. This growth rate is based on the population of objects greater than or equal to 10 cm, which is primarily fragmented material. This figure portrays the growth of the orbital debris environment. The figure highlights collisions and intentional destruction of spacecraft as the largest contributors to the debris environment. The figure also highlights the recent and rapid growth of operational spacecraft as large constellations continue to proliferate.

[50] Anz-Meader, P.D., Johnson, N., Cizek, E., and Portman, S. (July 31, 2001). *History of On-Orbit Satellite Fragmentation, 12th ed.* NASA Lyndon B. Johnson Space Center Orbital Debris Program Office, Houston, TX, JSC29517.

[51] 14 C.F.R. § 417.129(b) and (c) and § 450.171.(a)(2)-(3).

[52] Liou, J.-C. (8 Feb 2022). U.S. Space Debris Environment and Activity Updates. 59th Session of the Scientific and Technical Subcommittee, Committee on the Peaceful Uses of Outer Space, United Nations.

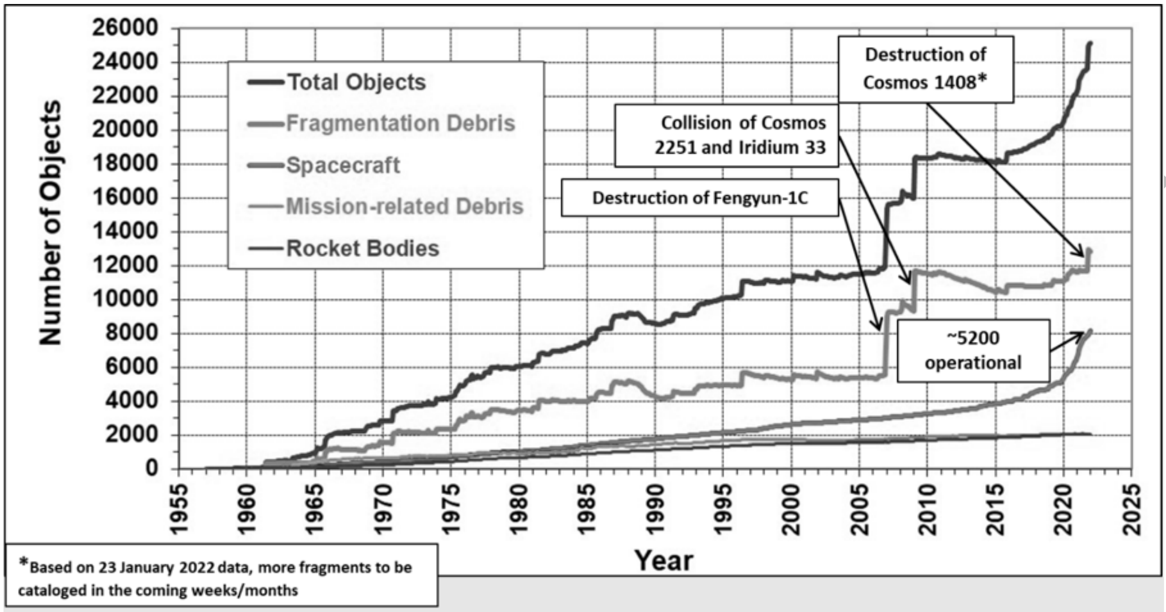

Figure 4: Predicted Growth of the LEO Debris Population.

The Iridium 33/Cosmos 2251 collision and the Chinese Fengyun-1C anti-satellite test have been the worst debris creating events ever recorded. These two events contributed approximately 5,900 catalogued objects to the environment. Launch vehicle upper stages are significantly more massive than any of the objects involved in these events and a catastrophic collision involving an upper stage would produce many more times the debris created in these events.

Debris imposes a cost on active satellites. Maneuvering an active spacecraft to avoid collision with space debris will mitigate the immediate threat of collision, but doing so uses up valuable resources. It takes time and effort to plan a maneuver; and, in some cases, the fuel expended on the maneuver will lead to a shortened mission life for the spacecraft. Most importantly, only active spacecraft are capable of maneuvering, whereas upper stages have no maneuverability after the end-of-launch. Removing upper stages from congested orbits would lessen the likelihood of debris-on-debris collisions and would reduce the probability of active satellites maneuvering to avoid a collision.

The first accidental hypervelocity collision between two intact spacecraft occurred in February 2009. The operational U.S. Iridium 33 communications satellite and the defunct Russian Cosmos 2251 communications satellite collided at a speed of 11.7 km/sec (26,172.2 mph), above northern Siberia. [18] The collision destroyed both satellites and produced more than 2,300 pieces of trackable debris.

The Chinese anti-satellite test and the Iridium/Cosmos collision were not the only orbital debris events to occur. In July 1996, a collision occurred between a French Cerise satellite and a briefcase-sized piece of debris left in orbit from an exploded Ariane third stage. The impact tore off a 4.2 m section of the Cerise's gravity-gradient stabilization boom. [19]

An example of orbital debris colliding with other orbital debris occurred on January 17, 2005, when a 31-year-old U.S. rocket body and a Thor-Burner 2A collided with a fragment from an exploded third stage of a Chinese CZ-4 launch vehicle. The collision occurred at an altitude of 885 km above the South Polar Region. [20]

If the amount of debris is not curtailed, the risk of future collisions between spacecraft and orbital debris will increase at a greater rate which will create more debris and degrade the usefulness of popular orbits. Fragments generated from one breakup can be large enough to

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[18] The NASA Orbital Debris Program Office. (April 2009). Satellite Collision Leaves Significant Debris Clouds. *NASA JSC Orbital Debris Quarterly News, 13*(2), page 1-2.

[19] C.A. Belk, J.H. Robinson, M.B. Alexander, W.J. Cooke, and S.D. Pavelitz. (August 1997). Meteoroids and Orbital Debris: Effects on Spacecraft. *NASA Reference Publication 1408, Marshall Space Flight Center, AL.*

[20] Williamsen, J., Blacklock, K., Evans, H.J., and Guay, T.D. (1999). Quantifying and Reducing International Space Station Vulnerability Following Orbital Debris Penetration. *Journal of Spacecraft, 36*(1), page 1333-141.

catastrophically break up another target mass of the same size, continuing the cycle to create more debris. This cycle is referred to as the "Kessler Syndrome."[21]

Figure 5 shows the projected accidental collision activity in LEO as determined using 100 Monte Carlo runs in NASA's LEGEND model from 2010. An average of 8 to 9 collisions were expected to occur over the next 40 years (approximately 1 collision every 5 years).[22] The uppermost line shows the increasing number of collisions based on a non-mitigation scenario. The middle line shows the effects if 90 percent of all launchers worldwide[23] followed the proposed orbital debris mitigation standards. However, this model did not account for the large constellations that have now started to populate LEO.

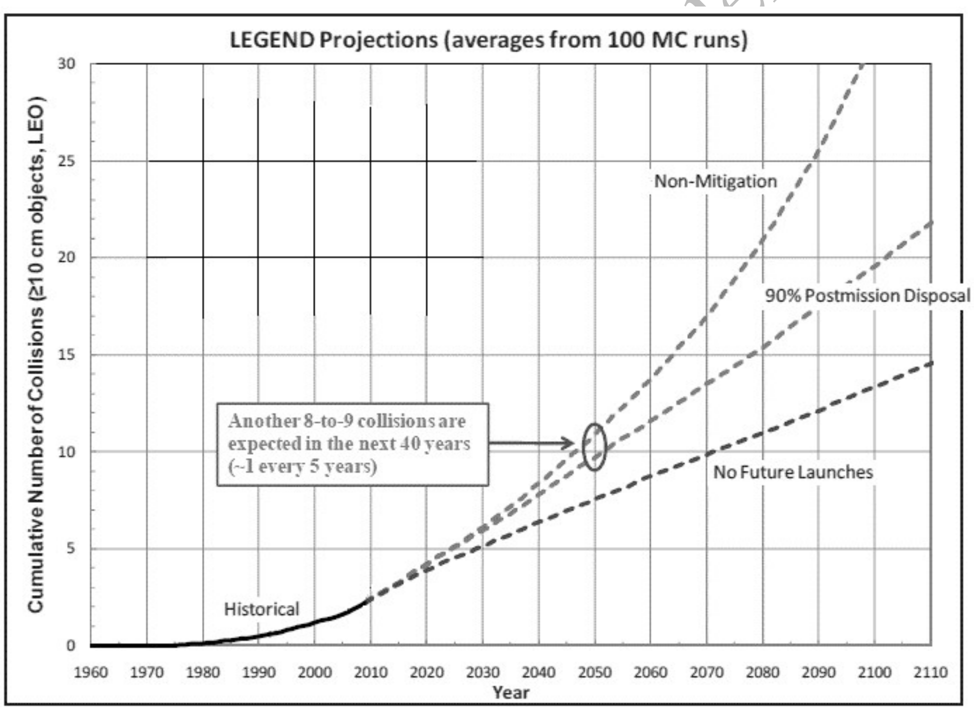

Figure 5: Predicted Accidental Collision Activities in LEO.[24]

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21 Kessler, D.J., Johnson, N., Liou, J.-C., and Matney, M., "The Kessler Syndrome: Implications to Future Space Operations", Presented at the 33rd Annual AAS Guidance and Control Conference, Paper AAS 10-016, Breckenridge, CO, February 6-10, 2010, Published in Vol. 137 of the Advances in the Astronautical Sciences Series.

[22] *NASA JSC Orbital Debris Quarterly News 14*(1), page 7-8.
[23] In 2021, there were 135 successful worldwide orbital launches of which 39 were FAA licensed. [24] *NASA JSC Orbital Debris Quarterly News 14*(1), page 7-8.

Figure 6 shows the updated collision expectation taking into account large constellations. With an addition of 8,300 spacecraft in constellations, the number of on-orbit collisions are expected to range from 1 every 2.2 years, up to more than 1 collision per year. The variance depends on the post-mission disposal (PMD) rate of the spacecraft in constellations, which is the probability that the spacecraft will be removed from LEO after its mission is complete. This study assumed that the constellations were refreshed with new satellites every 20 years, so the large constellations were renewed and remained on orbit, just swapping out individual satellites. After 200 years, for a PMD rate of 90 percent, a total of 260 catastrophic collisions are estimated to have occurred in LEO. With the accumulation of large constellations in LEO, it is imperative that large mass upper stages are removed from orbit so as to prevent collisions between upper stages and constellation spacecraft that could create large amounts of debris in already crowded orbital regions.

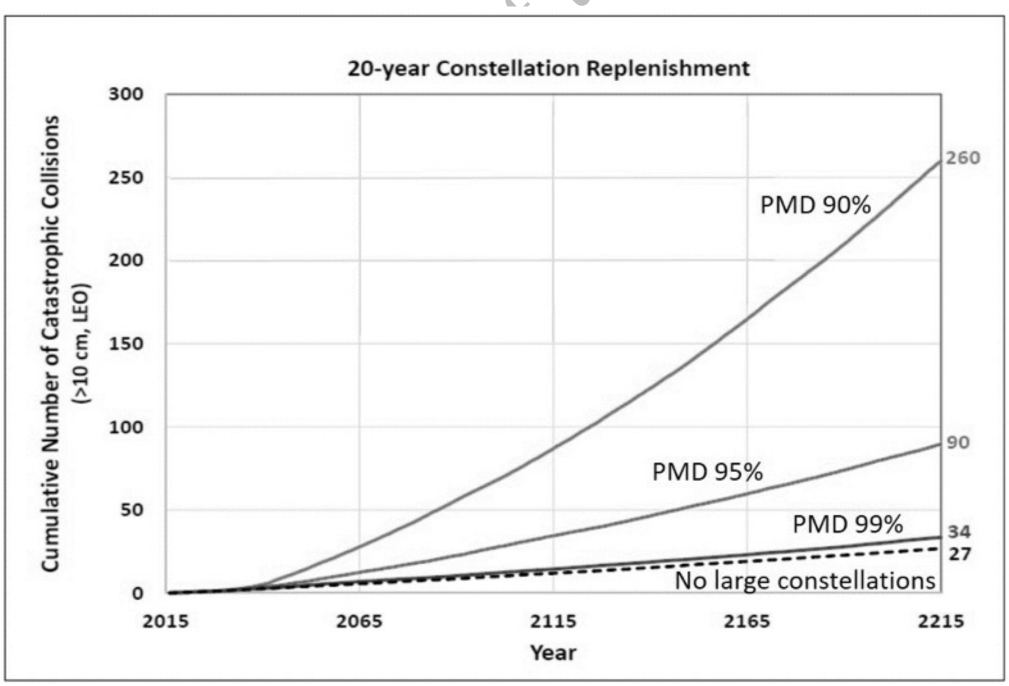

Figure 6: Cumulative Number of Catastrophic Collisions in LEO.[53]

Orbital debris also poses a high risk to safety for the International Space Station (ISS). The ISS is a high-value asset occupied by a constant human presence; therefore, it requires more protection than that provided by its protective shielding. Through shielding, the U.S. modules of the ISS are protected against impacts from debris ranging from 1 mm to 1 cm in size. During the first 8 years of ISS operations between 1999 and 2007, 6 successful maneuvers were conducted to avoid debris. However, since the Chinese anti-satellite test and the Iridium/Cosmos collision, the ISS has on average made an evasive maneuver twice a year due to debris from those events. Each maneuver costs millions of dollars in fuel usage and to perform the risk calculations to determine whether to move the station or shelter the crew.[54] Collision events and their risk to the ISS, and other on-orbit human activity, highlight the need to remove upper stages and prevent more debris creation.

Orbital debris mitigation is crucial to stem the increase of accumulation of large objects in orbit. Projections indicate that orbital debris in the LEO environment will increase approximately 75 percent in the next 200 years, even if 90 percent of spacecraft and upper stages reenter the Earth's atmosphere within 25 years of the end of the mission.[55] This projection was done before the proliferation of large constellations and the increased launch rate seen in the past few years. Launch and reentry operators' compliance with the U.S. Government Orbital Debris Mitigation Standard Practices (USGODMSP)[56] and any action to remove a number of large objects from orbit would help prevent this increase.[57] This proposed rule reflects the best practices agreed to in the USGODMSP and is reflective of international consensus for orbital debris mitigation. Currently, research efforts are underway to develop the technology necessary to economically remove the critical debris pieces; however, there are no operational systems and the costs are expected to be high, approximately $30 million to $50 million per large object[58] (large objects are objects weighing roughly over 5,000 kilograms). These large objects are primarily rocket body upper stages. A recent paper[59] introduced at the 2020 International Astronautical Congress identified the 50 most dangerous pieces of orbital debris. The paper identified 39 of the 50 objects as upper stages capable of producing large amounts of space debris were they to collide.

With this proposal, the FAA also seeks to mitigate the risk to the public posed by uncontrolled disposals. Uncontrolled disposals of large upper stages, such as the Chinese Long March stage that reentered on May 9, 2021, and the Falcon 9 upper stage that reentered as an uncontrolled atmospheric disposal over the Pacific Northwest in March 2021, pose a significant risk to people on the ground due to their mass and the uncertainty of where they will land. Such disposals occur frequently, from upper stages, defunct spacecraft, and other debris. Per NASA, "During the past 50

[53] J.-C. Liou, M. Matney, A. Vavrin, A. Manis, and D. Gates. (September 2018). NASA ODPO's Large Constellation Study. *Orbital Debris Quarterly News, 22*(3), pages 4-7.

[54] Discussion with NASA VIPER office, January 2012.

[55] *NASA JSC Orbital Debris Quarterly News 14*(1), page 7-8.

[56] The USGODMSP apply to all U.S. government space launches.

[57] D.J. Kessler, N. Johnson, J.-C. Liou, and M. Matney. (February 6-10, 2010). The Kessler Syndrome: Implications to Future Space Operations; Paper AAS 10-016. *Advances in the Astronautical Sciences Series, 137.* Presented at the 33rd Annual AAS Guidance and Control Conference, Breckenridge, CO.

[58] Braun, V., Schulz, E., and Wiedemann, C. (August 2014). *Cost Estimation for the Active Debris Removal of Multiple Priority Targets.* Presented at the 40th COSPAR Scientific Assembly.

[59] McKnight, D., et al. (April 2021). Identifying the 50 statistically-most-concerning derelict objects in LEO. *Acta Astronautica, 181*, page 282-291.

years an average of one cataloged, or tracked, piece of debris fell back to Earth each day."[60] Large upper stages carry the most risk to people on the ground; risk that is above the common acceptable risk limit of 1×10^{-4}. This is the same risk limit codified in

14 CFR § 450.101 for purposeful reentries, in International Standard (ISO) 24113, and in the USGODMSP, and the risk limit has been in common practice in the launch safety industry for more than 20 years. Although there are currently no documented cases of reentering debris causing casualties, uncontrolled disposal of large upper stages presents a significant safety risk to persons and property on the ground, or aircraft in flight. That risk can be mitigated by the operator performing a controlled disposal into an unpopulated area shortly after the end of launch, and providing advance notice to aircraft and vessels in the area. Uncontrolled disposals would not be permitted under the proposed orbital debris mitigation rule unless the operator can demonstrate that the effective casualty area, in total spread over the entire projected path, for the sum of all surviving debris will be less than 7 square meters or the expected average number of casualties will be less than 1×10^{-4}.

B. History

There have been many national and international efforts to protect against the effects of orbital debris. Early spaceflight operated under the theory that, because space was large, collisions were unlikely. Recent events discussed previously have demonstrated that to continue to operate under this theory is dangerous.

On February 11, 1988, President Reagan issued a Presidential Directive[61] on national space policy which included a requirement to limit the accumulation of orbital debris. This directive was the foundation for a coordinated effort among U.S. agencies and other nations to increase the understanding of the hazards caused by orbital debris and to establish effective techniques to manage the orbital debris environment. The National Security Council produced a Report on Orbital Debris[62] in 1989 outlining the problem and recommended more study of the orbital debris situation. An updated Interagency Report on Orbital Debris[63] by the new National Science and Technology Council was released in 1995, directing government agencies to develop a coordinated orbital debris work plan, to consult with U.S. industry, and to continue efforts to achieve international consensus on dealing with the orbital debris problem.

In response, NASA and the Department of Defense, coordinating with other space-related Federal agencies, developed a draft set of USGODMSP, derived in large measure from NASA Safety Standard 1740.14.[64] These standard practices, applicable to launches by the U.S.

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[60] Frequently Asked Questions: Orbital Debris, www.nasa.gov/news/debris_faq.html

[61] The White House. (February 11, 1988). Presidential Directive on National Space Policy, spp.fas.org/military/docops/national/policy88.htm#:~:text=The%20directive%20states%20that%20the%20national%20security%20space%20sector%20will,Space%20Control

[62] National Security Council. (February 1989). Report on Orbital Debris by Interagency Group (Space), ntrs.nasa.gov/citations/19900003319.

[63] The National Science and Technology Council Committee on Transportation Research and Development. (November 1995). Interagency Report on Orbital Debris, www.hsdl.org/?view&did=722496.

[64] NASA. (August 1995). *NSS 1740.14, NASA Safety Standard: Guidelines and Assessments for Limiting Orbital Debris.*

Government, were adopted by the U.S. Government in February 2001 and mandated by the National Space Policy of 2006.[65] The Department of Defense and its service and defense agencies issued their own detailed orbital debris mitigation requirements to meet the

USGODMSP standard.

U.S. regulatory agencies, particularly the FAA, the National Oceanic and Atmospheric Administration (NOAA), and the Federal Communications Commission (FCC), have also addressed orbital debris mitigation by establishing requirements for space activities that they regulate. In a final rule published September 19, 2000,[66] the FAA adopted some, but not all, debris mitigation practices that were widely accepted by NASA and the commercial space industry at the time, such as the removal of stored energy sources that could generate debris.[67] The only collision mitigation measure the FAA established was to require avoiding any unplanned contact between the launch vehicle and the payload after payload separation.[68] At that time, the FAA aimed to align with then-current international practice without negatively affecting U.S. launch competition in the international market.

Since then, there has been considerable progress in addressing requirements to reduce orbital debris. Most notably, the FCC adopted a comprehensive set of regulations that apply to U.S. satellites and to satellites that provide communications services to the United States.[69] The

FCC regulations closely reflect the USGODMSP.

The international community is also adopting practices that reduce orbital debris generation. The Inter-Agency Space Debris Coordination Committee (IADC), in which NASA represents the U.S., issued Space Debris Mitigation Guidelines in 2002. The IADC coordinates activities related to orbital debris issues and is comprised of representatives from space agencies around the world. Member States are encouraged to use the consensus-based IADC guidelines. These include implementing a mitigation plan for each launch that details how the operator will limit debris from normal operations, minimize the potential of unplanned breakup, and dispose of spacecraft and stages post-mission.[70] The USGODMSP, which apply to U.S. Government launches, are consistent with, and in parts surpass, the IADC guidelines. The FAA's current regulations do not meet all the USGODMSP or the IADC guidelines. The FAA currently only requires passivation at the end of launch and prevention of collisions between the payload and upper stage. The current FAA regulations do not

[65] The White House. (August 31, 2006). *U.S. National Space Policy.*
[66] Commercial Space Transportation Reusable Launch Vehicle and Reentry Licensing Regulations, 65 FR 182 (September 19, 2000).
[67] 64 FR 19586, 19608 ("The FAA has elected to adopt only selected debris mitigation practices that are of almost universal applicability.")
[68] 14 C.F.R. § 417.129(a).
[69] Mitigation of Orbital Debris, 69 FR 54581 (September 9, 2004).
[70] IADC. (October 2002). *IADC Space Debris Mitigation Guidelines; IADC-02-01.*

otherwise address debris mitigations or postmission disposal, and do not restrict uncontrolled reentries based on the risk posed to public safety.

In 2010, the National Space Policy specifically encouraged the development and adoption of industry standards for the purpose of minimizing debris and preserving the space environment for the responsible, peaceful, and safe use of all users.[43] Subsequent policies have retained similar language.

In 2011, the National Research Council recommended incorporating orbital debris mitigation practices into regulations:

> NASA should continue to engage relevant federal agencies as to the desirability and appropriateness of formalizing NASA's Orbital Debris Mitigation Standard Practices, including the "25-year rule,"[44] and NASA Procedural Requirements for Limiting Orbital Debris as legal rules that could be applicable to U.S. non-NASA missions and private activities.[45]

In response, NASA engaged with relevant agencies: NOAA, regarding implementing orbital debris mitigation standard practices as part of NOAA's commercial remote sensing licensing program; FCC, regarding licensing of communications spacecraft; and the FAA, regarding launch vehicles.

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[43] The White House. (June 28, 2010). *National Space Policy of the United States of America.*

[44] NASA requires that "[a]ll debris released during the deployment, operation, and disposal phases shall be limited to a maximum orbital lifetime of 25 years from date of release (Requirement 56398)." NASA-STD-8719.14A, 201205-25.

[45] The National Academy of Sciences. (September 2011). *Limiting Future Collision Risk to Spacecraft: An Assessment of NASA's Meteoroid and Orbital Debris Programs*.

In 2019, in response to the National Space Council's Space Policy Directive 3,[71] the U.S. Government released an updated version of the USGODMSP[72] to address the effects of large constellations and small satellites. The updates consist of a quantitative limit on debris released during normal operations, a probability limit on accidental explosions, probability limits on accidental collisions with large and small debris, and a reliability threshold for successful postmission disposal. The new standard practices updated disposal options and incorporated new sections to clarify and address operating practices for large constellations, rendezvous and proximity operations, small satellites, satellite servicing, and other classes of space operations.

For this proposed rulemaking, the FAA considered the orbital debris requirements of NASA, FCC, NOAA, and the IADC, in an effort to align commercial standards and government standards and to address the persistent risks associated with heavy upper stages abandoned in orbit. The FAA focused on NASA because it has the most detailed orbital debris requirements and guidance, and is an internationally recognized leader in orbital debris and space exploration whose expertise in space and mission planning is a benchmark for the FAA's rulemaking efforts. The effort to establish common standards is consistent with the U.S. Space Transportation Policy, which states the Secretary of Transportation shall execute exclusive authority, consistent with existing statutes and executive orders, to address orbital debris mitigation practices for U.S.licensed commercial launches, to include launch vehicle components such as upper stages, through its licensing procedures.[48]

The FAA believes the proposed regulations would not hinder U.S. companies from competing in the international launch market because regulations of foreign countries are also expected to comply with IADC guidelines, and some countries' regulations are stricter than the requirements proposed in this rule. For example, the French space agency, Centre National d'Études Spatiales (CNES), issued technical regulations in 2009 that extend beyond the requirements of the IADC guidelines and spell out the acceptable reentry risk from orbital debris for those with French space operation licenses. The IADC guidelines are a consensus document originally based on the USGODMSP. Due to the consensus nature of the IADC guidelines, an agreed-upon document between 13 different space agencies, the guidelines are not as thorough and specific as the USGODMSP. Several of the IADC's ~~13 participating space agencies~~ are currently working to implement regulations that align with the IADC guidelines; however, not all

IADC participants have launch capability.

III. Discussion of the Proposal

The FAA proposes several new requirements for limiting the lifetime of debris in LEO and in GEO. First, the FAA proposes to amend the definition of "disposal" in § 401.7 to include each of the

[71] The White House. (June 18, 2018). *Space Policy Directive-3, National Space Traffic Management Policy.* trumpwhitehouse.archives.gov/presidential-actions/space-policy-directive-3-national-space-traffic-managementpolicy/

[72] United States Government. (November 2019) *U.S. Government Orbital Debris Mitigation Standard Practices, November 2019 Update.* orbitaldebris.jsc.nasa.gov/library/usg_orbital_debris_mitigation_standard_practices_november_2019.pdf

[48] The White House. (November 21, 2013). *National Space Transportation Policy of the United States of America.* www.nasa.gov/sites/default/files/files/national_space_transportation_policy_11212013.pdf

disposal options proposed for part 453. The existing definition describes controlled atmospheric disposal, and would exclude the other four options proposed in §§ 453.14 through 453.18 for the disposal of spent upper stages and launch or reentry vehicle components. The FAA therefore proposes to define "disposal" as the execution or attempt to execute "controlled atmospheric disposal, heliocentric disposal, uncontrolled atmospheric disposal, disposal orbit, or direct retrieval of launch vehicle stages or components of launch or reentry vehicles under part 453 of this chapter."

The FAA also proposes to add definitions to § 401.7 for "Low Earth Orbit (LEO)," "Medium Earth Orbit (MEO)," "Geostationary Earth Orbit (GEO)," "the geosynchronous region," and "orbital debris." "LEO" would be defined as any Earth orbit with both apogee and perigee below 2,000 km altitude. "MEO" would be defined as any Earth orbit in which an object's apogee and perigee both remain between LEO and GEO. "GEO" would be defined as any Earth orbit where the orbiting object orbits at the same angular velocity as the Earth and the object appears stationary from the ground. The altitude of this zero-inclination, zero-eccentricity orbit is 35,786 km. "The geosynchronous region" would be defined as the band of orbital space surrounding GEO. It is bound by altitude limits of 35,786 km +/- 200 km altitude and +/- 15 degrees latitude.

The IADC defines Space Debris as "all man-made objects including fragments and elements thereof, in Earth orbit or re-entering the atmosphere, that are non-functional."[73] The FAA agrees with the IADC definition of space debris and refines the debris issue further by establishing the size of debris applicable for regulation. "Orbital debris" would be defined as all human-generated debris in Earth orbit that is greater than 5 mm in any dimension. This includes, but is not limited to, payloads that can no longer serve a useful purpose, rocket bodies and other hardware (e.g., bolt fragments and covers) left in orbit as a result of normal launch and operational activities, and fragmentation debris produced by failure or collision. The FAA proposes to expressly exclude released gases and liquids from the definition of orbital debris. The release of gases and liquids is often deliberate for the purpose of maneuvering or to evacuate excess gases and liquids at the end of launch. The FAA does not believe addressing the release of gases and liquids is necessary at this time because the risk is low. One of the debris mitigation actions at the end of launch is the release of pressurized gases and propellants because the risks of accidental explosion outweigh the risks of released gases and liquids. Based upon this understanding, the FAA finds that it is unnecessary to regulate released gases and liquids at this time.

The FAA proposes 5 mm as the threshold size because an object of that size, traveling at 10 km per second, a speed typical of objects on orbit, can incapacitate a functioning satellite, which in turn may contribute to the creation of more debris. Most active satellites on orbit are protected against small pieces of debris and micrometeoroids less than 5 mm in size with shielding or thermal blankets. However, pieces as small as 5 mm can do significant damage to satellite operations. The kinetic energy that a 5 mm cube of titanium (4.43 g/cm^3 density) has, while traveling 10 km per second in

[73] IADC Space Debris Mitigation Guidelines, IADC-02-0, Revision 2, Mar 2020.

LEO, is 27,700 Joules. Comparably, the energy of a .30-06 rifle bullet (11.7 grams) when exiting a gun muzzle is only 3,700 Joules.

Spacecraft vary in design and material composition, so it is hard to identify an exact threshold size of debris that could significantly damage a spacecraft. Nevertheless, the National Research Council found in its 2011 report on orbital debris that typical spacecraft are not well shielded from small debris, and that objects 5 mm and larger can cause substantial damage.[74] For this reason, the FAA proposes to use 5 mm as the size threshold for orbital debris. However, the FAA requests comments on further lowering the size threshold to below 5 mm.

The FAA recognizes that a launch operator cannot prevent the release of all small debris fragments, such as paint flakes and solid rocket motor (SRM) slag. SRMs—used to boost satellites into higher orbits—are potentially a significant source of numerous pieces of aluminum oxide slag up to 5 cm in diameter. Likewise, flaking paint is a debris hazard, albeit of very small size. Debris of this size usually will not disable a spacecraft, but it does pose a hazard to spacewalkers, and over time it causes erosion damage and more debris. The FAA is not, however, proposing to regulate debris smaller than 5 mm, paint flakes, or solid rocket motor slag of any size, due to the current impracticality of tracking and mitigating the propagation of such small items. At this time, the only practical mitigation for debris smaller than 5 mm is to harden spacecraft to make them less susceptible to small debris.

Proposed § 453.1 would provide the scope of part 453: the requirements of a launch or reentry operator for orbital debris mitigation, including collision avoidance analysis, prior to launch or reentry operations licensed or permitted under this chapter with a planned altitude greater than 150 km. The FAA proposes to require in § 453.1(b) that for each licensed or permitted launch or reentry with a planned altitude greater than 150 km, an operator must submit (1) an ODAP containing the information required by this part, not less than 60 days before the licensed or permitted launch or reentry, unless the Administrator agrees to a different time frame in accordance with § 404.15; and (2) a Collision Avoidance Analysis Worksheet in accordance with § 453.11(f). The submittals must be emailed to the address provided in proposed § 453.1(c) or otherwise submitted as agreed to by the Administrator in the license or permit. The FAA proposes to require that operators submit their ODAP no later than 60 days prior to the launch or reentry subject to part 453 to be consistent with the timeframes in part 450 and in the legacy regulations. The FAA proposes no change to the timeline for submitting the Collision Avoidance Analysis Worksheet, which is currently required by § 450.169 and would be moved to

§ 453.11(f).

Proposed § 453.3 would state that part 453 applies to launches and reentries licensed or permitted under this chapter with a stage or other component with a planned altitude greater than 150 km. Few satellites operate below the altitude of 150 km, hence mitigation of orbital debris below 150 km is not necessary.

[74] The National Academy of Sciences. (September 2011). *Limiting Future Collision Risk to Spacecraft: An Assessment of NASA's Meteoroid and Orbital Debris Programs*.

A. Limitations on Orbital Lifetime of Debris Released During Normal Operations

Current §§ 417.129 and 450.171 do not address the planned release of debris during normal operations, such as the deliberate planned release of payload spacers, retaining rings, or tension rods. To reduce the amount of debris in orbit, the FAA proposes to require that launch operators ensure that no vehicle stages or components release orbital debris during normal operations that will remain in orbit for more than 25 years. Proposed § 453.5(a) would require a launch operator to ensure that no vehicle stages or components that reach Earth orbit release orbital debris into LEO that would remain in orbit for more than 25 years. The 25-year rule is a common standard recommended by the IADC and a requirement for U.S. Government launches under the USGODMSP.

For the lowest region of LEO—orbits with perigee altitudes below 600 km—debris typically has an orbital lifetime of less than 25 years, and smaller pieces of debris here may reasonably be expected to burn up on reentry into Earth's atmosphere within the allowable time limit. This proposed requirement would have a greater impact on operations releasing debris above 700 km, where debris may remain on-orbit for hundreds of years. The most efficient and practical approach to comply with the proposed requirements would be to avoid creating any debris in the upper portions of LEO and higher altitudes. For example, if a launch operator cannot demonstrate that it will remove all debris larger than 5 mm from orbit within 25 years, as required by § 453.5, then the launch operator must prevent such objects from separating from the launch vehicle. A launch operator could do so by redesigning the separation system (a common source of debris) or by using lanyards or other means to prevent debris release.

Given that most current launch vehicles have been designed to minimize or eliminate normal operations debris release, the FAA anticipates that this proposed requirement would impose no more than a minimal burden on operators for compliance. Operators usually meet this requirement because they want to minimize the release of debris and the possibility of damage to their deployed payloads. Since commercial launches are deploying increasing numbers of payloads, which could result in additional debris release, the FAA finds it appropriate to require that all operators limit their release of debris.

The FAA also proposes to require in § 453.5(a) that the total object-time product for all debris planned to be released into LEO shall not exceed 100 object-years per licensed or permitted launch. Object-time is a unit of measure used by NASA. It means the number of objects multiplied by the unit of time, typically years. A higher object-time means more objects on orbit for a higher cumulative amount of time. Limiting the object-time reduces the number of objects in orbit. The more objects released, the less time they can spend in orbit to meet the object-time requirement. For example, if an operator plans to release 5 debris objects, none of those objects can remain in Earth orbit longer than 25 years, and the total orbital lifetime of all 5 debris objects cannot exceed 100 years. The regulation would specify that the total object-time product in LEO is the sum of the orbit dwell time in LEO for all planned released objects, excluding the upper stage and any released payloads. The requirement would target debris released into LEO since, as discussed above, this small spatial area is heavily used and currently contains the most debris. This requirement is consistent with the USGODMSP guidelines and is necessary to limit the number of released objects per launch. The FAA supports the

USGODMPS object-time standard and notes the standard is particularly relevant to space launch activities that use payload deployment devices.

The FAA notes that the 100 object-years limit would apply to debris that the operator plans to release during launch activities, and would not include debris released due to nonnominal conditions or launch or reentry activity outside the 3-sigma trajectory provided for collision avoidance. However, an operator would be required to immediately notify the FAA and provide the information required by § 453.20 at the detection of a debris-creating event or any launch or reentry outside the 3-sigma trajectory provided for collision avoidance.

The FAA solicits comments on its proposal to limit the total object-time product of all debris released by a single launch into LEO to 100 object-years. Although, as noted above, this standard derives from the USGODMSP, the FAA recognizes that this standard is new, and the commercial space industry has not had an opportunity to weigh in on the effectiveness or operational implications of this requirement. As a result, FAA seeks insight into stakeholders' opinions on limiting the total object-time product of all debris released by a single launch into LEO to 100 object-years, and whether a smaller object-time should be imposed.

The FAA would also require that debris released into the geosynchronous region be removed within 25 years after release. Proposed § 453.5(b) would require a launch operator to ensure that any orbital debris released into the geosynchronous region enters an orbit with an apogee that would not remain within the geosynchronous region within 25 years of the release. Operators would need to submit analysis showing that the debris will stay below the geosynchronous region 25 years after release, and that it will not enter the operational geosynchronous region again. Released debris can only move into lower orbits. Debris released above GEO would eventually return to the GEO protected region.

The FAA solicits public comments on its proposal to require that debris be removed within 25 years, as opposed to a shorter deadline. While the FAA recognizes the current IADC and USGODMSP guidelines, which limit post-mission lifetimes in LEO to 25 years, the FAA recognizes that increases in the numbers and kinds of activities in Earth orbit may render the 25year timeframe inadequate to prevent the growth of orbital debris. Given that the entire mission lifetime of upper stages and their components is quite short, and spent upper stages pose a significant risk of debris propagation the longer they are in orbit, it may be appropriate to have a shorter disposal timeline of 5 years or another time period less than 25 years. Shortening the removal deadline would decrease the risk of orbital debris causing damage to spacecraft, which could create more debris, shorten another spacecraft's mission, or endanger the lives of human spaceflight participants. The FAA requests comments on the degree to which a shorter timeline for removal from LEO or GEO within 5 years or another period shorter than 25 years would further encourage the minimization of released debris, as well as the relative impact of a shorter timeframe on operational capabilities.

Proposed § 453.5(c) would specify the information that must be included in an ODAP to demonstrate compliance with § 453.5(a) and (b). Specifically, the ODAP must include (1) a demonstration through environmental qualification and acceptance testing that the system is designed to limit the release of orbital debris; and (2) a statistical analysis, including inputs and assumptions, demonstrating that any orbital debris released will be disposed of within 25 years and satisfy the 100 object-year requirement. The environmental qualification and acceptance testing could include vibration, shock, vacuum, or any other appropriate testing to demonstrate that debris will not be released from the upper stage. Operators should provide the FAA specific verifiable analysis or test results that demonstrate the mitigation measures the launch operator would take to prevent release of debris greater than 5 mm in size or to ensure that it departs LEO or GEO within 25 years. Results of hardware and software tests, if performed on the separation system, would fulfill the requirement to demonstrate the effectiveness of debris prevention measures. The testing should apply to the entire lifetime of the system. If debris will be released, an orbital lifetime analysis using the methods described in ISO 27852[75] or NASA's Debris Assessment Software (DAS) or similar software would be acceptable. The inputs and assumptions referenced in § 453.5(c)(2) would include the initial orbit, the altitude of the release, and information about the debris objects planned to be released, such as their mass, area, and estimated orbital lifetime. The FAA seeks public comments on the proposed demonstration through specific analysis and testing of debris release prevention.

B. Collision Mitigation Between Launched Objects

The current FAA regulations in parts 415, 417, 431, 435, and 450 require that launch operators prevent the unplanned physical contact between a launch vehicle and each payload after payload separation. The FAA proposes to move these current requirements for safety at the end of launch to § 453.9(a). The FAA proposes to add a requirement in § 453.9(b) to limit the probability of collision with orbital objects greater than 10 cm to less than 1 in 1,000 over the orbital lifetime of the upper stage. This proposal matches the standard in USGODMSP and is necessary to lower the risk of debris impacts with the upper stage and its components. The probability of collision during orbital lifetime can be reduced by removing the upper stage and components from orbit, as discussed in the next section, and by operating the upper stage in an orbit with a low density of orbital objects.

Proposed § 453.9(c) would require launch operators to include in their ODAP for each launch or reentry a procedure for preventing vehicle and payload collision after payload separation. The end-of-life activities, including any propellant depletion burns and compressed gas releases, could increase or decrease the probability of subsequent collisions; therefore, the launch operator should explain in the ODAP how these activities will affect potential collision risks. The ODAP must also include the results of a probability of collision analysis between the upper stage and its components and orbital objects. The analysis must use commonly accepted engineering and probability assessment methods, such as those available in NASA's DAS tool.

C. Post-Mission Disposal

In the current debris environment, the greatest risk to operational orbits is collision between objects having considerable mass. Spent upper stages are large, strong structures that contribute to the debris threat because their size increases the chance of a collision, and because their mass

[75] International Organization for Standardization. (September 7, 2010). *ISO 27852:2010(E), "Space Systems— Estimation of orbit lifetime*."

provides an ample source of fragmentation debris in the event of a collision. As noted above, the amount of orbital debris is projected to rapidly increase based on the current population of objects greater than 10 cm.[76]

Disposal, either through reentry or another form of disposal, is necessary to mitigate the propagation of orbital debris because it removes upper stages and other vehicle components from the most populated orbits. If proper disposal is not implemented, spacecraft operators would need to employ increased shielding of payloads, along with additional on-orbit collision avoidance, in order to continue to utilize the most populated orbits. However, neither of these options would mitigate the volume of dormant upper stages in orbit, and therefore, the growth of orbital debris. The only option in the future for these upper stages would be remediation— dedicated missions to remove them from orbit. This kind of remediation is forecasted to be expensive and has not yet been shown to be a viable operation. Research and development is still on-going into debris removal techniques.[77]

Given that disposal is at this time the only viable means of mitigating the threat of orbital debris in populated orbits, the FAA is proposing to require in § 453.13 that launch operators dispose of all launch vehicle stages or jettisoned components using one of five methods:

(1) controlled atmospheric disposal, (2) Heliocentric, Earth-escape disposal, (3) direct retrieval, (4) uncontrolled atmospheric disposal, or (5) maneuver to a disposal orbit. The proposed requirements for each disposal method are set forth in §§ 453.14 through 453.18, respectively. A launch or reentry subject to part 453 must identify the chosen disposal method in the ODAP and satisfy the regulatory requirements applicable to that disposal method. Table 1 provides a list of disposal options derived from the USGODMSP. Options that promptly remove the upper stage and its components from orbit are the preferred disposal options according to the USGODMSP, as they significantly reduce both long term collision and debris generation risks. Delayed disposals through either direct retrieval or uncontrolled atmospheric disposal impose some risks to other on-orbit spacecraft until removal. Disposal orbits may become overly populated in the future which would preclude the future use of them for disposal. The FAA notes that while the USGODMSP identifies disposal methods in order of preference in the following table, the proposed rules do not allocate preference or distinguish between disposal methods in order to provide flexibility to operators to perform any of these valid methods of debris disposal. However, the FAA expects that as space continues to become more congested, orbital debris requirements will tighten in response, such that delayed disposal options that pose some additional risk to on-orbit spacecraft (i.e. uncontrolled atmospheric disposal, highly eccentric

[76] See Figures 3 and 4 in the Statement of the Problem.

[77] Zhao, et.al. (2020) Science China Technological Sciences, *Survey on research and development of on-orbit active debris removal methods*.

Disposal Method	*453 Section*	*Time Frame*
Controlled Atmospheric Disposal	453.14	Within 30 days of mission completion
Heliocentric (Earthescape)	453.15	Within 30 days of mission completion
Direct Retrieval	453.16	Not to exceed 5 years post mission completion
Uncontrolled Atmospheric Disposal	453.17(b)	Not to exceed 25 years after launch
Highly Eccentric LongTerm Disposal	453.17(c)	Not to exceed 200 years after mission completion
Disposal Orbit	453.18	Within 30 days of mission completion into a perpetual disposal orbit

long-term disposal, or use of a disposal orbit) may be restricted or eliminated. FAA requests comments on whether the prompt and safest disposal options (controlled atmospheric, heliocentric, and direct retrieval) should be the preferred disposal methods based upon expected growing orbital congestion. Additionally, the FAA seeks comment on whether it should impose a requirement to use the prompt disposal options unless shown to be impracticable.

Table 1: Disposal Options

a. Controlled Atmospheric Disposal

Upper stage-controlled reentry is the most effective method of orbital debris prevention and the safest reentry method. Controlled reentry eliminates the upper stage as a piece of orbital debris and therefore mitigates the risk of future debris creation through collision because the reentry would occur shortly after the end of launch. The FAA proposes to allow operators to perform controlled disposal by reentering Earth's atmosphere if they meet the requirements of § 453.14. The requirements of § 453.14 would only apply if the operator elects controlled disposal for its disposal method, as required by § 453.13.

A controlled disposal means a planned burn of the upper stage engine to aim for a lowrisk area on the surface of the Earth. The FAA acknowledges that the upper stage is not "controlled" during the entire atmospheric disposal. Variations in the engine burn, the atmospheric density, and other factors beyond the operator's control can affect the actual disposal location. Therefore, those uncertainties must be accounted for in the disposal risk assessment or in the determination of the disposal ellipse in a broad ocean area, in accordance with § 453.14(d).

In order to perform controlled disposal, proposed § 453.14(b) would require a launch operator to ensure the return of the upper stage and each of its components to the Earth's surface within 30 days after mission completion in a controlled manner that ensures the effective casualty area of any surviving debris is less than 7 square meters, targets a broad ocean area, or meets the risk criteria set forth in § 450.101(d)(1)(iii)(A) through (C). This proposal would effectively require launch and reentry operators to consider disposal risks in their vehicle and mission designs—for instance, by designing components that demise when heated by atmospheric reentry or by reentering in remote locations.

The FAA's proposal to allow operators to target a broad ocean area or meet the risk criteria set forth in § 450.101(d)(1)(iii)(A) through (C) is substantively equivalent to the current text of § 450.101(d), which requires that all disposals—currently defined as controlled atmospheric disposal in § 401.7—either target a broad ocean area or meet the risk criteria in § 450.101(b). As discussed later in this preamble, the FAA proposes to amend § 450.101(d) to specify the risk criteria applicable to atmospheric disposals, rather than relying on the reentry risk criteria in § 450.101(b), since disposal is distinct from reentry. The FAA therefore proposes to extend the safety criteria applicable to licenses under part 450 to all launches or reentries covered by part 453, including experimental permits. The FAA is proposing that all launches or reentries authorized by the FAA that exceed 150 km be required to meet the risk criteria in

§ 450.101(d)(1)(iii)(A) through (C), target a broad ocean area, or have an effective casualty area less than 7 square meters for the following reasons.

Disposal into a broad ocean area would reduce the risk of casualties to near zero. The

FAA considers an area 370 km (200 nm) from land to be "broad ocean area," as used in § 450.101(d) and proposed part 453. Two hundred nautical miles is also the recognized limit of exclusive economic zones (EEZ), which are zones prescribed by the United Nations Convention on the Law of the Sea[78] over which the owning State has exclusive exploitation rights over all natural resources. Deorbiting beyond an EEZ further reduces the chance of disrupting economic operations such as commercial fishing.

For massive objects reentering the atmosphere, a controlled disposal into the broad ocean area may be necessary for safety because it would ensure that the casualty expectation of reentry could be kept below 1 in 10,000. Because the broad ocean area has a population density of nearly zero, objects that survive reentry in this area can be fairly large without inordinate risk of human casualties. Alternatively, the operator could show that the 1×10^{-4} collective risk and 1×10^{-6} individual risk limits are met for the controlled disposal in another area. The expectation of casualty alternative might allow for controlled disposal into areas near islands or coast lines with low populations. The operator could also choose to demonstrate that the cumulative effective casualty area of surviving debris will be less than 7 square meters. That small casualty area ensures that the expectation of casualty will be met without requiring a full expectation of casualty calculation.

The effective casualty area for inert debris is the region associated with a fragment's impact location where it is assumed a person would become a casualty. Debris from atmospheric reentry of an upper stage is usually made up of multiple pieces, as the upper stage breaks up due to heating and friction. The total effective casualty area is determined by adding up the casualty area of each of those pieces.

An expectation of casualty calculation requires determination of the effective casualty area along with analysis of the expected trajectory and exposed populations to determine how many people could become a casualty due to the uncontrolled disposal of the upper stage. Due to uncertainty and growth in population, that calculation can be difficult to complete for disposals that are expected on long timeframes like 25 years. As a result, FAA is proposing to allow an operator to demonstrate that the effective casualty area of surviving debris will be less than 7 square meters.

The FAA proposes to require in § 453.14(c) that operators performing controlled disposal notify the public of any region of land, sea, or air that contains, with 97 percent probability of containment, all debris resulting from normal flight events capable of causing a casualty. The FAA currently imposes this requirement on operators performing disposal operations under a part 450 license, and would extend the part 450 requirement to proposed § 453.14(c). The FAA finds that all operations required to comply with part 453 should provide this degree of notification to the public. These measures could include arrangements with the FAA or U.S.

[78] United Nations Convention on the Law of the Sea, Dec. 10, 1982, 1833 U.N.T.S. 397.

Coast Guard to provide Notice to Air Mission (NOTAM) and Notice to Mariners (NOTMAR).

The FAA proposes that an operator would be required to implement a controlled reentry within 30 days after the completion of the mission, which is also how long a launch operator must have insurance coverage under § 440.11. The FAA further proposes to require that operators accomplish any actions necessary to end a launch and commence controlled disposal within the insurance coverage timeframe. As discussed later in this preamble, the FAA proposes to apply the 30-day deadline to the Earth-escape and orbit disposal options as well.

Additionally, the FAA finds that 30 days would almost always provide sufficient time to assess the possible consequences of a launch anomaly, such as delivery to a wrong orbit or failure of a payload to separate from the vehicle's upper stage. Current technologies and practices are adequate to require the following within 30 days (1) perform final maneuvers to direct controlled disposal, (2) relocate to a lower orbit where the upper stage will decay within 25 years, or (3) relocate to a disposal orbit.

Another reason for the proposed requirement to implement a disposal option within 30 days is the short time frame an upper stage would have to maneuver. Typically, most upper stages have limited electrical power supplied by flight batteries, and, by design, must maneuver expeditiously after payload separation. In order to mitigate the possibility of an explosion occurring, the FAA requires a launch operator to power down its batteries at the end of launch. Accordingly, an affirmative act such as controlled reentry, placement to ensure reentry within 25 years, or maneuvering to a disposal orbit would have to occur within that time frame. Upper stages in orbits with an expected lifetime below 25 years would have no additional required actions to meet the post-mission 25-year rule. However, these upper stages may be required to move to disposal orbits if they cannot be safely deorbited due to excessive risk in uncontrolled reentries.

The FAA proposes to require in § 453.14(d) that operators submit a description of the controlled disposal in the ODAP prior to each launch or reentry pursuant to § 453.1(b). The ODAP must include verification through hardware and software testing or analysis that the system has at least a 90 percent probability of successfully executing the controlled atmospheric disposal as planned. The FAA proposes to require a probability of success of at least 90 percent.

The FAA is adopting a 90 percent probability of success criteria that is consistent with the IADC Guidelines, ISO Standard 16126[79] and USGODMSP guidelines. ISO Standards represent a consensus international standard for specialized space activities. The testing and analysis can include engine re-light qualification tests or reliability analysis or similar. The ODAP must also include a description of how the system will achieve controlled atmospheric disposal under nominal and off-nominal conditions, such as a partial burn failure or off-trajectory scenario. Lastly, unless the operator is targeting a broad ocean area, the ODAP must include the calculated total collective and individual casualty expectations for the proposed operation or the effective casualty area of any surviving debris, pursuant to § 453.14(d)(3).

[79] International Organization for Standardization. (April 1, 2014). *ISO 16126:2014, "Space systems—Assessment of survivability of unmanned spacecraft against space debris and meteoroid impacts to ensure successful post-mission disposal."*

b. Heliocentric, Earth-escape Disposal

The FAA proposes to allow operators to perform heliocentric, Earth-escape disposal if they meet the performance-based requirements of § 453.15. The requirements of proposed § 453.15 would only apply if the operator elects heliocentric, Earth-escape disposal as its disposal method under § 453.13. Proposed § 453.15(b) would require that the operator ensure, within 30 days after mission completion, that the upper stage and each of its components is placed in a hyperbolic trajectory that no longer orbits Earth. This option would remove the upper stage from orbit completely and also result in zero risk to the people of Earth. The upper stage and its components would travel into an orbit around the Sun rather than remain as debris in Earth orbit. The FAA recognizes that this disposal option is prohibitively costly for operators not already planning inter-planetary missions, as the energy needed to fully escape Earth orbit is greater than the energy needed for other disposal options. Operators without the available fuel will not be able to execute this option.

Operators who elect to perform heliocentric, Earth-escape disposal would be required under proposed § 453.15(c) to include a description of the Earth-escape disposal in the ODAP submitted prior to each launch or reentry. The description must include (1) verification through hardware and software testing or analysis that the system has at least a 90 percent probability of successfully executing the planned heliocentric, Earth-escape disposal, and (2) a description of how the system will achieve a controlled disposal under nominal and off-nominal conditions, such as a partial burn failure or off-trajectory scenario. The testing and analysis could include engine re-light qualification tests, reliability analyses, or similar tests.

c. Direct Retrieval

Another means by which an operator could dispose of the upper stage of a vehicle, or any other orbital debris released, would be direct retrieval, also called Active Debris Removal or remediation, in which an operator retrieves the upper stage and removes it from orbit via a controlled disposal or maneuver into a disposal orbit. Direct retrieval would require the launch of a device or spacecraft that attaches to or otherwise affects the upper stage and causes it to deorbit in a controlled manner or move to a disposal orbit. Current research and economic feasibility studies performed by commercial operators and international space agencies suggest this option could be commercially viable within a few years.[80] Demonstrations of this capability have already been conducted.[81] For this reason, the FAA proposes to include as § 453.16 the option

for operators to perform direct retrieval if they meet the requirements of § 453.16. The requirements of § 453.16 would only apply if the operator elects direct retrieval as its disposal method under § 453.13.

Proposed § 453.16 would require that operators retrieve the upper stage by either removing it from orbit in a controlled manner or maneuvering it to a disposal orbit no more than 5 years after completion of the mission. The FAA proposes to allow operators up to 5 years from mission

[80] Yamamoto, et.al (2017) 7th European Conference on Space Debris, *Cost analysis of active debris removal scenarios and system architectures*.

[81] On August 25, 2021, a Japanese spacecraft successfully captured a simulated piece of space debris as a first step to demonstrate technology to remove orbital debris. On October 24, 2021, China launched a mission with the stated aim of testing space debris removal technologies.

completion to perform the direct retrieval as a means of balancing the burden on operators to carry out the subsequent retrieval mission against the compelling need to remove the spent upper stage and its components from orbit. A 5-year timeline is consistent with

USGODMSP recommendations and would require operators to demonstrate that they are capable of performing the direct retrieval based on actual technical capabilities, rather than hypothetical future capabilities. Operators will have 5 years to perform the direct retrieval, however, removal should occur as soon as possible to reduce the risk of creating more debris. Under proposed § 453.16(b), if the result of the direct retrieval is a controlled disposal of the upper stage into a planned disposal area, then the retrieval would be required to meet the disposal safety requirements in § 453.14(b) and (c). Conversely, if the result of the direct retrieval is a maneuver into a disposal orbit, then the retrieval would need to meet the disposal orbit lifetimes and analysis requirements of § 453.18.

Under proposed § 453.16(c), an operator would be required to describe its plan for direct retrieval in its ODAP, and demonstrate a probability of successful disposal of at least 90 percent. The description must include verification through hardware and software testing or analysis that the system has at least a 90 percent probability of successfully executing the planned direct retrieval. If the planned retrieval will result in a controlled disposal, then the operator must include in its ODAP (i) a description of how the system will achieve a disposal under nominal and off-nominal conditions; and (ii) the total collective and individual casualty expectations for the proposed operation or the effective casualty area of any surviving debris, if the operator will not dispose of the debris into a broad ocean area. The operator should identify the intended disposal location so that the FAA can discern whether the operator will target a broad ocean area or verify the expectation of casualty from disposal into that location. Alternatively, if the operator intends to retrieve and maneuver the debris to a disposal orbit, under proposed § 453.16(c)(3), the operator would need to include in their ODAP (i) a description of how the system will achieve and maintain the planned disposal orbit for the required time limit as specified in § 453.18(b) through (d); and (ii) a statistical analysis demonstrating that the probability of collision with operational spacecraft and debris is within the lifetime limit of § 453.18(e). The testing and analysis performed in accordance with § 453.16(c) should include qualification tests, reliability analyses, or similar tests.

d. Uncontrolled Atmospheric Disposal

The FAA proposes to allow launch or reentry operators to perform uncontrolled atmospheric disposal to meet the requirement of § 453.13 by using one of two methods. Under proposed § 453.17, an operator could either dispose of debris from LEO through natural decay by leaving the upper stage and its components in an orbit where the debris will gradually lower until it falls to Earth, or from MEO or higher orbit by maneuvering the debris to a highly elliptical orbit for long-term atmospheric disposal. The requirements of proposed § 453.17 would only apply if the operator elects to perform uncontrolled atmospheric disposal to meet the disposal requirement of § 453.13.

In order to dispose of debris from LEO—an orbit below 2,000 km—an operator would be required in § 453.17(b)(1) to leave an upper stage and its components in an orbit where, accounting for the mean projections for solar activity and atmospheric drag, the orbital lifetime is as short as practicable, but does not exceed 25 years after launch. Instead of reentering immediately, the orbit of the upper stage and its components would gradually lower over months or years until the debris falls to Earth.

The disposal would be considered uncontrolled in the sense that the operator would not initiate the disposal at a particular time, and the disposal could occur anywhere on Earth under its orbital path.

The 25-year rule, which the FAA also proposes to implement in § 453.5, is a common standard recommended by the IADC and a requirement for U.S. Government launches under the

USGODMSP. The IADC's *Support to the IADC Space Debris Mitigation Guidelines*, *Oct 2004 Working Group Report* states that a 25-year post-mission lifetime appears to be a good compromise between an immediate (or very short lifetime) de-orbit policy which is very effective but much more expensive to implement, and a 50 or 100 year lifetime de-orbit policy which is less costly to implement but can lead to higher collision risks in the long-term.[82] Greater depth of technical analysis is available in the IADC working group report.

While the FAA concurs with the current IADC and USGODMSP guidelines, which limit post-mission lifetimes in LEO to 25 years, the FAA recognizes that increases in the numbers and kinds of activities in Earth orbit may necessitate reevaluation of the adequacy of a 25-year postmission lifetime in the future. The FAA seeks public comment on whether a shorter deadline should be imposed. The FAA notes that upper stages of launch vehicles become debris as soon as the payloads are released; upper stages in orbits with perigee altitudes below 350 km typically

have orbital lifetimes less than 5 years. Given that the entire mission lifetime of upper stages and their components is quite short, and spent upper stages pose a significant risk of debris propagation the longer they are in orbit, it may be appropriate to have a shorter disposal timeline of 5 years. A shorter deadline of 5 years that removes the highest-mass objects from orbit would vastly reduce the risk of creating more debris and would make U.S. commercial space a leader in orbital debris mitigation.

Uncertainties in modeling should be accounted for in evaluation of the orbital lifetime of an object. The use of publicly available software such as NASA's DAS and the French Space Agency's STELA (Semi-analytic Tool for End of Life Analysis) regularly update model inputs for atmospheric density, which is responsible for the largest uncertainty, could be used to estimate orbital lifetime prior to launch.

In addition to meeting the 25-year requirement of § 453.17(b)(1), the FAA would require in § 453.17(b)(2) that operators performing uncontrolled atmospheric disposal from LEO satisfy either an expected casualty (E_C) of 1×10^{-4}, or an equivalent effective casualty area of 7 square meters. The FAA proposes to delay the effective date of § 453.17(b)(2) until 1 year after the effective date of the rule, so as to avoid interference with current planned launches and provide operators additional time to come into compliance with the requirement. The FAA proposes to regulate uncontrolled atmospheric disposal in this manner due to the inherent risks posed to people and property on Earth whenever upper stages reenter the Earth's atmosphere in either a controlled or uncontrolled manner. Upper stages are designed to be robust systems capable of withstanding the stresses and temperatures of launch. Therefore, most upper stages are composed of heat-resistant material that does not burn-up upon reentry and can be expected to survive reentry to impact the ground.

[82] Inter-Agency Space Debris Coordination Committee. (October 2004). Support to the IADC Space Debris Mitigation Guidelines. *Oct 2004 Working Group Report*, section 5.3.2.

Although tracking and analysis can be done to help narrow down where an uncontrolled reentry may occur, and the appropriate civil authorities can be notified, there are no means to stop or move the impact location of reentering debris. Furthermore, the science of predicting impact points for uncontrolled disposals is limited. Re-entry Assessment is difficult. It is virtually impossible to precisely predict where and when space debris will impact. This is due to limitations in the U.S. tracking system as well as environmental factors that impact on the debris.[83]

National U.S. policy guidelines cited above, as well as those of NASA[84], Department of Defense[85], and the FCC[62], along with a growing international consensus, recommend that the risk to the public on the ground not exceed 1 E_C in 10,000 events or 1×10^{-4}. This applies to reentries of orbital debris, whether they are a deliberate controlled disposal or an uncontrolled disposal through natural decay. The E_C should be calculated to one-significant figure unless an uncertainty analysis justifies a more precise estimate of risk.

The E_C can vary greatly due to factors outside of the launch vehicle designer's control.

Growing world populations and various orbital inclination choices have direct correlations to the E_C rating for reentries. The FAA realizes that the E_C prediction can be difficult to calculate; therefore, the FAA sought an alternative method in addition to E_C.

As alternatives to a launch operator's calculating and satisfying of an E_C of 1×10^{-4}, the FAA is also proposing to allow an operator to demonstrate that it can limit the casualty area during disposal by natural decay. Some companies may find the debris casualty area determination to be a more simplified analysis, and this analysis relies only on vehicle design and operation. Both analyses, E_C and debris casualty area, would be adequate to protect the public from disposal risk. Therefore, the FAA proposes disposal to be acceptable if a size limit is satisfied or if the E_C limit is met.

The FAA would permit uncontrolled reentry as an acceptable form of disposal if the surviving debris casualty area measured 7 square meters or less. This proposed casualty area matches that stated in the USGODMSP, guideline 4-1(e).[86] The casualty area is derived from the acceptance of a risk criteria of 1×10^{-4}. Applying the 1×10^{-4} expectation of casualty to uncontrolled disposal, NASA calculated the risk to account for the 2019 population of the world that could be affected and the size of the debris that could impact the ground. On average, analysis showed that a casualty area of 7 square meters of surviving debris would produce a 1×10^{-4} expectation of casualty. The debris casualty area takes into account that the force of impact of the debris is at least 11 ft-lb, the threshold for injury on an unsheltered person.[64] Specifying an acceptable casualty area as an alternative to a risk criterion eliminates the uncertainty inherent in risk calculations, including such variables as population counts and event probability assumptions.

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[83] United States Space Command. (Retrieved on August 26, 2021). Reentry Assessment - US Space Command Fact Sheet. *SpaceRef.* www.spaceref.com/news/viewpr.html?pid=4008

[84] NPR 8715.6B, *NASA Procedural Requirements for Limiting Orbital Debris and Evaluating the Meteoroid and Orbital Debris Environments*.

[85] Department of Defense Instruction 3100.12 and Air Force Instruction 91-202. [62] FCC Statute 25.114 *Applications for Space Authorizations.*

[86] United States Government. (November 2019) *U.S. Government Orbital Debris Mitigation Standard Practices, November 2019 Update.* orbitaldebris.jsc.nasa.gov/library/usg_orbital_debris_mitigation_standard_practices_november_2019.pdf [64] SANDIA National Laboratories. (April 1997). *Hazards of Falling Debris to People, Aircraft, and Watercraft*.

The total effective casualty area is determined by adding up the casualty area of each piece of debris that impacts Earth. The upper stage will not land intact, but is expected to breakup in the atmosphere during reentry. The total casualty area of all pieces added together would be required to be less than 7 square meters.

The second option for performing an uncontrolled atmospheric disposal under proposed § 453.17 would be to maneuver the debris to a highly elliptical orbit for long-term atmospheric disposal. Under proposed § 453.17(c), an operator would maneuver the upper stage and its components from semi-synchronous Molniya orbits, synchronous Tundra orbits, and other elliptical orbits, to a long-term disposal orbit where orbital resonances will increase the eccentricity for long-term atmospheric disposal of the upper stage. This proposal of up to a 200year disposal matches the USGODMSP guidelines to allow the upper stage to be maneuvered to a disposal where orbital resonances keep increasing the eccentricity and eventually decrease the perigee for an uncontrolled atmospheric disposal. During the development of the USGODMSP, the FAA, NASA, and the Department of Defense reviewed various timeframes for highly elliptical orbit disposals. Objects in highly elliptical orbits are affected by gravitational forces from the Earth, the Moon, and the Sun. These forces, over time, alter the object's orbit and eventually cause the object to reenter Earth's atmosphere. The FAA foresees that very few commercial operations would fall within this scenario, because it is rarely used by commercial operators.

If an operator maneuvers the debris to a highly elliptical orbit in accordance with § 453.17(c), the orbital lifetime must be as short as practicable, but must not exceed 200 years after mission completion. The responsible behavior is to remove debris objects from orbit as soon as practical. Highly elliptical objects have very high apogees; therefore, atmospheric drag only affects them during a small portion of their orbit. Drag is a major factor in atmospheric disposal, so these disposals take a long time to occur. These objects spend a smaller portion of time within congested orbits, so over a 200-year timeframe, the time in congested orbits equals that of objects that are in LEO for 25 years. The probability of collision with operational spacecraft and debris 10 cm and larger should also be limited to less than 0.001 for the entire lifetime. The FAA proposes to delay the effective date of the risk requirement so as not to interfere with current planned launches. The FAA finds that delaying the effective date of this requirement by 1 year will allow operators sufficient time to implement disposal options that meet the risk criteria, without jeopardizing public safety. After 1 year, the launch operator must show that when the upper stage reenters, the risk will meet the criteria of 1×10^{-4} or that the effective casualty area will be less than 7 square meters.

Proposed § 453.17(d) would identify the information that an operator must include in its ODAP prior to each launch or reentry in order to perform uncontrolled atmospheric disposal in accordance with this section. The ODAP must include (1) verification through hardware and software testing or analysis that the system has at least a 90 percent probability of successfully executing the planned disposal option; (2) an estimate of the E_C or the effective casualty area for any surviving debris; and (3) a statistical analysis demonstrating compliance with the requirements of § 453.17(b) or (c) to dispose of the debris within the prescribed time limit. The testing and analysis could include an analysis using NASA's DAS or similar material that demonstrates compliance with the 25-year rule in the case of natural decay from LEO, or the 200-year rule for highly elliptical orbits. Alternatively, an analysis should be provided showing that the upper stage can meet the casualty area limit or expectation of casualty limit.

e. Maneuver to a Disposal Orbit

The FAA proposes to give launch or reentry operators the option in § 453.18 of disposing of debris by maneuvering it to a disposal orbit. In this scenario, the operator would move the upper stage and its components into a less-populated disposal orbit. Disposal or storage orbits are orbits intended for post-mission long-term storage, where atmospheric effects and solar radiation will not move disposed objects into a protected orbit for at least 100 years. Disposal orbits protect LEO, a narrow band in MEO bounded by 20,182 km plus or minus 300 km, and the GEO region. The band in MEO is used by Global Positioning System (GPS) spacecraft and other global positioning constellations. On-orbit disposal is not a permanent solution, and some of these storage orbits may be used for future space operations. Even spacecraft orbiting beyond GEO will eventually degrade and reenter populated orbits. While use of disposal orbits fails to remove debris from orbit and therefore reduce the chance of debris-making collisions, on-orbit disposal remains an effective alternative to atmospheric disposal in today's environment and is preferable to clogging LEO and intersecting GEO with spent upper stages. This option is consistent with the USGODMSP. In addition, for some operators, all other methods of disposal would be costly. The FAA therefore proposes to allow operators to maneuver orbital debris to a disposal orbit in order to meet the disposal requirement of § 453.13. Disposal orbits still impose some risk for future space programs and interplanetary missions. The FAA seeks comments on whether disposal orbit options should be phased out. And, if so, what an appropriate timeframe for phasing out should be.

The requirements of § 453.18 would only apply if the operator elects to maneuver to a disposal orbit as its disposal method under § 453.13. To comply with § 453.18, the operator would move the upper stage and its components into a less-populated orbit within 30 days after mission completion. To prevent interference with active spacecraft for a significant length of time, the FAA proposes as disposal orbits those identified in the USGODMSP. If an operator elects to use a disposal orbit between LEO and GEO, then the operator would be required to place the upper stage and its components into either (1) an eccentric orbit where the perigee altitude remains above 2,000 km, the apogee altitude remains below the geosynchronous region for at least 100 years, and the time spent by the upper stage between 20,182 plus or minus

300 km is limited to 25 years or less over 200 years[87]; or (2) a near-circular disposal orbit that avoids altitudes 20,182 plus or minus 300 km, the geosynchronous region, and altitudes less than 2,000 km, for at least 100 years. Under proposed § 453.18(c)(1)(iii), an orbit that remains completely within the region bounded by 20,182 km plus or minus 300 km would not qualify as a disposal orbit. The orbital lifetime of any debris placed within this region would therefore be limited to 25 years or less over 200 years. If an operator elects to use a disposal orbit above GEO, the FAA proposes to require in § 453.18(d) that the operator place the upper stage and its components into an orbit with a perigee altitude above 36,100 km for a period of at least

100 years after disposal.

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[87] All figures match the guidelines in the USGODMSP. A 200-year timeline ensures that the upper stage will avoid the altitude range commonly used by global navigation satellite systems.

In addition to implementing the disposal orbits identified by the USGODMSP, the FAA proposes to require in § 453.18(e) that operators limit the probability of collisions with operational spacecraft and debris 10 cm and larger to less than 0.001 for 100 years after disposal. This requirement would be consistent with USGODMSP recommendations, as well as the requirement in proposed § 453.9(b) to limit the probability of collision between launched objects after the end of launch.

Proposed § 453.18(f) would prescribe the information that an operator must include in its ODAP to maneuver debris to a disposal orbit in accordance with § 453.18. Under proposed § 453.18(f), the ODAP must include: (1) verification through hardware and software testing or analysis that the system has at least a 90 percent probability of successfully executing the planned maneuver to the disposal orbit; (2) a description of how the system will achieve and maintain the planned disposal orbit for the required time limit; and (3) statistical analysis demonstrating compliance with the probability of collision lifetime limit with operational spacecraft and debris. ISO Standard 16126[88] provides an acceptable method for conducting the post-mission disposal probability of success analysis of § 453.18(f)(1). The testing and analysis can include engine re-light qualification tests or reliability analysis or similar.

D. Explosion Mitigation

The FAA proposes minor changes to its current requirement that a launch operator prevent fragmentation or explosion of its upper stage.[89] Currently, under §§ 417.129(c) and 450.171(a)(3), a launch operator must ensure the removal of stored energy from an upper stage by depleting residual fuel and leaving fuel lines open.[68]

Proposed § 453.7(a) would require that, except for energy sources that are safety critical on-orbit or during reentry, a launch operator must ensure: (1) the integrated probability of debrisgenerating explosions or other fragmentation from the conversion of energy sources (i.e. chemical, pressure, kinetic) of each upper stage is less than 0.001 (1 in 1,000) during operations; and (2) stored energy is removed by depleting residual propellants, venting any pressurized system, leaving all batteries in a permanent discharge state, and removing any remaining source of stored energy. The proposed rule would replace §§ 417.129(c) and 450.171(a)(3), and would not contain a specific requirement to leave valves open. After promulgation of its original debris requirements, the FAA has found on several occasions, through the licensing process, that leaving the valves open long enough for all fuels and oxidizers to vent and then permitting them to close, has provided a level of safety equivalent to leaving the valves open. Either approach removes the source of explosion risk—namely, the fuels and oxidizers. The FAA proposes a probability limit of 0.001, which matches the limit in the USGODMSP, in order to provide operators a quantitative requirement.

Proposed § 453.7(b) would identify the information that an operator would need to include in its ODAP to demonstrate compliance with § 453.7(a), specifically: (1) analysis, using commonly accepted engineering and probability assessment methods, showing how the operation meets

[88] International Organization for Standardization. (April 1, 2014) *ISO 16126:2014.*
[89] See proposed § 417.129(b) and (c). [68] See § 417.129(c).

paragraph (a)(1); and (2) test results or analysis, with 95 percent confidence levels,[90] of the planned end-of-mission passivation procedure that verifies dissipation of all energy sources to levels that will prevent explosion of any launch vehicle component. The test results or analysis submitted in accordance with § 453.7(b)(2) would be required to show that all residual propellants contained in the system can be purged or passivated to an acceptable level at the end of the launch, all pressurized systems can be purged or passivated, and all energy storage systems have sufficient structural design to prevent rupture and subsequent explosion. This proposal marks a departure from current requirements, which only ask for a demonstration, without specifying that the demonstration be made with analysis and verification. The FAA now considers the latter necessary because operators have historically only stated that they would comply without providing the test or analysis to show how they would comply. The FAA seeks to clarify in regulation that asserting compliance is not a demonstration of compliance that satisfies this requirement. The FAA seeks feedback on the proposed analysis and testing requirements.

E. Collision Mitigation Between Launched Objects

The FAA proposes minor changes to its current requirements that a launch operator prevent unplanned physical contact between the launch vehicle and payload. Currently §§ 417.129(a) and 450.171(a)(1) require a launch operator to ensure that there is no unplanned physical contact between the launch vehicle and its components and the payload. Proposed § 453.9(a) would require a launch operator to prevent unplanned physical contact between a launch vehicle or any of its components and each payload after payload separation, and would replace the requirements in §§ 417.129 and 450.171.

The FAA proposes to add a requirement in § 453.9(b) to take into account the probability of collision with orbital objects 10 cm and larger when designing the mission profile of an upper stage. The operator should ensure that the probability of collision is less than 0.001 (1 in 1,000) after the end of launch. Upper stages are the highest mass of orbital debris by far. It is important to prevent breakups of massive upper stages due to collisions with large debris. The proposed requirement also matches ODMSP Objective 3-1.

Proposed § 453.9(c)(1) would specify the information that an operator must include in its ODAP to demonstrate compliance with § 453.9: (1) the operator's procedure for preventing vehicle and payload collision after payload separation, including any propellant depletion burns and compressed gas releases that minimize the probability of subsequent collisions; and (2) the results of a probability of collision analysis, using commonly accepted engineering and probability assessment methods, meeting paragraph (b) of this section. This marks a departure from current requirements, which only require a demonstration, without specifying that the demonstration must consist of a written procedure. The FAA has received non-actionable demonstrations in previous applications

[90] In statistics, a confidence interval is the range of values that includes the true value at a specified confidence level. A confidence level of 95 percent is commonly used which means that there is a 95 percent chance that the true value is encompassed in the interval.

and now proposes requiring complete procedures in the ODAP. The FAA now considers the latter necessary for purposes of clarification as to what the FAA seeks. The analysis should use commonly accepted engineering and probability assessment methods.

F. Launch and Reentry Collision Avoidance.

The FAA proposes to move the collision avoidance analysis requirements from

§ 450.169, which are currently applicable to all orbital launches and reentries authorized by the FAA that exceed 150 km to § 453.11. The FAA would replace the current text in § 450.169 with a reference to § 453.11, and replace all references to § 450.169 outside of part 450 with a reference to new § 453.11, which would be called "Collision Avoidance with Orbital Objects." Proposed § 453.11 is substantially similar to the existing requirements in § 450.169, but would differ from the existing regulation in the following respects.

First, the FAA would omit from proposed § 453.11 the exclusion provided in § 450.169(d), which states that collision avoidance analysis is not required if the maximum planned altitude for any launched object is less than 150 km. This exclusion is necessary under current § 450.169 because part 450 is not limited to launch or reentry activity above 150 km. Since the FAA would relocate the collision avoidance analysis requirements to part 453, which would only apply to launch or reentry activity that exceeds 150 km, the exclusion found in § 450.169(d) is no longer necessary. As such, the FAA would exclude the phrase "except as provided in paragraph (d)," which appears in § 450.169(a) from proposed § 453.11(a).

The text of proposed § 453.11(a)(1) would match current § 450.169(a)(1).

The FAA proposes to refer to "active payloads" in § 453.11(a)(2), instead of "objects that are neither orbital debris nor inhabitable" as used in current § 450.169(a)(2). The updated language clearly states the intent of this section and is consistent with U.S. Space Force terminology and current practice. Active payloads do not include inhabitable objects like the ISS, which require more stringent screening.

In § 453.11(a)(2), the FAA proposes to retain the probability of collision and spherical separation distance options from § 450.169(a)(2)(i) and (ii), but add a third option for operators to screen against active payloads: ellipsoidal screening. The FAA would accept an ellipsoidal separation distance of 25 km in-track and 7 km cross-and-radial-track ellipsoidal separation from active payloads for collision avoidance analyses. The FAA looked at collision risk associated with the radial component greater than 7 km and found that it posed a risk less than 1×10^{-5}.

These ellipsoidal distances also match current practice identified by the Range Commanders Council. Operators would therefore have three options for screening against active payloads:

probability of collision (§ 453.11(a)(2)(i)), ellipsoidal screening (§ 453.11(a)(2)(ii)), and spherical screening (§ 453.11(a)(2)(iii)).

The FAA proposes to add a requirement in § 453.11(a)(3) to perform launch and reentry collision avoidance analysis against small objects with a radar cross section greater than 0.04 m^2. Currently, § 450.169(a)(3) only requires operators to screen against large objects with radar cross section greater than 1 m^2 and medium objects with radar cross section 0.1 m^2 to 1 m^2. However, small objects, including CubeSat-sized objects, can cause vehicle breakups and orbital debris if a collision were to occur between the object and a launching or reentering vehicle. The FAA did not include small debris in its recent Streamlined Launch and Reentry License Requirements rulemaking, as the FAA was still investigating the implications of the increase of small objects in the debris catalog due to the addition of the Department of Defense Space Fence. It is current practice at the Federal ranges to screen against all objects in the debris catalog, including small objects with a radar cross section greater than 0.04 m^2. Therefore, the FAA proposes to add launch and reentry collision avoidance analysis screening against those small objects. The FAA would retain under § 453.11(a)(3) the screening options provided in § 450.169(a)(3): an operator would be required to ensure either (i) that the probability of collision between the launching or reentering objects and any known orbital debris does not exceed 1×10^{-5}; or (ii) that the launching or reentering objects maintain a spherical separation distance of 2.5 km. Window closures that meet these requirements will ensure that launch and reentry vehicles do not collide with known objects during launch or reentry operations. Note that probability of collision is different than probability of casualty used elsewhere for public risk. Probability of collision is only the odds that two objects will occupy the same location at the same time. Probability of casualty factors in the odds of collision plus the vulnerability of a person. Thus, there are separate risk measures.

The FAA proposes to move the screening time requirements of § 450.169(b) to § 453.11(b), with several modifications. First, to enhance clarity the FAA would refer to "150 kilometers altitude" in § 453.11(b)(1) and (2), instead of "150 km," which appears in § 450.169(b)(1) and (2). The text of proposed § 453.11(b)(3) would match current § 450.169(b)(3). Second, to accommodate the additional disposal options proposed in part 453, the FAA proposes to specify appropriate screening times for controlled atmospheric disposal and maneuver to a storage orbit, rather than refer to "disposal" generally, as done in current § 450.169(b)(4). Under proposed § 453.11(b)(4), an operator performing controlled atmospheric disposal would need to screen during descent from initial disposal burn to 150 km altitude. To maneuver to a disposal orbit, under § 453.11(b)(5), an operator would need to screen during initial disposal operation until removal from LEO or GEO.

The FAA proposes to move § 450.169(c) to § 453.11(c) without any changes. Since the FAA would not include the exclusion in § 450.169(d) because it is redundant of proposed part 453, the *Analysis* requirements found in § 450.169(e) would appear under paragraph (d) of proposed § 453.11.

The FAA proposes to move the language currently found in § 450.169(e) to § 453.11(d), with two revisions. First, to enhance clarity, the FAA proposes to revise the first sentence of § 453.11(d) to use the active voice ("An operator must obtain a collision avoidance analysis…"). Second, the FAA proposes to identify in § 453.11(d)(2) the uncertainties that should be included in the vehicle trajectory and covariance calculation used in the collision avoidance analysis. Specifically, the FAA proposes to require that collision avoidance analyses account for uncertainties, “including launch or reentry vehicle performance and timing, atmospheric changes, variations in drag, and any other factors that affect position and timing of the launch or reentry vehicle.” It is important for a scientific and complete analysis to include these uncertainties because at the velocities of the objects in orbit, small variations or uncertainties can affect the collision prediction. By revising this provision, the FAA emphasizes the use of uncertainty at the beginning of collision analysis, whereas the previous language in

§ 450.169(e)(2) directed that uncertainties be used to modify the final analysis results.

The FAA proposes to move § 450.169(f) to § 453.11(e) without any substantive changes.

The FAA proposes to move part 450 Appendix A, the Collision Avoidance Analysis Worksheet, to § 453.11(f), with several revisions. First, the FAA proposes in § 453.11(f)(1) to update the launch and reentry information that must be included in the Collision Avoidance Analysis Worksheet. The FAA proposes to combine the “Segment Number” and “Orbiting objects to evaluate,” currently found in paragraphs (a)(5) and (a)(7) of Appendix A, into one requirement, § 453.11(f)(1)(v). These current requirements are redundant, and the updated requirement uses plain language to describe the objects that should be evaluated in the analysis: all free-flying launch vehicle stages, payloads, and components that reach orbit. The FAA also proposes to more clearly convey in § 453.11(f)(1)(vi) the orbital parameters of each free-flying launch vehicle stage, payload, or component achieving orbit that must be identified. The FAA would also refer to both launch and reentry in § 453.11(f)(1)(ii) and (iv), unlike the existing Appendix A, which inconsistently addresses launch and reentry. This is a correction, as all parts of the Collision Avoidance Analysis Worksheet are applicable to both launch and reentry. G. Real-time Reporting of Orbital Safety Hazards.

The FAA proposes to add a requirement in § 453.20 that would require a launch or reentry operator to submit certain information to the FAA and, if applicable, to other requesting Federal agencies, at the detection of any launch or reentry activity outside the 3-sigma trajectory provided for collision avoidance or any debris-creating event. Orbital safety is implemented through the pre-launch or reentry assessment of planned trajectories. If either an operator or Federal tracking capabilities detect activity outside the 3-sigma planned trajectory or a debrisgenerating event, the operator should contact the FAA to provide as much information as possible on the characteristics (size and mass), last known orbital or trajectory information, and other details determined necessary by the FAA to locate and categorize orbital objects. This should be done by phone or email as soon as the event is detected. The United States Strategic Command (USSTRATCOM) would be the Federal agency most likely to detect an event covered by § 453.20(a) and request information from the operator. This information may provide critical warning time to inhabited and active payloads on orbit, and allow USSTRATCOM to update its models and recalculate projected orbits. If a launch does not go as planned, and the vehicle ends up in a different orbit than expected, the original Collision Avoidance Analysis Worksheet would be moot. The FAA would need to reassess the collision probability against the new trajectory.

Specifically, proposed § 453.20(a) would require an operator to immediately submit the information identified in § 453.20(b) to the FAA and, if applicable, a requesting Federal agency, at the detection of any launch or reentry activity outside the 3-sigma trajectory provided for collision avoidance or any debris-creating event. If an operator identifies such an event, or is notified by a Federal agency (such as U.S. Space Force and NASA), then the operator would need to report to the FAA and, if applicable, the requesting Federal agency: (1) the size and mass of the affected objects; (2) the last known orbital or trajectory information; and (3) any other details determined necessary by the FAA to locate and categorize orbital objects, such as the vehicle orientation, whether it is tumbling, or the operator's ability to control the object.

H. Revisions to Existing Regulations

The FAA's proposal to consolidate existing requirements for orbital debris mitigation and end-of-launch safety under part 453 necessitates the following revisions to current regulations.

Under part 404, the FAA proposes to replace the reference to § 450.169 in Table A404.1 with a reference to § 453.11.

Under part 415, the FAA proposes to revise § 415.2(b) to reference part 450 as well as part 453. The proposed revision would make clear that operations licensed under part 415 must comply with the critical asset protection requirements in § 450.101(a)(4) and (b)(4) and, for launches with a planned altitude greater than 150 km, the launch collision avoidance requirements in § 453.11. The FAA also proposes to revise § 415.35(d) to require that launch vehicles be operated "in a manner that ensures that flight risks meet the criteria of paragraph

(a) of this section and in accordance with collision avoidance requirements in § 453.11 and critical asset protection requirements in § 450.101(a)(4) and (b)(4)."

The FAA also proposes to revise § 415.39 by revising the heading to read,

"Demonstration of Orbital Debris Mitigation," instead of "Safety at End of Launch," and by replacing the reference to § 417.129 with a reference to the sections of proposed part 453 under which those end of launch requirements would appear: §§ 453.7 and 453.9. Similarly, the FAA proposes to revise § 415.133 by revising the heading to read, "Orbital Debris Mitigation," and by replacing the reference to § 417.129 with a reference to the sections of proposed part 453 under which those end of launch requirements would appear: §§ 453.7 and 453.9. These revisions would direct readers to the Code of Federal Regulations (CFR) part under which the FAA's safety at end of launch requirements would be relocated under this proposal, and affirm that any FAA-licensed launches exceeding 150 km would be required to comply with part 453. Lastly, the FAA would revise Appendix B to part 415 to reflect the revised heading of § 415.133 (Orbital Debris Mitigation).

Under part 417, the FAA proposes to revise § 417.113(c)(1) to reference the collision avoidance analysis requirements of proposed § 453.11, instead of § 450.169. The FAA proposes to replace the requirements in § 417.129 for safety at end of launch with a reference to the sections of proposed part 453 under which those end of launch requirements would appear: §§ 453.7 and 453.9. This revision would direct readers to the CFR part under which the FAA's safety at end of launch requirements would be relocated under this proposal, and affirm that any FAA-licensed launches exceeding 150 km would be required to comply with part 453. As discussed above, the FAA proposes changes to the end of launch requirements under part 453, consistent with USGODMSP guidelines.

The FAA proposes to revise §§ 431.2(b) and 435.2(b) to reference part 450 and part 453. The proposed revisions would make clear that operations licensed under part 431 and 435 must comply with the critical asset protection requirements in § 450.101(a)(4) and (b)(4) and, for launches with a planned altitude greater than 150 km, the launch collision avoidance requirements in § 453.11. The FAA proposes to revise § 431.43(a)(1) to reference § 453.11 instead of § 450.169. The FAA also proposes to replace the reference to § 450.169 in § 431.43(c)(3) with a reference to the sections of proposed part 453 under which those end of launch requirements will appear: §§ 453.7 and 453.9. As discussed above, the FAA proposes to change the end of launch requirements consistent with USGODMSP guidelines. This revision would direct readers to the CFR part under which the FAA's safety at end of launch requirements would be relocated under this proposal, and affirm that any FAA-licensed launches or reentries exceeding 150 km would be required to comply with part 453.

Under part 437, the FAA proposes to replace the reference to § 450.169 in § 437.65 with a reference to § 453.11. The FAA also proposes to remove the word, "maximum" from § 437.65 because it is an unnecessary modifier to the phrase, "permitted flight with a planned altitude greater than 150 km."

Under part 450, the FAA proposes to revise § 450.101(d), titled Disposal Safety Criteria, to specify the risk criteria applicable to controlled and uncontrolled atmospheric disposals. As discussed earlier in this preamble, the current definition of "disposal" in § 401.7 includes only controlled atmospheric disposal. As a result, the disposal safety criteria currently identified in § 450.101(d) only apply to controlled atmospheric disposal. Since the FAA is proposing to amend the "disposal" definition to include all five disposal options proposed in §§ 453.14 through 453.18, and the disposal risk criteria currently identified in § 450.101(d) would not apply to all five disposal methods, the FAA must therefore revise § 450.101(d) to identify the risk criteria applicable to each disposal method. Additionally, § 450.101(d) currently refers to the reentry risk criteria in (b), which may create confusion since reentry is distinct from disposal.

The risk criteria outlined in § 450.101 would only apply to disposals that result in orbital debris returning to Earth's surface or atmosphere—that is, controlled or uncontrolled atmospheric disposal. There is no need to calculate collective or individual risks to the public, or aircraft risk if an operator elects to maneuver orbital debris to a disposal orbit or a hyperbolic trajectory that no longer orbits Earth (Earth-escape disposal). Thus, the FAA proposes to revise § 450.101(d) to limit the applicability of the risk criteria to controlled atmospheric disposal performed in accordance with § 453.14, direct retrieval resulting in controlled atmospheric disposal per § 453.16(b)(1), and uncontrolled atmospheric disposal performed in accordance with § 453.17. The risk criteria applicable to controlled atmospheric disposal would appear in paragraph (d)(1), while the risk criteria applicable to uncontrolled atmospheric disposal would appear in paragraph (d)(2).

With respect to controlled atmospheric disposal, the FAA's proposed revision to § 450.101(d) is substantively equivalent to the current regulation. Operators performing controlled atmospheric disposal will still have the option of targeting a broad ocean area or meeting the same collective, individual, and aircraft risk criteria required for reentries under § 450.101(b). The FAA proposes to add a third alternative for compliance as § 450.101(d)(1)(i): ensuring that the effective casualty area of any surviving debris is less than 7 square meters. This revision renders the disposal risk criteria in § 450.101(d)(1) consistent with the safety criteria for controlled atmospheric disposal under proposed § 453.14.

The risk criteria applicable to uncontrolled atmospheric disposal will similarly match the criteria proposed in § 453.17. As noted in this section of this preamble discussing proposed § 453.17, the FAA will not require operators to calculate individual or aircraft risk as would an operator performing controlled atmospheric disposal because the science of predicting impact points for uncontrolled disposals is limited. Due to limitations in the U.S. tracking system and environmental factors that impact debris, it is virtually impossible to precisely predict when and where debris disposed through natural decay will impact. Instead, consistent with the USGODMSP, the FAA would require that operators performing uncontrolled atmospheric disposal ensure that either (i) the effective casualty area for any surviving debris will be less than 7 square meters; or (ii) the risk to the public on the ground will not exceed 1 E_C in 10,000 events or 1×10^{-4}.

The FAA also proposes to revise § 450.101(e) to reflect the scope of proposed part 453. Specifically, the FAA would require in § 450.101(e)(1) that operators prevent collisions between a launch or reentry vehicle stage or component with a planned altitude greater than 150 km and people, property, and debris on orbit, in accordance with the requirements in § 453.11. Similarly, the FAA would require in § 450.101(e)(2) that operators perform debris mitigation in accordance with part 453 for any launch or reentry vehicle stage or component with a planned altitude greater than 150 km. The FAA also proposes to replace the reference to § 450.169 in

§ 450.165(a)(3) with a reference to § 453.11, and in § 450.213 with a reference to § 453.11(f). As discussed above, the FAA proposes to move the collision avoidance analysis requirements set forth in §§ 450.169 to 453.11, and replace the current language of § 450.169 with a reference to § 453.11.

The FAA also proposes to revise the equivalent level of safety requirements in § 450.37 to allow operators the option to seek an equivalent level of safety for collision avoidance analysis requirements (which would be located under § 453.11) and all other orbital debris mitigation requirements under part 453. Previously, § 450.37 did not include an equivalent level of safety for collision avoidance analysis. Upon further consideration, the FAA decided that an equivalent level of safety is appropriate. The FAA has found a need for flexibility in the current regulation, which does not allow an equivalent level of safety for collision avoidance analysis, to accommodate deployments of large numbers of satellites and for new launch operators. The FAA has found that collision avoidance is a difficult task for new launch operators, and options need to be available to get the operators to meet compliance. The FAA believes operators might be capable of proposing alternatives to the collision avoidance analysis requirements such as active debris avoidance that provide a level of safety equivalent to FAA regulations. The FAA also proposes to amend the flight safety analysis scope requirements of § 450.113 regarding disposal. The current regulation requires an operator to perform and document a flight safety analysis for all phases of flight, including for "disposal," from the initiation of the deorbit through final impact. As discussed earlier in this preamble, the FAA is proposing to expand the definition of

"disposal" in § 401.7 to include all 5 disposal options proposed in §§ 453.14 through 453.18. The FAA does not believe it would be necessary or feasible to prepare a flight safety analysis for each of the 5 disposal methods proposed in part 453. The FAA will continue to only require a flight safety analysis for controlled atmospheric disposals. The FAA therefore proposes to replace the word "disposals" in § 450.113(a)(3) with "controlled atmospheric disposal performed in accordance with § 453.14 or direct retrieval resulting in controlled atmospheric disposal under § 453.16(b)(1)." Additionally, in order to reflect the safety criteria alternatives proposed in § 453.14(b), the FAA proposes to specify in § 450.113(c) that an operator would not need to prepare a flight safety analysis if the

Administrator agrees that the disposal will target a broad ocean area or have an effective casualty area less than 7 square meters.

Lastly, the FAA proposes to replace the current requirements of § 450.171 for safety at end of launch with a reference to the sections of part 453 under which those requirements will now be found: §§ 453.7 and 453.9. As discussed above, the FAA is proposing changes to the requirements for safety at end of launch to include all orbital debris mitigation requirements. As such this revision will expand the scope of § 450.171, but as discussed earlier, should present no more than a minimal burden on operators for compliance.

IV. Regulatory Notices and Analyses

Federal agencies consider impacts of regulatory actions under a variety of executive

orders and other requirements. First, Executive Order 12866 and Executive Order 13563, as amended by Executive Order 14094 ("Modernizing Regulatory Review"), direct that each Federal agency shall propose or adopt a regulation only upon a reasoned determination that the benefits of the intended regulation justify the costs. Second, the Regulatory Flexibility Act of 1980 (Public Law 96-354) requires agencies to analyze the economic impact of regulatory changes on small entities. Third, the Trade Agreements Act (Public Law 96-39) prohibits agencies from setting standards that create unnecessary obstacles to the foreign commerce of the United States. Fourth, the Unfunded Mandates Reform Act of 1995 (Public Law 104-4) requires agencies to prepare a written assessment of the costs, benefits, and other effects of proposed or final rules that include a Federal mandate that may result in the expenditure by State, local, and tribal governments, in the aggregate, or by the private sector, of $100,000,000 or more (adjusted annually for inflation) in any 1 year. The current threshold after adjustment for inflation is $165,000,000, using the most current (2021) Implicit Price Deflator for the Gross Domestic

Product. The FAA has provided a detailed Regulatory Impact Analysis (RIA) in the docket for this rulemaking. This portion of the preamble summarizes the FAA's analysis of the economic impacts of this rule.

In conducting these analyses, the FAA has determined that this rule: would result in benefits that justify costs; is a "significant regulatory action" as defined in section 3(f) of Executive Order 12866, as amended by Executive Order 14094 ("Modernizing Regulatory Review"); would not have a significant economic impact on a substantial number of small entities; would not create unnecessary obstacles to the foreign commerce of the United States; and would not impose an unfunded mandate on State, local, or tribal governments, or on the private sector.

A. Summary of the Regulatory Impact Analysis

To limit the growth of orbital debris, the FAA is proposing to require that upper stages of commercial launch vehicles and other components be removed from orbit within 25 years after launch using an acceptable means of disposal. This document provides the FAA's analysis of the impact of this regulatory change.

Assumptions:

- All monetary values are expressed in 2020 dollars.
- A 15-year analysis period is used based on the available forecast and cost information.
- Present values using 3 percent and 7 percent discount rate as prescribed by OMB in Circular A-4.

Entities Potentially Affected by this Rulemaking:

- Licensed and permitted operators for launches and reentries with a planned altitude above 150 km.
- All space users.
- Commercial space transportation suppliers.

- Satellite operators and owners.
- The Federal Aviation Administration and other government agencies.
- The general public.

Currently, the FAA has no regulations requiring post-mission disposal of upper stages. In this rulemaking, the FAA considers the U.S. Government Orbital Debris Mitigation Standard Practices (USGODMSP) and policies of NASA, Federal Communications Commission (FCC), National Oceanic and Atmospheric Administration (NOAA), and the Inter-agency Space Debris Coordination Committee (IADC) in an effort to establish common standards as the commercial space industry evolves and utilization of space grows.

This proposed rule would prevent an estimated 427 used upper stages from becoming large orbital debris over the next 15 years. Furthermore, this proposed rule would likely result in cost savings resulting from avoiding orbital remediation costs in the long run. The proposed rule would reduce risks to human spaceflight and space property, and internalize the externality to benefit the satellite industry. In addition, the proposed mitigation requirements are in line with the public demand for a sustainable space environment and the commercial space industry's interest in driving down orbital debris awareness costs. Therefore, this rulemaking would improve public safety and eventually save the industry money in the long run.

The FAA assesses scenarios of compliance costs using low, central, and high scenarios, which vary by the number of controlled disposals per year. Cost of present values and annualized costs for the lower case, central case and higher case are presented in the following table.

Low, Central, and High-Cost Scenarios in 2022 US Dollars

Million Dollar	Present Value at a 7% discount rate	Present Value at a 3% discount rate	Annualized Cost at a 7% discount rate	Annualized Cost at a 3% discount rate
Lower Case	$16	$20	$2	$2
Central case	$24	$31	$3	$3
High Case	$48	$59	$5	$5

The central estimate of the present value of total costs over 15 years is $24 million at a 7 percent discount rate or $31 million at a 3 percent discount rate. The annualized costs at a 7 percent discount rate would be $2.6 million or $2.6 million at a 3 percent discount rate. Without post-mission disposal, the upper stages contribute to the majority of orbital debris due to their mass. Moreover, prevention of large orbital debris would reduce risks to human spaceflight and space property.

The following table is the summary of the total costs for central estimate, the FAA's preferred estimate.

Present Value and Annualized Cost in 2022 US Dollars

Summary of Costs ($ Million)	Present value at a 3% rate	Present value at a 7% rate	Annualized Cost at a 3% discount rate	Annualized Cost at a 7% discount rate
Mitigation Costs	$31.1	$23.9	$2.6	$2.6

The following table summarizes benefits and costs.

Summary of Benefits and Costs

Benefits
- Preventing 427 used upper stages from becoming orbital debris over the 15 years

- Avoiding orbital remediation costs in the long run - Mitigating risks to valuable space assets - Internalizing the externality (spill-over cost) to benefit the satellite industry - Aligning FAA requirements with interagency policies and common standards for orbital debris mitigation, and encouraging reciprocal regulatory action in foreign countries, which will further benefit U.S. commercial and government space operations by reducing space debris - Preventing collisions and protecting human spaceflight
Costs
- Present-value cost over 15-years (7 percent) would be $24 million ($3 million annualized). The costs are categorized into five groups: four disposal methods and reporting costs.

The FAA encourages the public interest parties to read a full context of the regulatory impact analysis (RIA) of this proposed rule in the docket for this rulemaking.

B. Regulatory Flexibility Determination

The Regulatory Flexibility Act of 1980 (Public Law 96-354) (RFA) establishes "as a principle of regulatory issuance that agencies shall endeavor, consistent with the objectives of the rule and of applicable statutes, to fit regulatory and informational requirements to the scale of the businesses, organizations, and governmental jurisdictions subject to regulation." To achieve this principle, agencies are required to solicit and consider flexible regulatory proposals and to explain the rationale for their actions to assure that such proposals are given serious consideration." The RFA covers a wide range of small entities, including small businesses, notfor-profit organizations, and small governmental jurisdictions.

Agencies must perform a review to determine whether a rule will have a significant economic impact on a substantial number of small entities. If the agency determines that it will, the agency must prepare a regulatory flexibility analysis as described in the RFA.

However, if an agency determines that a rule is not expected to have a significant economic impact on a substantial number of small entities, section 605(b) of the RFA provides that the head of the agency may so certify and a regulatory flexibility analysis is not required. The certification must include a statement providing the factual basis for this determination, and the reasoning should be clear.

Currently, there are five FAA-licensed United States commercial space launch orbital vehicle manufacturers and operators under the Small Business Administration small-entity criteria of 1,200 employees. Two of the five small entities are either a suborbital launcher whose space vehicles would not reach high space altitude to become orbital debris against the 25-year rule or not an active launcher, but listed as a launch license holder. The other three of the five are considered to be rocket builders, whose products as low-cost suborbital rockets would not be affected by this proposed rule. Therefore, as provided in section 605(b), the head of the FAA certifies that this rulemaking will not result in a significant economic impact on a substantial number of small entities.

The FAA invites interested parties to submit data and information regarding the potential economic impact that would result from the proposal.

C. International Trade Impact Assessment

The Trade Agreements Act of 1979 (Public Law 96-39), as amended by the Uruguay Round Agreements Act (Public Law 103-465), prohibits Federal agencies from establishing standards or engaging in related activities that create unnecessary obstacles to the foreign commerce of the United States. Pursuant to these Acts, the establishment of standards is not considered an unnecessary obstacle to the foreign commerce of the United States, so long as the standard has a legitimate domestic objective, such as the protection of safety, and does not operate in a manner that excludes imports that meet this objective. The statute also requires consideration of international standards and, where appropriate, that they be the basis for U.S. standards. The FAA has assessed the potential effect of this proposed rule and determined that it would respond to a domestic safety objective and would not be considered an unnecessary obstacle to trade.

D. Unfunded Mandates Assessment

Title II of the Unfunded Mandates Reform Act of 1995 (Public Law 104-4) requires each Federal agency to prepare a written statement assessing the effects of any Federal mandate in a proposed or final agency rule that may result in an expenditure of 100 million or more (in 1995 dollars) in any 1 year by State, local, and tribal governments, in the aggregate, or by the private sector; such a mandate is deemed to be a "significant regulatory action." The FAA currently uses an inflation-adjusted value of $155 million in lieu of $100 million. This proposed rule does not contain such a mandate; therefore, the requirements of Title II of the Act do not apply.

E. Paperwork Reduction Act

The Paperwork Reduction Act of 1995 (44 U.S.C. 3507(d)) requires that the FAA consider the impact of paperwork and other information collection burdens imposed on the public. According to the 1995 amendments to the Paperwork Reduction Act (5 CFR

1320.8(b)(2)(vi)), an agency may not collect or sponsor the collection of information, nor may it impose an information collection requirement unless it displays a currently valid OMB control number.

This action contains the following proposed amendments to the existing information collection requirements previously approved under OMB Control Number 2120-0608. As required by the Paperwork Reduction Act of 1995 (44 U.S.C. 3507(d)), the FAA has submitted these proposed information collection amendments to OMB for its review.

Summary: Under §§ 453.5 through 453.18, the proposed rule would require applicants to submit an ODAP that includes several analyses, descriptions, and demonstrations. The analyses would detail the release of debris during normal operations, how that debris release could be mitigated, and how any debris released will meet the 25-year rule and 100 object-year rule. An analysis detailing the end-of-mission passivation procedure and its probability of success would also be required, as well as a procedure for collision avoidance after payload separation and an analysis of the lifetime probability of collision. For post-mission disposal, analysis and description of the disposal method and its probability of success are proposed along with the calculated risk, effective casualty area, or the broad ocean location of any disposals into Earth's atmosphere.

Use: The information would be used by the FAA's Office of Commercial Space to evaluate the operator's application.

Respondents (including number of): There are approximately 13 FAA-licensed or permitted launches and reentries per year that would be affected by this proposed regulation.

Frequency: Operators would need to submit a mission-specific ODAP at least 60 days before each launch or reentry with a planned altitude above 150 km. In 2021, the FAA issued 24 space launch and reentry licenses held by 11 license holders. Many operators will be able to reuse the ODAP or parts of the ODAP for multiple operations, as some information will not change operation to operation. The FAA uses 25 ODAP per year for the calculation of the frequency.

Annual Burden Estimate: Changes in §§ 453.5 through 453.18 would result in some paperwork burden cost by requiring engineer time for analyses and documentations of mission disposal, normal operations debris release, explosion mitigation, and collision mitigation in an ODAP. The FAA estimates an aerospace engineer would spend approximately 10 hours per launch at the mean hourly wage rate of $81.28.[91] To determine reporting requirement cost, the FAA calculates the annual launch number potentially for orbital debris creation. The annual impacted launch number was estimated to be 25 by dividing the total forecasted launches subtracting sub-orbital launches (or natural decay) by 15 years. Based on impacted 25 launches, the paperwork burden would be $341,376 over 15-year analysis period.

[91] The spent hour estimate is based on FAA/AST office and government launchers data sources. The wage rate is based on U.S. Bureau of Labor Statistics (BLS), Occupation Employment and Wages, occupation code 17-2011 for Aerospace Engineers, in Feb 2019.

In order to comply with § 453.20, launch operators would need to notify the FAA or, if appropriate, a requesting Federal agency, by phone call or email at the detection of a debriscreating event or any launch or reentry activity outside the 3-sigma trajectory provided for collision avoidance. The FAA estimated the time required to report by phone or email would be about 0.25 hours per launch or approximately 95 hours (0.25 x 25 x 15) over a 15-year period, assuming operators would have an event to report under proposed § 453.20 after every launch. It would cost $8,677 (see table 2, column 3) over the entire 15-year period based on the average wage rate of $81.28 for aerospace engineers.

The compliance costs for § 453.11, launch and reentry collision avoidance analysis and the associated worksheet, are unchanged from the previous part 450 burden determination.

Combing all the reporting costs, the undiscounted total reporting requirement cost would be $350,053 ($341,376 + $8,677) over the 15-year period. The FAA believes the paperwork burden is insignificant.

The agency is soliciting comments to—

(1) Evaluate whether the proposed information requirement is necessary for the proper performance of the functions of the agency, including whether the information will have practical utility;

(2) Evaluate the accuracy of the agency's estimate of the burden;

(3) Enhance the quality, utility, and clarity of the information to be collected; and

(4) Minimize the burden of collecting information on those who are to respond, including by using appropriate automated, electronic, mechanical, or other technological collection techniques or other forms of information technology.

Individuals and organizations may send comments on the information collection requirement to the address listed in the ADDRESSES section at the beginning of this preamble by [INSERT DATE 90 DAYS AFTER PUBLICATION IN THE FEDERAL REGISTER]. Comments also should be submitted to the Office of Management and Budget, Office of Information and Regulatory Affairs, Attention: Desk Officer for FAA, New Executive Building, Room 10202, 725 17 Street, NW, Washington, DC 20053.

F. Environmental Analysis

FAA Order 1050.1F identifies FAA actions that are categorically excluded from preparation of an environmental assessment or environmental impact statement under the National Environmental Policy Act in the absence of extraordinary circumstances. The FAA has determined this rulemaking action qualifies for the categorical exclusion identified in paragraph 5-6.6f for regulations and involves no extraordinary circumstances. Use

V. Executive Order Determinations

A. Executive Order 13132, Federalism

The FAA has analyzed this proposed rule under the principles and criteria of Executive Order 13132, Federalism. The agency has determined that this action would not have a substantial direct effect on the States, or the relationship between the Federal Government and the States, or on the distribution of power and responsibilities among the various levels of government, and, therefore, would not have Federalism implications.

B. Executive Order 13211, Regulations that Significantly Affect Energy Supply, Distribution, or

The FAA analyzed this proposed rule under Executive Order 13211, Actions Concerning Regulations that Significantly Affect Energy Supply, Distribution, or Use (May 18, 2001). The agency has determined that it would not be a "significant energy action" under the executive order and would not be likely to have a significant adverse effect on the supply, distribution, or use of energy.

VI. Additional Information

A. Comments Invited

The FAA invites interested persons to participate in this rulemaking by submitting written comments, data, or views. The agency also invites comments relating to the economic, environmental, energy, or Federalism impacts that might result from adopting the proposals in this document. The most helpful comments reference a specific portion of the proposal, explain the reason for any recommended change, and include supporting data. To ensure the docket does not contain duplicate comments, commenters should send only one copy of written comments, or if comments are filed electronically, commenters should submit only one time.

The FAA will file in the docket all comments it receives, as well as a report summarizing each substantive public contact with FAA personnel concerning this proposed rulemaking, or a memorandum submitted by outside parties to memorialize communications with the FAA. Before acting on this proposal, the FAA will consider all comments it receives on or before the closing date for comments. The FAA will consider comments filed after the comment period has closed to the extent practicable. The agency may change this proposal in light of the comments it receives.

Proprietary or Confidential Business Information: Commenters should not file proprietary or confidential business information in the docket. Such information must be sent or delivered directly to the person identified in the FOR FURTHER INFORMATION CONTACT section of this document, and marked as proprietary or confidential. If submitting information on a disk or CD ROM, mark the outside of the disk or CD ROM, and identify electronically within the disk or CD ROM the specific information that is proprietary or confidential.

Under 14 CFR 11.35(b), if the FAA is aware of proprietary information filed with a comment, the agency does not place it in the docket. It is held in a separate file to which the public does not have access, and the FAA places a note in the docket that it has received it. If the FAA receives a request to examine or copy this information, it treats it as any other request under the Freedom of Information Act (5 U.S.C. 552). The FAA processes such a request under Department of Transportation procedures found in 49 CFR part 7.

B. Availability of Rulemaking Documents

An electronic copy of rulemaking documents may be obtained from the Internet by—

1. Searching the Federal eRulemaking Portal (www.regulations.gov);

2. Visiting the FAA's Regulations and Policies web page at www.faa.gov/regulations_policies; or,

3. Accessing the Government Printing Office's web page at www.GovInfo.gov.

Copies may also be obtained by sending a request to the Federal Aviation Administration, Office of Rulemaking, ARM-1, 800 Independence Avenue SW, Washington, DC 20591, or by calling (202) 267-9677. Commenters must identify the docket or notice number of this rulemaking.

All documents the FAA considered in developing this proposed rule, including economic analyses and technical reports, may be accessed from the Internet through the Federal eRulemaking Portal referenced in item (1) above.

List of Subjects

14 CFR Part 401

Organization and functions (Government agencies). Space Transportation and exploration.

14 CFR Part 404

Administrative practice and procedure. Space transportation and exploration.

14 CFR Part 415

Reporting and recordkeeping requirements, Space transportation and exploration.

14 CFR Part 417

Reporting and recordkeeping requirements, Space transportation and exploration.

14 CFR Part 431

Reporting and recordkeeping requirements, Space transportation and exploration.

14 CFR Part 435

Reporting and recordkeeping requirements, Space transportation and exploration.

14 CFR Part 437

Aircraft. Aviation safety. Reporting and recordkeeping requirements. Space transportation and exploration.

14 CFR Part 450

Reporting and recordkeeping requirements, Space transportation and exploration.

14 CFR Part 453

Reporting and recordkeeping requirements, Space transportation and exploration.

The Proposed Amendment

In consideration of the foregoing, the Federal Aviation Administration proposes to amend chapter III of title 14, Code of Federal Regulations as follows:

PART 401--ORGANIZATION AND DEFINITIONS

1. The authority citation for part 401 continues to read as follows:

Authority: 51 U.S.C. 50901-50923

§ 401.7 Definitions.

2. Amend § 401.7 to add or revise the following items, in alphabetical order, to read as follows:

* * * *

Disposal means to execute or attempt to execute controlled atmospheric disposal,

*

heliocentric disposal, uncontrolled atmospheric disposal, disposal orbit, or direct retrieval of launch vehicle stages or components of launch or reentry vehicles under part 453 of this chapter. * * * * *

Geostationary Earth Orbit (GEO) means any Earth orbit where the orbiting object orbits at the same angular velocity as the Earth and the object appears stationary from the ground. The altitude of this zero inclination, zero eccentricity orbit is 35,786 km.

Geosynchronous region is the band of orbital space surrounding GEO. It is bound by altitude limits of 35,786 km +/- 200 km altitude and +/- 15 degrees latitude.

* * * * *

Low Earth Orbit (LEO) means any Earth orbit with both apogee and perigee below 2,000 km altitude.

* * * * *

Medium Earth Orbit (MEO) means any Earth orbit in which an object's apogee and perigee both remain between LEO and GEO.

* * * * *

Object time means the number of objects multiplied by the unit of time, typically years. A higher object-time means more objects on orbit for a higher cumulative amount of time.

* * * * *

Orbital debris means all human-generated debris in Earth orbit that is greater than 5 mm in any dimension. This includes, but is not limited to, payloads that can no longer serve a useful purpose, rocket bodies and other hardware (e.g., bolt fragments and covers) left in orbit as a result of normal launch and operational activities, and fragmentation debris produced by failure or collision. Released gases and liquids in a free state, and solid rocket motor slag of any size are

*

*

*   * not orbital debris.

*   *   *   *   *

PART 404—PETITION AND RULEMAKING PROCEDURES

3. The authority citation for part 404 continues to read as follows:

Sections	Paragraphs
§ 404.5—Filing a petition for waiver	(a).
§ 413.23—License or permit renewal	(a).
§ 414.31—Safety element approval renewal	(a).
§ 420.57—Notifications	(d).
§ 437.89—Pre-flight reporting	(a), (b).
§ 440.15—Demonstration of compliance	(a)(1), (a)(2), (a)(3), (a)(4).

§ 453.11—Launch and Reentry Collision Avoidance Analysis Requirements	(e)(1).
§ 450.213—Pre-flight reporting	(b), (c), (d), (e).
§ 450.215—Post-flight reporting	(a).

Authority: 51 U.S.C. 50901-50923

4. Revise Table A404.1 to read as follows:

* * * * *

PART 415—LAUNCH LICENSE

5. The authority citation for part 415 continues to read as follows:

Authority: 51 U.S.C. 50901-50923

§ 415.2 Licenses issued under this part.

6. Amend § 415.2 by revising paragraph (b) to read as follows:

* * * * *

(b) *Compliance with parts 450 and 453 of this chapter*. Operations under this part must comply with the critical asset protection requirements in § 450.101(a)(4) and (b)(4) of this chapter and, for launches with a planned altitude greater than 150 kilometers, the collision avoidance requirements in § 453.11 of this chapter.

§ 415.35 Acceptable flight risk.

7. Amend § 415.35 by revising paragraph (d) to read as follows:

* * * * *

(d) *Operation.* A launch vehicle must be operated in a manner that ensures that flight risks meet the criteria of paragraph (a) of this section and in accordance with collision avoidance requirements in § 453.11 and critical asset protection requirements in §§ 450.101(a)(4) and (b)(4). An applicant must identify all launch operations and procedures that must be performed to ensure acceptable flight risk.

*   *   *   *

8. Revise § 415.39 to read as follows:

§ 415.39 Demonstration of Orbital Debris Mitigation.

An applicant must demonstrate compliance with §§ 453.7 and 453.9 of this chapter for any proposed launch of a launch vehicle with a stage or component that will travel to an altitude of 150 kilometers or higher.

9. Revise § 415.133 to read as follows:

§ 415.133 Orbital Debris Mitigation.

An applicant must demonstrate compliance with §§ 453.7 and 453.9 of this chapter for any proposed launch of a launch vehicle with a stage or component that will travel to an altitude of 150 kilometers or higher.

10 . Amend Appendix B to Part 415 by revising item 13.0 to read as follows:

Appendix B to Part 415—Safety Review Document Outline

*   *   *   *

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*

13.0 Orbital Debris Mitigation (§ 415.133)

PART 417—LAUNCH SAFETY

11. The authority citation for part 417 continues to read as follows:

§ 417.113 Launch safety rules.

12 . Amend § 417.113 by revising paragraph (c)(1) to read as follows:

* * * *

(c) * * *

(1) The flight-commit criteria must implement the flight safety analysis of subpart C of this part, the collision avoidance requirements in § 453.11, and critical asset protection requirements in § 450.101(a)(4) and (b)(4). These must include criteria for:

* * * *

(iii) Implementation of any launch wait in the launch window for the purpose of collision avoidance in accordance with collision avoidance requirements in § 453.11.

* * * *

13 . Revise § 417.129 to read as follows:

§ 417.129 Orbital Debris Mitigation.

A launch operator must perform orbital debris mitigation as required by §§ 453.7 and 453.9 of this chapter.

PART 431—LAUNCH AND REENTRY OF A REUSABLE LAUNCH VEHICLE (RLV)

14 . The authority citation for part 431 continues to read as follows:

Authority: 51 U.S.C. 50901–50923

§ 431.2 Licenses issued under this part.

Authority: 51 U.S.C. 50901–50923

15. Amend § 431.2 by revising paragraph (b) to read as follows:

* * * * *

(b) Compliance with parts 450 and 453 of this chapter. Operations under this part must comply with the critical asset protection requirements in § 450.101(a)(4) and (b)(4) of this

chapter and, for launches or reentries with a planned altitude greater than 150 kilometers, the launch and reentry collision avoidance requirements in § 453.11 of this chapter.

§ 431.43 Reusable launch vehicle mission operational requirements and restrictions.

16 . Amend § 431.43 by revising paragraphs (a)(1) and (c)(3) to read as follows:

(a) * * *

(1) That ensure RLV mission risks do not exceed the criteria set forth in §§ 431.35, 450.101(a)(4) and (b)(4), and 453.11 for nominal and non-nominal operations;

* * * *

(c) * * *

(3) A launch operator must perform orbital debris mitigation as required by §§ 453.7 and 453.9 of this chapter; and

* * * *

PART 435—REENTRY OF A REENTRY VEHICLE OTHER THAN A REUSABLE LAUNCH VEHICLE (RLV)

17 . The authority citation for part 435 continues to read as follows:

Authority: 51 U.S.C. 50901–50923

§ 435.2 Licenses.

18. Amend § 435.2 by revising paragraph (b) to read as follows:

* * * *

*

*

*

(b) *Compliance with parts 450 and 453 of this chapter.* Operations under this part with a planned altitude greater than 150 kilometers must comply with launch and reentry collision avoidance requirements in § 453.11 of this chapter and critical asset protection requirements in § 450.101(a)(4) and (b)(4) of this chapter.

PART 437—EXPERIMENTAL PERMITS

19. The authority citation for part 437 continues to read as follows:

Authority: 51 U.S.C. 50901–50923

§ 437.65 Collision avoidance analysis.

20. Revise § 437.65 to read as follows:

For a permitted flight with a planned altitude greater than 150 kilometers, a permittee must obtain a collision avoidance analysis in accordance with § 453.11 of this chapter.

PART 450—LAUNCH AND REENTRY LICENSE REQUIREMENTS

21. The authority citation for part 450 continues to read as follows:

Authority: 51 U.S.C. 50901–50923

§ 450.37 Equivalent level of safety.

22. Amend § 450.37 by revising paragraph (b) to read as follows:

*   *   *   *

(b) Paragraph (a) of this section does not apply to § 450.101(a), (b), (c)(1) and (3), (d), and (g).

§ 450.101 Safety criteria.

23. Amend § 450.101 by revising paragraphs (d) and (e) to read as follows:

*   *   *   *

(d) *Disposal risk criteria*. For any controlled or uncontrolled atmospheric disposal, an

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*

operator may initiate the deorbit of a vehicle or its components only if all risks to the public satisfy the criteria in this paragraph.

(1) *Controlled atmospheric disposal*. For any controlled atmospheric disposal performed in accordance with § 453.14 or direct retrieval resulting in controlled atmospheric disposal under § 453.16(b)(1), an operator must:

(i) Ensure that the effective casualty area for any surviving debris will be less than 7 square meters;

(ii) Target a broad ocean area; or

(iii) Meet the following risk criteria:

(A) *Collective risk*. The collective risk, measured as expected number of casualties (E_C), consists of risk posed by impacting inert and explosive debris, toxic release, and far field blast overpressure. Public risk due to any other hazard associated with the proposed deorbit of a launch vehicle stage or component of a launch or reentry vehicle will be determined by the Administrator on a case-by-case basis. The risk to all members of the public, excluding persons in aircraft must not exceed an expected number of 1×10^{-4} casualties.

(B) *Individual risk*. The individual risk, measured as probability of casualty (P_C), consists of risk posed by impacting inert and explosive debris, toxic release, and far field blast overpressure. Public risk due to any other hazard associated with the proposed deorbit of a launch vehicle stage or component of a launch or reentry vehicle will be determined by the Administrator on a case-by-case basis. The risk to any individual member of the public must not exceed a probability of casualty of 1×10^{-6} per disposal.

(C) *Aircraft risk*. An operator must establish any aircraft hazard areas necessary to ensure the probability of impact with debris capable of causing a casualty for aircraft does not exceed 1 x 10⁻

(i) Ensure that the effective casualty area for any surviving debris will be less than 7 square meters; or

(ii) Meet the collective risk criterion of paragraph (1)(iii)(A) of this subsection.

(e) *Protection of people and property on orbit*.

(1) A launch or reentry operator must prevent the collision between a launch or reentry vehicle stage or component with a planned altitude greater than 150 kilometers and people, property, and debris on orbit, in accordance with the requirements in § 453.11.

(2) For any launch or reentry vehicle stage or component with a planned altitude greater than 150 kilometers, a launch operator must perform orbital debris mitigation in accordance with the requirements in §§ 453.7 and 453.9.

* * * *

§ 450.113 Flight safety analysis requirements—scope.

24. Amend § 450.113 by revising paragraph (a) and adding paragraph (c) to read as follows:

(a) An operator must perform and document a flight safety analysis for all phases of flight, except as specified in paragraphs (b) and (c) of this section, as follows—

* * * *

(1) * * *

(3) For controlled atmospheric disposal performed in accordance with § 453.14 or direct retrieval resulting in controlled atmospheric disposal under § 453.16(b)(1), from the initiation of

(2) Uncontrolled atmospheric disposal. For any uncontrolled atmospheric disposal performed in accordance with § 453.17, an operator must either:

* the deorbit through final impact; and

(c) An operator is not required to perform and document a flight safety analysis for a controlled atmospheric disposal if agreed to by the Administrator that the disposal will target a broad ocean area or the effective casualty area for any surviving debris will be less than 7 square meters.

§ 450.165 Flight commit criteria.

25. Amend § 450.165 by revising paragraph (a)(3) to read as follows:

* * * *

(a) * * *

(3) Implementation of any launch or reentry window closure in the launch or reentry window for the purpose of collision avoidance in accordance with § 453.11;

* * * *

26. Revise § 450.169 to read as follows:

§ 450.169 Launch and reentry collision avoidance analysis requirements.

A launch or reentry operator must perform collision avoidance analysis as required by § 453.11 .

27. Revise § 450.171 to read as follows:

§ 450.171 Orbital Debris Mitigation.

A launch operator must perform orbital debris mitigation as required by §§ 453.7 and 453.9 of this chapter.

§ 450.213 Pre-flight reporting.

28. Amend § 450 .213 to revise paragraph (e) to read as follows:

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*   *   *   *   *

(e) *Collision avoidance analysis*. A licensee must submit collision avoidance information to a Federal entity identified by the FAA and to the FAA in accordance with § 453.11(f). *

*   *   *   *

Appendix A to Part 450—Collision Analysis Worksheet [REMOVED]

29. Remove Appendix A to Part 450—Collision Analysis Worksheet.

30. Add part 453 to read as follows:

PART 453—ORBITAL SAFETY REQUIREMENTS

Sec.

Authority: 51 U.S.C. 50901–50923

§ 453.1 Applicability

(a) This part establishes the requirements of a launch or reentry operator (operator) for orbital debris mitigation, including collision avoidance analysis, prior to launch or reentry operations licensed or permitted under this chapter with a planned altitude greater than 150 kilometers.

(b) For each licensed or permitted launch or reentry with a planned altitude greater than 150 kilometers, an operator must submit —

(1) An Orbital Debris Assessment Plan containing the information required by this part not less than 60 days before the licensed or permitted launch or reentry, unless the Administrator agrees to a different time frame in accordance with § 404.15; and

(2) A Collision Avoidance Analysis Worksheet in accordance with § 453.11(f).

(c) An operator must send the information required by this part as an email attachment to ASTOperations@faa.gov, or other method as agreed to by the Administrator in the license or permit.

§ 453.3 [Reserved]

§ 453.5 Control of Debris Released During Normal Operations

An operator must ensure for any proposed launch that for all vehicle stages and components related to launch that reach an altitude greater than 150 kilometers—

(a) The component will not release orbital debris into LEO that will remain in orbit for more than 25 years. For all planned released orbital debris, the total debris object-time product in LEO shall not exceed 100 object-years per licensed or permitted launch. The total object-time product in LEO is the sum of the orbit dwell time in LEO for all planned released debris objects, excluding the upper stage and any released payloads.

(b) Any orbital debris released into the geosynchronous region must enter an orbit with an apogee that will not remain in the geosynchronous region within 25 years of the release.

(c) Information Requirements. An operator must submit the following information in an Orbital Debris Assessment Plan—

(1) A demonstration through environmental qualification and acceptance testing that the system is designed to limit the release of orbital debris; and

(2) A statistical analysis, including inputs and assumptions, demonstrating that any orbital debris released will be disposed of within 25 years and satisfy the 100 object-year requirement.

§ 453.7 Minimizing Debris Generated by Explosions

(a) An operator must ensure for any proposed launch that for all vehicle stages or other component that reaches an altitude greater than 150 kilometers, except for energy sources that are safety critical on-orbit or during reentry:

(1) The integrated probability of debris-generating explosions or other fragmentation from the conversion of energy sources (i.e. chemical, pressure, kinetic) of each upper stage is less than 0.001 (1 in 1,000) during operations; and

(2) Stored energy is removed by depleting residual propellants, venting any pressurized system, leaving all batteries in a permanent discharge state, and removing any remaining source of stored energy.

(b) Information Requirements. An operator must submit the following information in an Orbital Debris Assessment Plan—

(1) Analysis, using commonly accepted engineering and probability assessment methods, showing how the operation meets paragraph (a)(1) of this section.

(2) Test results or analysis, with 95 percent confidence levels, of the planned end-ofmission

prevent explosion of any launch vehicle component, to show that:

(i) All residual propellants contained in the system can be purged or passivated at the end of launch;

(ii) All pressurized systems can be purged or passivated; and

(iii) All energy storage systems (e.g., batteries or fuel cells) have sufficient structural design to prevent rupture and subsequent explosion.

§ 453.9 Collision Mitigation between Launched Objects

(a) Payload Separation . A launch operator must prevent unplanned physical contact between a launch vehicle or any of its components and each payload after payload separation;

(b) Collision after the End of Launch . In developing the design and mission profile for an upper stage, the launch operator shall limit the probability of collision with objects 10 cm and larger after the end of launch to less than 0.001 (1 in 1,000);

(c) Information required . A launch operator must submit the following information in an Orbital Debris Assessment Plan—

(1) Procedure for preventing vehicle and payload collision after payload separation, including any propellant depletion burns and compressed gas releases that minimize the probability of subsequent collisions; and

(2) The results of a probability of collision analysis between the upper stage and its components and orbital objects, using commonly accepted engineering and probability

passivation procedure that verifies dissipation of all energy sources to levels that will assessment methods, meeting paragraph (b) of this section.

§ 453.11 Collision Avoidance with Orbital Objects

(a) *Criteria.* For an orbital or suborbital launch or reentry, an operator must establish window closures needed to ensure that the launch or reentry vehicle, any jettisoned components, or payloads meet the following requirements with respect to orbiting objects, not including any object being launched or reentered.

(1) For inhabitable objects, one of the following three criteria must be met:

(i) The probability of collision between the launching or reentering objects and any inhabitable object must not exceed 1×10^{-6};

(ii) The launching or reentering objects must maintain an ellipsoidal separation distance of 200 kilometers in-track and 50 kilometers cross-track and radially from the inhabitable object;

(iii) The launching or reentering objects must maintain a spherical separation distance of 200 kilometers from the inhabitable object.

(2) For active payloads, one of the following criteria must be met:

(i) The probability of collision between the launching or reentering objects and the active payload must not exceed 1×10^{-5};

(ii) The launching or reentering objects must maintain an ellipsoidal separation distance of 25 kilometers in-track and 7 kilometers cross-track and radially from the active payload; or

(iii) The launching or reentering objects must maintain a spherical separation distance of 25 kilometers from the active payload.

(3) For all other known orbital debris identified by the FAA or other Federal Government entity with a radar cross section greater than 0.04 m^2:

or

(i) The probability of collision between the launching or reentering objects and any known orbital debris must not exceed 1×10^{-5}; or

(ii) The launching or reentering objects must maintain a spherical separation distance of 2.5 kilometers.

(b) *Screening time.* An operator must ensure the requirements of paragraph (a) of this section are met as follows:

(1) Through the entire segment of flight of a suborbital launch vehicle above 150 kilometers altitude;

(2) For an orbital launch, during ascent from a minimum of 150 kilometers altitude to initial orbital insertion and for a minimum of 3 hours from liftoff;

(3) For reentry, during descent from initial reentry burn to 150 kilometers altitude;

(4) For controlled atmospheric disposal, during descent from initial disposal burn to 150 kilometers altitude; and

(5) For maneuver to a disposal orbit, during initial disposal operation until removal from LEO or GEO.

(c) *Rendezvous*. Planned rendezvous operations that occur within the screening time frame are not considered a violation of collision avoidance if the involved operators have pre-coordinated the rendezvous or close approach. (d) *Analysis.* An operator must obtain a collision avoidance analysis for each launch or reentry from a Federal entity identified by the FAA, or another entity agreed to by the Administrator.

(1) An operator must use the results of the collision avoidance analysis to establish flight commit criteria for collision avoidance; and

(2) The collision avoidance analysis must account for uncertainties including launch or

reentry vehicle performance and timing, atmospheric changes, variations in drag, and any other factors that affect position and timing of the launch or reentry vehicle.

(e) *Timing and information required.* An operator must prepare a Collision Avoidance Analysis Worksheet for each launch or reentry using a standardized format that contains the input data required by § 453.11(f), as follows:

(1) Except as specified in paragraphs (e)(1)(i) and (e)(1)(ii) of this section, an operator must file the input data with an entity identified in paragraph (d) of this section and the FAA at least 7 days before the first attempt at the flight of a launch vehicle or the reentry of a reentry vehicle.

(i) Operators that have never received a launch or reentry conjunction assessment from the entity identified in paragraph (d) of this section must file the input data at least 15 days in advance.

(ii) The Administrator may agree to an alternative time frame in accordance with § 404.15.

(2) An operator must obtain a collision avoidance analysis performed by an entity identified in paragraph (d) of this section no later than 3 hours before the beginning of a launch or reentry window; and

(3) If an operator needs an updated collision avoidance analysis due to a launch or reentry delay, the operator must file the request with the entity identified in paragraph (d) of this section and the FAA at least 12 hours prior to the beginning of the new launch or reentry window.

(f) *Collision Avoidance Analysis Worksheet*. The Collision Avoidance Analysis Worksheet must include—

(1) Launch or reentry information. An operator must file the following information:

(i) Mission name. A mnemonic given to the launch or reentry vehicle/payload combination identifying the launch or reentry mission distinctly from all others;

(ii) Launch or reentry location. Launch or reentry site location in latitude and longitude;

(iii) Launch or reentry window. The launch or reentry window opening and closing times in Greenwich Mean Time (referred to as ZULU time) and the Julian dates for each scheduled launch or reentry attempts including primary and secondary launch or reentry dates;

(iv) Epoch. The epoch time, in Greenwich Mean Time (GMT), of the expected launch vehicle liftoff time or, for reentry, the times of reentry events such as the beginning of descent, atmospheric reentry below 150 kilometers, and touchdown;

(v) Orbiting objects to evaluate. An operator must identify all orbiting object descriptions including object name, dimensions (e.g., length, width, height, and diameter), and mass. These orbiting objects include each free-flying launch vehicle stage, payload, or component achieving orbit;

(vi) Orbital Parameters. An operator must identify the orbital parameters for each freeflying launch vehicle stage, payload, or component achieving orbit including the parameters for each object after thrust ends;

(vii) Time of powered flight and sequence of events. The elapsed time in hours, minutes, and seconds, from liftoff to passivation or disposal. The input data must include the time of powered flight for each stage or jettisoned component measured from liftoff; and

(viii) Point of contact. The person or office within an operator's organization that collects, analyzes, and distributes collision avoidance analysis results.

(2) Collision avoidance analysis results transmission medium. An operator must identify the transmission medium, such as voice or e-mail, for receiving results.

(3) Deliverable schedule/need dates. An operator must identify the times before flight, referred to as "L-times," for which the operator requests a collision avoidance analysis. The final collision avoidance analysis must be used to establish flight commit criteria for a launch.

(4) Trajectory files. Individual position and velocity trajectory files, including:

(i) The position coordinates in the Earth-Fixed Greenwich (EFG) coordinates system measured in kilometers and the EFG velocity components measured in kilometers per second, of each launch vehicle stage or payload starting below 150 kilometers through screening time frame;

(ii) Radar cross section values for each individual file;

(iii) Position Covariance, if probability of impact analysis option is desired; and

(iv) Separate trajectory files identified by valid window time frames, if launch or reentry trajectory changes during launch or reentry window.

(5) Screening. An operator must select spherical, ellipsoidal, or collision probability screening as defined in this paragraph for determining any conjunction:

(i) Spherical screening. Spherical screening centers a sphere on each orbiting object's center-of-mass to determine any conjunction;

(ii) Ellipsoidal screening. Ellipsoidal screening utilizes an impact exclusion ellipsoid of revolution centered on the orbiting object's center-of-mass to determine any conjunction. An operator must provide input in the UVW coordinate system in kilometers. The operator must provide delta-U measured in the radial-track direction, delta-V measured in the in-track direction, and delta-W measured in the cross-track direction; or

(iii) Probability of Collision. Collision probability is calculated using position and velocity information with covariance in position.

§ 453.13 Post-Mission Disposal

(a) *General*. An operator must dispose of all vehicle stages or jettisoned components in accordance with one of the disposal methods identified in §§ 453.14 through 453.18.

(b) *Information requirements*. An operator must submit a description of the chosen disposal option in an Orbital Debris Assessment Plan.

§ 453.14 Controlled Atmospheric Disposal

(a) *Applicability*. This section applies to the use of controlled atmospheric disposal of vehicle stages or components by reentering the atmosphere to meet the post-mission disposal requirement of § 453.13.

(b) *Disposal safety criteria*. A launch or reentry operator must ensure the upper stage and each of its components, or any components of a reentry vehicle excluding the reentry vehicle itself, reenters the Earth's atmosphere within 30 days after mission completion in a controlled manner that:

(1) Ensures that the effective casualty area for any surviving debris will be less than 7 square meters;

(2) Targets a broad ocean area; or

(3) Meets the risk criteria of § 450.101(d)(1)(iii)(A) through (C).

(c) *Notification of planned impacts*. For any controlled atmospheric disposal, an operator must notify the public of any region of land, sea, or air that contains, with 97 percent probability of containment, all debris resulting from normal flight events capable of causing a casualty.

(d) *Information requirements*. An operator must submit a description of the controlled atmospheric disposal in an Orbital Debris Assessment Plan including—

(1) Verification through hardware and software testing or analysis that the system has at least a 90 percent probability of successfully executing the controlled atmospheric disposal as

planned;

(2) A description of how the system will achieve a controlled atmospheric disposal under nominal and off-nominal conditions; and

(3) If not targeting a broad ocean area, the calculated total collective and individual casualty expectations for the proposed operation or the effective casualty area of any surviving debris.

§ 453.15 Heliocentric, Earth-escape Disposal

(a) *Applicability*. This section applies to the use of heliocentric, Earth-escape disposal to meet the post-mission disposal requirement of § 453.13.

(b) *General*. A launch operator must ensure, within 30 days after mission completion, that the upper stage and each of its components enters a hyperbolic trajectory which no longer orbits Earth;

(c) *Information requirements*. A launch operator must submit a description of the planned heliocentric, Earth-escape disposal in an Orbital Debris Assessment Plan including:

(1) Verification through hardware and software testing or analysis that the system has at least a 90 percent probability of successfully executing the planned heliocentric, Earth-escape disposal; and

(2) A description of how the system will achieve a controlled disposal under nominal and off-nominal conditions.

§ 453.16 Direct Retrieval

(a) *Applicability*. This section applies to the use of direct retrieval to meet the postmission disposal requirement of § 453.13.

(b) *General*. No more than 5 years after completion of the mission, an operator must ensure the removal of the upper stage and each of its components from orbit by either—

(1) Performing a controlled atmospheric disposal that meets the disposal safety requirements of § 453.14(b) and (c); or

(2) Maneuvering the debris into a disposal orbit in accordance with § 453.18.

(c) *Information requirements*. An operator must submit a description of the planned direct retrieval in an Orbital Debris Assessment Plan including—

(1) Verification through hardware and software testing or analysis that the system has at least a 90 percent probability of successfully executing the planned direct retrieval; and

(2) If performing a controlled atmospheric disposal—

(i) A description of how the system will achieve a disposal under nominal and off-nominal conditions; and

(ii) If not disposing into a broad ocean area, the calculated total collective and individual casualty expectations for the proposed operation or the effective casualty area of any surviving debris; or

(3) If maneuvering to a disposal orbit—

(i) A description of how the system will achieve and maintain the planned disposal orbit for the required time limit as specified in § 453.18(b) through (d); and

(ii) A statistical analysis demonstrating that the probability of collision with operational spacecraft and debris is within the lifetime limit of § 453.18(e).

§ 453.17 Uncontrolled Atmospheric Disposal

(a) Applicability. This section applies to the use of uncontrolled atmospheric disposal to meet the post-mission disposal requirement of § 453.13.

(b) *LEO Disposal*. For orbits below 2,000 kilometers:

(1) A launch or reentry operator must leave an upper stage and its components in an orbit where, accounting for mean projections for solar activity and atmospheric drag, the orbital lifetime should be as short as practicable but does not exceed 25 years after launch, and

(2) For all launches and reentries after [ONE YEAR AFTER THE REGULATION EFFECTIVE DATE], an operator must ensure that the effective casualty area for any surviving debris will be less than 7 square meters, or the expected average number of casualties will be less than 1×10^{-4}.

(c) *Highly elliptical long-term disposal*. For highly elliptical MEO (including semisynchronous Molniya) and highly elliptical GEO orbits (including synchronous Tundra orbits), and other orbits subject to significant eccentricity growth, the operator must maneuver the upper stage to a long-term disposal orbit where orbital resonances will increase the eccentricity for its long-term disposal. In developing this disposal plan, the operator must:

(1) Limit the orbital lifetime to be as short as practicable, but no more than 200 years after mission completion;

(2) Limit the probability of collisions with operational spacecraft and debris 10 cm and larger to less than 0.001 during orbital lifetime; and

(3) For launches after [ONE YEAR AFTER THE REGULATION EFFECTIVE DATE],

a launch operator must ensure that the effective casualty area for any surviving debris will be less than 7 square meters, or the expected average number of casualties will be less than 1×10^{-4}. (d) *Information requirements*. A launch or reentry operator must submit the following information in an

Orbital Debris Assessment Plan—

(1) Verification through hardware and software testing or analysis that the system has at least a 90 percent probability of successfully executing the planned disposal option;

(2) An estimate of the expected casualties or the effective casualty area for any surviving debris; and

(3) A statistical analysis demonstrating compliance with the requirements of § 453.17(b) or (c) to dispose of the debris within the prescribed time limit.

§ 453.18 Maneuver to a disposal orbit

(a) *Applicability*. This section applies to the use of a disposal orbit to meet the post-mission disposal requirement of § 453.13.

(b) *General*. Within 30 days after mission completion, a launch or reentry operator must place the upper stage and its components either—

(1) Between LEO and GEO in accordance with paragraph (c) of this section; or

(2) Above GEO in accordance with paragraph (d) of this section.

(c) *Maneuver to disposal orbit between LEO and GEO*. The operator must place the upper stage and its components into either—

(1) An eccentric disposal orbit where—

(i) Perigee altitude remains above 2,000 kilometers for at least 100 years;

(ii) Apogee altitude remains below the geosynchronous region for at least 100 years; and

(iii) The time spent by the upper stage between 20,182 +/- 300 kilometers is limited to 25 years or less over 200 years; or

(2) A near-circular disposal orbit that avoids for at least 100 years:

(i) Altitudes 20,182 +/- 300 kilometers;

(ii) The geosynchronous region; and

(iii) Altitudes less than 2,000 kilometers.

(d) *Maneuver to disposal orbit above GEO*. The operator must place the upper stage and its components into an orbit with a perigee altitude above 36,100 kilometers for a period of at least 100 years after disposal.

(e) *Probability of Collision*. The operator must limit the probability of collisions with operational spacecraft and debris 10 cm and larger to less than 0.001 for 100 years after disposal.

(f) *Information requirements*. A launch or reentry operator must submit the following information in an Orbital Debris Assessment Plan—

(1) Verification through hardware and software testing or analysis that the system has at least a 90 percent probability of successfully executing the planned disposal option;

(2) A description of how the system will achieve and maintain the planned disposal orbit for the required time limit; and

(3) Statistical analysis demonstrating compliance with the probability of collision lifetime limit with operational spacecraft and debris.

§ 453.20 Real-Time Reporting of Orbital Safety Hazards

(a) At the detection of any launch or reentry activity outside the 3-sigma trajectory provided for collision avoidance or any debris-creating event, or if requested by a cognizant Federal agency, an operator must immediately provide information to the FAA and, if appropriate, to the requesting agency pertinent to locating and categorizing any orbital objects.

(b) The operator shall provide the following information to the FAA and, if applicable, the requesting Federal agency:

(1) The size and mass of the affected objects,

(2) The last known orbital or trajectory information,

and

(3) Other details as determined by the FAA necessary to locate and categorize orbital objects.

Issued under authority provided by 49 U.S.C. 106(f) and 51 U.S.C. 50903, 50905 in Washington, DC, on

Kelvin B. Coleman
Associate Administrator for
Commercial Space Transportation

Proposed Rules

This section of the FEDERAL REGISTER contains notices to the public of the proposed issuance of rules and regulations. The purpose of these notices is to give interested persons an opportunity to participate in the rule making prior to the adoption of the final rules.

DEPARTMENT OF TRANSPORTATION

Federal Aviation Administration

14 CFR Parts 401, 413, 415, 431, 435, 437, 440, 450, and 460

[Docket No.: FAA–2023–1656; Notice No. 23–11]

RIN 2120–AL19

U.S. Commercial Space Launch Competitiveness Act Incorporation

AGENCY: Federal Aviation Administration (FAA), Department of Transportation (DOT).

ACTION: Notice of proposed rulemaking (NPRM).

SUMMARY: This proposed rule would incorporate various changes required by the United States Commercial Space Launch Competitiveness Act of November 2015. This proposed rule would provide regulatory clarity to applicants seeking licenses for space flight operations involving government astronauts by adding two new subparts to the human space flight regulations containing requirements for operators with government astronauts with and without safety-critical roles on board vehicles. The proposed rule would also require an operator to demonstrate any government astronauts on board can perform their role in safety-critical tasks. This proposed requirement would maintain public safety by ensuring operators provide mission specific training on safety-critical tasks to government astronauts, as has been done in the NASA Commercial Crew Program. The proposed rule would also update definitions relating to commercial space launch and reentry vehicles and occupants to reflect current legislative definitions, expand applicability of permitted operations for reusable suborbital rockets to include reusable launch vehicles that will be launched into a suborbital trajectory or reentered from a suborbital trajectory, as well as implement clarifications to financial responsibility requirements in accordance with the United States Commercial Space Launch Competitiveness Act. Finally, this proposed rule would move the templates for waiver of claims to an advisory circular. **DATES:** Comments are due on or before October 17, 2023. **ADDRESSES:** Send comments identified by docket number FAA–2023–1656 using any of the following methods:

- *Federal eRulemaking Portal:* Go to *www.regulations.gov* and follow the online instructions for sending your comments electronically.
- *Mail:* Send comments to Docket Operations, M–30; U.S. Department of Transportation (DOT), 1200 New Jersey Avenue SE, Room W12–140, West Building Ground Floor, Washington, DC 20590–0001.
- *Hand Delivery or Courier:* Take comments to Docket Operations in Room W12–140 of the West Building Ground Floor at 1200 New Jersey Avenue SE, Washington, DC, between 9 a.m. and 5 p.m., Monday through Friday, except Federal holidays.
- *Fax:* Fax comments to Docket Operations at (202) 493–2251.

Privacy: In accordance with 5 U.S.C. 553(c), DOT solicits comments from the public to better inform its rulemaking process. DOT posts these comments, without edits, including any personal information the commenter provides, to *www.regulations.gov,* as described in the system of records notice (DOT/ALL–14 FDMS), which can be reviewed at *www.dot.gov/privacy.*

Docket: Background documents or comments received may be read at *www.regulations.gov* at any time. Follow the online instructions for accessing the docket or go to the Docket Operations in Room W12–140 of the West Building Ground Floor at 1200 New Jersey Avenue SE, Washington, DC, between 9 a.m. and 5 p.m., Monday through Friday, except Federal holidays.

FOR FURTHER INFORMATION CONTACT: Charles Huet, Space Policy Division, Space Regulations and Standards Branch, ASZ–210, Federal Aviation Administration, 800 Independence Avenue SW, Washington, DC 20591; telephone (202) 306–9069; email *charles.huet@faa.gov.*

SUPPLEMENTARY INFORMATION:

Federal Register

Vol. 88, No. 159

Friday, August 18, 2023

Authority for This Rulemaking

The Commercial Space Launch Act of 1984, as amended and codified at 51 U.S.C. 50901–50923 (the Act), authorizes the Secretary of Transportation to oversee, license, and regulate commercial launch and reentry activities, and the operation of launch and reentry sites within the United States (U.S.) or as carried out by U.S. citizens. Section 50905 directs the Secretary to exercise this responsibility consistent with public health and safety, safety of property, and the national security and foreign policy interests of the U.S. In addition, section 50903 directs the Secretary to encourage, facilitate, and promote private sector commercial space launches and reentries. As codified in 49 CFR 1.83(b), the Secretary has delegated authority to the FAA Administrator to carry out these functions.

I. Overview

This proposed rule would amend title 14 of the Code of Federal Regulations (14 CFR) parts 401, 413, 415, 431, 435, 437, 440, 450, and 460 by incorporating statutory changes resulting from the United States Commercial Space

Launch Competitiveness Act (CSLCA).[92] This rule proposes to add definitions for ''Government astronaut,'' ''International partner astronaut,'' and ''International Space Station Intergovernmental Agreement'' and would also revise other definitions required to address the addition of ''Government astronaut.'' This proposed rule would also: (1) expand applicability of permitted operations for suborbital rockets to suborbital launch and reentry vehicles (2) revise the human space flight sections of parts 415, 431, 435, 437, and 450 to include the term ''human being'' in order to incorporate government astronauts; (3) update the financial responsibility requirements in part 440 to exclude government astronauts from the definitions of ''Third party'' and ''Government personnel'' in part 440; (4) add space flight participants to the insurance requirements in §440.9, and the reciprocal waiver of claims requirements in §440.17; and (5) remove the templates for waiver of claims and assumption of responsibilities in appendices B through E of part 440 from the regulations and place them in a separate advisory circular (AC). Finally, this rule would create two new subparts in 14 CFR part 460 to include proposed requirements for operators and applicants whose licensed or permitted operations involve government astronauts with and without safety-critical roles on board a vehicle.

II. Background

A. National Aeronautics and Space Administration's Commercial Crew

Program

The National Aeronautics and Space Administration (NASA) Commercial Crew Program provides human transportation between the U.S. and the International Space Station (ISS) through the purchase of transportation services from American commercial launch providers. It has resulted in NASA astronauts flying on board licensed commercial vehicles to or from the ISS since 2020. A new generation of spacecraft and launch systems capable of carrying government astronauts to low-Earth orbit and the ISS provides expanded utility, additional research time, and broader opportunities for discovery on the ISS. The Commercial Crew Program represents a revolutionary approach to government and commercial collaborations for the advancement of space exploration.

NASA—including Johnson Space Center and Kennedy Space Center—and the FAA have previously discussed the statutory and regulatory definitions that apply to NASA astronauts riding on board Commercial Crew Program- provided spacecraft and the associated roles and responsibilities of both agencies. These discussions led NASA and the FAA to establish the NASA– FAA Joint Legal Working Group in January 2012. This working group eventually contributed to a series of recommendations NASA provided to Congress in proposed legislation. As detailed below, title 51 did not effectively accommodate NASA astronauts flying on commercially owned and operated spacecraft. NASA and the FAA jointly determined that the legal definitions for crew and space flight participants were insufficient

[92] Public Law 114–90, sections 103, 104, 107, and 112.

to accommodate the role of government astronauts on board Commercial Crew missions. The agencies agreed that a change to legislation would be needed to support the success of its Commercial Crew Program and to support commercial human space flight endeavors in general.[93][94]

B. Issues With Categorizing NASA Astronauts as ''Space Flight

Participants'' or ''Crew''

Before the passage of the CSLCA in 2015, title 51—and by extension FAA regulations codifying the statutes—only contemplated two categories of persons carried on board FAA-licensed launch and reentry vehicles: ''crew'' and ''space flight participants.'' These designations were problematic for NASA astronauts for several reasons. ''Crew'' was defined as any employee of a licensee or transferee, or of a contractor or subcontractor of a licensee or transferee, who performs activities in the course of that employment directly relating to the launch, reentry, or other operation of or in a launch vehicle or reentry vehicle that carries human beings.[3] A ''space flight participant'' was defined as an individual, who is not crew, carried within a launch vehicle or reentry vehicle.[95][96] FAA regulations mirror these two definitions.[5] One of the NASA– FAA Joint Legal Working Group's concerns in 2012 was that the professionally trained and experienced NASA astronauts could not be appropriately categorized either as ''space flight participants'' or ''crew'' as then defined in title 51.

Before passage of the CSLCA, government astronauts were categorized as space flight participants because they were not employees of the licensee or transferee or of a contractor or subcontractor of a licensee or transferee. The FAA could not categorize government astronauts as crew for the same reason. This categorization, however, presented multiple issues.

First, 51 U.S.C. 50914(b) requires space flight participants to sign waivers of claims against the U.S. Government for personal injury, death, or property damage when participating in FAA- licensed launches and reentries. On the other hand, in Legal Interpretation to Courtney B. Graham (December 23, 2013), the FAA explained that NASA astronauts may not sign reciprocal waivers of claims because doing so would conflict with various federal statutes, including the Federal Employees Compensation Act and the

Military Personnel and Civilian
Employees Claims Act.[6]
Second, NASA expressed concerns regarding the requirement in 51 U.S.C. 50905(b)(5) for operators to inform space flight participants of the risks of licensed activity and obtain written informed consent from space flight participants. However, unlike space flight participants, government astronauts are already familiar with the particular risks involved in space flight and should not need to provide informed consent. Nevertheless, because the informed consent requirements for space flight participants did not conflict with federal statutes, unlike reciprocal waivers of claims, the government astronauts would have been required to comply with the requirements. Accordingly, the FAA issued a legal interpretation stating that NASA and international partner astronauts are space flight participants

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[93] *Interpretation Concerning Involvement of NASA Astronauts During a Licensed Launch or Reentry.* 78 FR 72011 (2013).
[94] U.S.C. 50902 (2014).
[95] *Id.*
[96] CFR 401.5 and 401.7.

and therefore must provide informed consent in accordance with the statute and 14 CFR 460.45;[97] however, it was deemed not necessary when flying as a government astronaut.

Finally, NASA sought clarification on whether a government astronaut, as a space flight participant, could perform operational functions during a commercial space launch or reentry under license from the FAA.[98] In 2013, the FAA issued a legal interpretation stating that, while the applicable statute and regulations did not limit a space flight participant's conduct or operations during launch or reentry, the FAA was concerned with space flight participants interacting with a launch or reentry vehicle based on the possibility that space flight participants would not have the proper vehicle and mission- specific training.[99] The interpretation noted, however, that NASA astronauts must meet rigorous medical and training requirements, which include training specific to each mission, launch vehicle, and reentry vehicle.[100][101]

C. United States Commercial Space

Launch Competitiveness Act

NASA and the FAA submitted a joint legislative request to Congress in 2013 to address the discussed above. In response, Congress passed the CSLCA in 2015 and included a definition of a new category of person on board an FAA- licensed launch or reentry vehicle: government astronaut. Under 51 U.S.C. 50902, government astronaut is defined as an individual who is designated by the National Aeronautics and Space Administration Administrator under section 51 U.S.C. 20113(n), is carried within a launch vehicle or reentry vehicle in the course of his or her employment, which may include performance of activities directly relating to the launch, reentry, or other operation of the launch vehicle or reentry vehicle, and is either an employee of the United States Government, including the uniformed services, engaged in the performance of a Federal function under authority of law or an Executive act, or an international partner astronaut. Per 51 U.S.C. 20113(n), for purposes of a license issued or transferred by the Secretary of Transportation under chapter 509 to launch a launch vehicle or to reenter a reentry vehicle carrying a government astronaut (as defined in section 50902), NASA designates a government astronaut in accordance with requirements prescribed by NASA.[11] The FAA accepts any NASA designation of government astronaut.

In addition to adding a new definition of government astronaut, the CSLCA added launch and reentry vehicles on a suborbital trajectory to permitted operations in 51 U.S.C. 50902.[102] The CSLCA also added space flight participants to the insurance requirements and reciprocal waiver of claims requirements in 51 U.S.C. 50914 and the paying claims exceeding liability insurance and financial responsibility requirements in 51 U.S.C. 50915.

III. Discussion of the Proposed Rule

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[97] Legal Interpretation to Courtney B. Graham (July 9, 2014) (requesting a legal interpretation on whether the holder of a license or permit under 51 U.S.C. Ch. 509 must obtain written informed consent from a space flight participant who is a NASA astronaut and a U.S. Government employee, either as a civil servant or a member of the U.S. armed forces; and whether a licensee or permittee must obtain informed consent from a space flight participant who is an astronaut employed by one of NASA's international partners).

[98] Whereas the definition of crew in title 51 expressly acknowledges a crew member's ability to perform activities directly relating to operation of the vehicle, the definition of space flight participant contains no express authority to do so. *See* Legal Interpretation to Courtney B. Graham (Dec. 23, 2013) in which the FAA answers NASA questions regarding whether the space transportation regulations would restrict NASA astronauts from performing operational functions during a commercial space launch or reentry under license from the FAA.

[99] Legal Interpretation to Courtney B. Graham (Dec. 2, 2013) (78 FR 72011).

[100] *Id.*

[101] U.S.C. 20113(n).

[102] Prior to the CSLCA, only reusable suborbital rockets qualified for a permit.

A. Summary

In this rulemaking, the FAA proposes to add the statutory definition of ''government astronaut'' to its regulations to conform to the CSLCA. In addition to incorporating the title 51 definition of ''government astronaut,'' this rulemaking would also create two new subparts to part 460 to address the varying responsibilities government astronauts might have during a launch or reentry. One subpart would address requirements for government astronauts whose actions have the ability to impact public safety because they perform a safety-critical role, and one subpart would address requirements for government astronauts that do not play a safety-critical role during licensed or permitted activity. The proposed rule is not intended to conflict with NASA vehicle certification and safety processes.

Other changes proposed by this rulemaking would align various related definitions and regulations with the addition of ''government astronaut,'' such as replacing the terms ''crew'' and ''space flight participant'' with the term ''human being'' in order to encompass all three categories of persons carried on board a vehicle. The proposed addition of the ''government astronaut'' category would further require revisions to part 440 to exclude ''government astronauts'' from the definitions of ''Third party'' and ''Government personnel.'' Furthermore, this rulemaking proposes additional changes to the financial responsibility requirements in part 440 as required by the CSLCA. More specifically, this rulemaking would add space flight participants to the insurance requirements in §440.9 and the reciprocal waiver of claims requirements in §440.17. This rulemaking would remove the templates for waiver of claims and assumption of responsibilities in appendices B through E of part 440 from the regulations, which the Agency proposes to relocate in a separate AC.

B. Changes to Part 460—Human Space

Flight Requirements

Current part 460 contains requirements for launches involving human space flight. Subpart A of part 460 contains requirements for launches and reentries with crew on board, including requirements for crew training, informing crew about risk, and waiver of claims against the U.S. Government. Subpart B of part 460 contains requirements for launches and reentries with human space flight participants on board, including requirements for informed consent, training space flight participants for an emergency scenario, security, and waiver of claims against the U.S.

Government.

In this NPRM, the FAA proposes to add subparts C and D to part 460 to create requirements for operators conducting licensed or permitted

operations carrying government astronauts. Proposed subpart C of part 460 would contain operator requirements for licensed or permitted operations with government astronauts who perform a safety-critical role during launch or reentry. Consistent with the definition of ''safety critical'' in §§401.5 and 401.7, a role is safety-critical if it is essential to safe performance or operation.[103] As the FAA regulates for public safety, a government astronaut performs a safety-critical role because of their ability to control in real time, a launch or reentry vehicle's flight path during a phase of flight capable of

[103] ''Safety critical'' for purposes of part 460
''means essential to safe performance or operation. A safety-critical system, subsystem, component, condition, event, operation, process, or item is one whose proper recognition, control, performance, or tolerance is essential to ensuring public safety. Something that is a safety-critical item creates a safety hazard or provides protection from a safety hazard.'' 14 CFR 401.5.

endangering the public. Proposed subpart D of part 460 would contain operator requirements for licensed or permitted operations with government astronauts who do not perform a safety- critical role during launch or reentry.

1. Proposed Subpart C—Government Astronauts With Safety-Critical Roles

To protect public safety, the FAA is proposing to require operators to provide training and establish environmental controls for operations involving government astronauts with a safety-critical role. As with crew, the FAA finds that government astronauts likewise would need to be protected from atmospheric conditions and receive training that is necessary for the safety of members of the public, including those on the ground, in the air, and in space.[104] Previously, the FAA has determined that in a piloted vehicle, the vehicle's flight crew is an integral part of its flight safety system. This determination is based on the fact that they are in a position to respond to risk to the public, such as aborting the flight or maneuvering a vehicle away from populated areas.[105] Similarly, government astronauts may be in a position to respond to risk to the public; therefore, the FAA is proposing a number of training requirements, not intended to duplicate, conflict with, or replace NASA's training requirements for government astronauts, if they are identified by the operator as having safety critical roles. Training provides government astronauts the knowledge and skill necessary to perform safety- critical tasks. Government astronauts with a safety-critical role would be required to be trained to successfully carry out their role on the vehicle.

The FAA proposes in §460.57 to specify the groups to which subpart C would apply. Section 460.57(a) and (b) would state that subpart C would apply to an applicant for a license or permit and a licensed or permitted operator who intends to have a government astronaut with a safety-critical role on board a vehicle. In order to determine which government astronauts would need additional vehicle-specific training to meet the proposed requirements of subpart C, the operator would identify during the licensing process safety- critical tasks that require qualified personnel and whether a government astronaut would be performing any of those tasks.[106] The operator would then be responsible for ensuring that those government astronauts identified as performing safety-critical tasks receive additional vehicle-specific training in accordance with proposed subpart C.

The FAA proposes in §460.59(a)(1) to require an operator to train a government astronaut to carry out any safety-critical role on board so that the vehicle will not endanger the public. As stated above, the FAA is proposing this requirement because government astronauts with a safety-critical role can affect risk to the public. A government astronaut with a safety-critical role may have the ability to affect public safety, for example, through control of the trajectory of the vehicle, and must therefore be trained on how to carry out his or her mission-specific role on board the vehicle. Operators are in the best position to train government astronauts on particular aspects of the vehicle and mission that can affect public safety because they are most familiar with the vehicle and its operation. This training has been current practice on all Commercial Crew Program flights to date because NASA has required it from the operator through contract. The FAA proposes the following training requirements for those

[104] As further discussed, the FAA proposes adding §460.61 to require operators to provide an environment adequate to sustain life and consciousness for all inhabited areas within a vehicle that house a government astronaut with a safety-critical role.

[105] Human Space Flight Requirements for Crew and Space Flight Participants, NPRM, 70 FR 77262, 77265 (Dec. 29, 2005).

[106] In accordance with §450.149, an applicant must identify safety-critical tasks that require qualified personnel, ensure that those personnel are trained, qualified, and capable of performing their safety-critical tasks, and provide internal training and currency requirements, or any other means for demonstrating compliance. Similar requirements can also be found in §§417.105, 417.311, and 415.113.

matters that affect public safety under its authority to issue regulations to license commercial space launch and reentry consistent with public safety.[107][108]

The FAA proposes to require an operator to provide government astronauts who perform safety-critical roles a training program similar to the training program required for crew. Because crew and government astronauts with a safety-critical role could be responsible for accomplishing the same tasks on board a vehicle, this rule would require the operator to provide them with similar training on the unique aspects of each vehicle and mission so they can successfully perform their roles on board.

While the requirements this rule proposes for government astronauts are similar to crew requirements, they are not identical. Current crew qualification and training requirements include a demonstration of the ability to withstand the stresses of space in sufficient condition to safely carry out his or her duties so that the vehicle will not harm the public.[18] Each crew member with a safety-critical role is also required to possess and carry an FAA second-class medical certificate.[19] The proposed rule would not require government astronauts with a safety- critical role to demonstrate an ability to withstand the stresses of space or to possess and carry an FAA medical certificate because the underlying concerns addressed by these crew requirements are satisfied by the NASA designation process for government astronauts.[109][110]

The FAA proposes in §460.59(a)(2) to require an operator to train government astronauts (either directly or through another entity) with a safety-critical role on their roles in nominal and non- nominal conditions related to the launch or reentry vehicle, including abort scenarios and emergency operations, to the extent that performance of their role could endanger public safety. This vehicle-specific training has been current practice on all Commercial Crew Program flights to date, by contract between NASA and the operator. This requirement would be the same as the current crew training requirements in subpart A of part 460.[21] In order to meet the proposed training requirement, the operator would be responsible for conducting a safety analysis in accordance with §450.149 to identify which government astronaut tasks could endanger public safety.[111] As previously mentioned, this analysis is necessary because government astronauts may be in a position to affect risk to the public

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107 The FAA notes that, while operators and NASA may establish mission-specific training of government astronauts through contract, the FAA has broader responsibility to issue regulations to protect public health and safety during licensed activity.

108 CFR 460.5(b). 19 14 CFR 460.5(e).

109 For crew members to demonstrate a basic level of health within 12 months of launch or reentry, the FAA requires that each crew member with a safety- critical role must possess and carry an FAA second- class airman medical certificate. Human Space Flight Requirements for Crew and Space Flight Participants, Final Rule, 71 FR 75616, 75620 (Dec. 15, 2006). The FAA finds that such a requirement would be unnecessary for government astronauts because to achieve a government astronaut designation, NASA has verified a basic level of health during its training process. Additionally, any government astronaut designated by NASA has been trained by NASA to withstand the stresses of space flight while performing their duties. For example, Commercial Crew Transportation contractual requirements CCT–PLN–1120 section 6.3.1, and CCT–STD–1150 section 5.0 (Operations Training) ensure government astronauts can withstand the stresses of space flight while performing safety-critical tasks. See *https:// ntrs.nasa.gov/api/citations/20150010760/ downloads/20150010760.pdf, https://ntrs.nasa.gov/ api/citations/20150010761/downloads/ 20150010761.pdf.*

110 CFR 460.5(a)(2).

111 Section 450.149 requires an operator to ensure that its safety-critical personnel are trained, qualified, and capable of performing their safety- critical tasks, and that their training is current. The FAA would consider any task that may have an effect on public safety and meets the definition of safety-critical found in §401.5 subject to the requirements of §450.149. These tasks would include, but are not limited to, operating and installing flight safety system hardware, operating safety support systems, monitoring vehicle performance, performing flight safety analysis, conducting launch operations, controlling public access, surveillance, and emergency response. With the many different kinds of operations currently underway, an operator is in the best position to identify the operations, personnel, and training needed for its operation. See Streamlined Launch and Reentry Licensing Requirements, NPRM, 84 FR 15332 (Apr. 15, 2019).

and should be aware of and receive training on the tasks specific to their mission which could impact public safety. The operator would then need to ensure that the government astronaut is trained to successfully conduct those tasks. For missions where crew and government astronauts are on board, an operator may need to train government astronauts with crew as a team if safety- critical tasks require that government astronauts and crew work together. If a government astronaut does not have a role in nominal or non-nominal conditions to the extent that performance of their role could endanger public safety, then no additional training would be required.

The FAA proposes in §460.59(b)(1) that an operator would ensure any government astronaut who has the ability to control, in real time, a launch or reentry vehicle's flight path during a phase of flight capable of endangering the public, receives vehicle specific training for each phase of flight capable of endangering the public and over which the government astronaut has the ability to control the vehicle. Although government astronauts may have been trained on other vehicles, each vehicle has specific safety features that should be familiar to the person operating it. Under proposed §460.59(b)(1), the training could be achieved by a method or device that simulates the flight, by an aircraft whose characteristics are similar to the vehicle or has similar phases of flight to the vehicle, by flight testing, or by an equivalent method of training approved by the FAA. The first three methods would ensure the government astronaut has familiarity with the vehicle and its operation by requiring means that are sufficiently similar to actual operations. The final method would provide flexibility and allow an operator to demonstrate that an alternative method would achieve the training objective. This familiarity would ensure the government astronaut is capable of operating the vehicle safely. This proposed requirement is the same as the requirement for crew in §460.5(b)(3).

Proposed §460.59(b)(2) would require an operator to train a government astronaut who can control the vehicle for each mode of control or propulsion, including any transition between modes, such that the government astronaut is able to control the vehicle in all phases of flight, including transitions between phases, that can endanger the public. This proposed requirement is the same as the requirement for crew in §460.5(c)(5).[112]

The training device fidelity requirement that the FAA proposes in §460.59(c) would ensure that any government astronaut training device used to meet the training requirements realistically represents the vehicle's configuration and mission or the operator informs the government astronaut being trained of the differences between the training device and the vehicle's configuration and mission. This proposed requirement would be the same as the requirement in §460.7(b) for crew.[113]

Because they have the ability to control a vehicle's flight path in real time, crew who are pilots[114] or remote operators[115] are also required to satisfy a number of additional requirements including requirements to possess and carry an FAA pilot certificate with an instrument rating and possess aeronautical knowledge, experience, and skills necessary to pilot and control the launch or reentry

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112 A pilot would have to undergo training in procedures that direct the vehicle away from the public in the event the flight crew had to abandon the vehicle during flight. The FAA emphasizes the importance of an operator training in each mode of control or propulsion, including any transition between modes, so that the pilot would be able to control the vehicle throughout the flight regime to protect the public. See Human Space Flight Requirements for Crew and Space Flight Participants, NPRM, 70 FR 77267 (Dec. 29, 2005).

113 See Human Space Flight Requirements for Crew and Space Flight Participants, Final Rule, 71 FR 75621 (Dec. 15, 2006). Device fidelity speaks to the degree of realism achieved.

114 Section 401.5 defines ''pilot'' as a flight crew member who has the ability to control, in real time, a launch or reentry vehicle's flight path.

115 Section 401.5 defines ''remote operator'' as a crew member who (1) has the ability to control, in real time, a launch or reentry vehicle's flight path, and (2) is not on board the controlled vehicle.

vehicle that will operate in the National Airspace System (NAS).[116] For those government astronauts who have the ability to control the vehicle's flight path, the FAA proposes in §460.59(b)(3) to require operators to ensure that such government astronauts possess aeronautical knowledge, experience, and skills necessary to pilot and control the launch or reentry vehicle in the NAS. Aeronautical experience may include hours in flight, ratings, and training.[117] The FAA notes that this requirement would ensure that government astronauts with the ability to control a launch or reentry vehicle's flight path have the knowledge, experience, and skills to operate the vehicle safely in the NAS, which could potentially impact the public.

The FAA proposes in §460.59(d) to require an operator to update government astronaut vehicle-specific training continually to ensure that the training would incorporate lessons learned from training and operational launches and reentries. An operator would be required to track each revision, document the completed training for each government astronaut, and maintain the documentation for each active government astronaut who performs a safety-critical role. This proposed requirement is vital for maintaining proficiency of any government astronaut performing safety- critical roles and would be the same as the requirement in §460.7(c) for crew. As with the crew requirement, this proposed requirement would incorporate events and anomalies into the training as they are experienced so that government astronauts are trained on how to respond going forward.

The FAA proposes in §460.59(e) that an operator would be required to establish a recurrent training schedule and ensure that all training of government astronauts performing safety-critical roles is current before launch or reentry. This proposed requirement is vital for maintaining currency of any government astronaut performing safety-critical roles and would be the same as the requirement in §460.7(d) for crew.[118] The FAA notes that, for such performance-based requirements, the operator must carry out the method of compliance chosen in its application because the method an operator describes in its application has the same legal effect as a prescriptive requirement.[119]

In addition to the proposed training requirements, the FAA proposes in §460.61 that an operator would be required to provide an environment that sustains life and prevents incapacitation for government astronauts because a failure to control the environment, even for a short duration, could lead to a loss of life or serious injury to members of the public. The proper functioning of government astronauts in safety critical roles is necessary for protection of the public. Therefore, it would be vital that the launch

[116] Section 460.5(d) permits a pilot or a remote operator to demonstrate an equivalent level of safety to FAA airman certification through the license or permit process.

[117] The FAA explained that pilots and remote operators should hold a pilot certificate with an instrument rating because a pilot or remote operator should be educated in the rules of operating in the NAS and should demonstrate an appropriate level of instrument skills and competency to pilot various launch and reentry vehicles. Human Space Flight Requirements for Crew and Space Flight Participants, NPRM, 70 FR 77262, 77265 (Dec. 29, 2005). The proposed training requirements for government astronauts with a safety-critical role are tailored to ensure that an operator trains a government astronaut to successfully carry out his or her role. These proposed requirements include possessing the knowledge, experience, and skills necessary to pilot the vehicle in the NAS. The FAA is not proposing to require government astronauts to hold pilot certificates with an instrument rating because NASA astronaut requirements currently include at least two years of related professional experience obtained after degree completion or at least 1,000 hours pilot-in-command time on jet aircraft. *Astronaut Requirements;* March 4, 2020; *www.nasa.gov/audience/forstudents/postsecondary/features/F_Astronaut_ Requirements.html* (last viewed 3/6/2023). These requirements effectively meet the equivalent level of safety provision crew are allowed to leverage in place of holding a pilot certificate under §460.5(d).

[118] See Human Space Flight Requirements for Crew and Space Flight Participants, Final Rule, 71 FR 75621 (Dec. 15, 2006).

[119] See 14 CFR 450.5(b), 417.11(a), 431.9(b), and 437.83.

or reentry operator maintains an environment that supports life and consciousness. The environmental requirements proposed in §460.61 would be the same as the requirements for crew in §460.11.

The FAA proposes to add a reference to proposed §§460.59 and 450.61 to the application requirements for safety review and approval in §450.45(e). As such, the FAA acknowledges that government astronaut training is part of the broader review to determine that licensed activity would not jeopardize public safety. To that end, the FAA would evaluate and determine whether the license applicant's training and environmental control and life support systems for government astronauts with safety-critical roles are sufficient to protect public safety.[31]

The FAA expects that a safety review of the training requirements under proposed §460.59 would include an evaluation of the operator training program for government astronauts to verify that all personnel with safety- critical roles are adequately trained and fully capable of performing their mission specific safety critical duties. Furthermore, under §450.149, an operator is already required to ensure safety-critical personnel are trained, qualified, and capable of performing their safety-critical tasks, and that their training is current. Additionally, §450.149 requires an applicant to provide internal training and currency requirements, completion standards, or any other means of demonstrating compliance with the regulation and to describe the process for tracking currency.

2. Proposed Subpart D—Government

Astronauts Without Safety-Critical Roles Proposed §460.65 would specify the groups to which subpart D would apply. Section 460.65 (a) and (b) would state that subpart D would apply to both an applicant for a license or permit and a licensed or permitted operator who proposes to have a government astronaut without a safety-critical role on board a vehicle.

[31] If an operator met the contractual requirements in CCT–PLN–1120 and CCT–REQ–1130, or similar requirements for other NASA programs they would satisfy this proposed requirement. Therefore, the FAA would consider CCT–PLN–1120 and CCT– REQ–1130, and similar requirements applicable to other NASA programs, a means of compliance with this proposed requirement. CCT–PLN–1120 is the Joint Program Management Plan (PMP) between the National Aeronautics and Space Administration (NASA) Commercial Crew Program (CCP) and the Federal Aviation Administration (FAA) Office of Commercial Space Transportation (AST) and describes the partnership of these respective agencies for licensing the CCP missions for launch and reentry operations. The ISS Crew Transportation and Services Requirements Document (CCT–REQ–1130) contains all technical, safety, and crew health medical requirements that are mandatory for achieving a Crew Transportation System Certification that will allow for International Space Station delivery and return of NASA crew and limited cargo. The FAA defers to NASA as the expert on training government astronauts to perform their duties. Therefore, an operator should not be placing requirements on NASA. Rather, an operator would demonstrate adequate training for government astronauts by leveraging the training NASA requires through its contracts with commercial providers.

Proposed §460.67 would require that an operator train each government astronaut without a safety-critical role on how to respond to emergency situations, including smoke, fire, loss of cabin pressure, and emergency exits. This would be the only proposed requirement for government astronauts without a safety-critical role, and it would be the same requirement currently levied on space flight participants in §460.51. As with space flight participants, the FAA would require this training for government astronauts without a safety-critical role because, if a government astronaut did not receive this training, he or she might interfere with the ability of the crew and government astronauts with safety-critical roles to perform duties necessary to protect public safety.

The FAA considered requiring operators to impose security requirements on government astronauts that do not have a safety-critical role, similar to those in current §460.53. However, the FAA determined that such a requirement would be unnecessary because government astronauts and international partner astronauts undergo extensive screening and training.[32] Furthermore, the FAA expects that NASA's designation of government astronaut would include similar security requirements because NASA is responsible for the safety of the government astronauts and mission assurance.[33] Other requirements contained in subpart B of part 460, such as informed consent and waiver of claims, do not apply to government astronauts, as previously explained.

C. Changes to Part 401—Definitions

The FAA proposes to define the term ''government astronaut'' to align §§401.5 and 401.7 (Definitions) with the CSLCA's addition of the term ''government astronaut'' to 51 U.S.C. 50902. By defining the term in part 401, the definition will inform the use of the term throughout the FAA's commercial

[32]To ensure mission success, NASA identifies the best qualified candidates who then undergo additional reviews through tests and two rounds of interviews, in addition to two years of basic astronaut training including robotics training, flight training, and extravehicular activities. NASA's Management of Its Astronaut Corps, Report No. IG– 22–007 (Jan. 11, 2022).

[33]NASA is responsible for managing overall mission success by ensuring certification and astronaut safety requirements are being met. The FAA serves to protect the public health and safety, safety of property, and the national security and foreign policy interests of the U.S. during commercial launch and reentry activities. National Aeronautics and Space Administration and Federal Aviation Administration Joint Program Management Plan for the Commercial Crew Program, CCT–PLN–1020, section 3.0 Roles and Responsibilities (April 1, 2016).

space regulations, including part 460. The same definition of ''Government astronaut'' would be added to both sections because definitions in §401.5 apply to parts 415, 417, 431, 435, 440, and 460, and definitions in §401.7 apply to parts 440, 450, and 460.

Furthermore, the FAA proposes to revise the definition of ''Space flight participant'' in §§401.5 and 401.7 to align with the statutory definition by expressly excluding government astronauts from the category of space flight participant. As revised, ''space flight participant'' would be defined as ''an individual, who is not crew or a government astronaut, carried within a launch vehicle or reentry vehicle.''

The FAA also proposes to amend §401.5 by revising the definitions of ''Human space flight incident,'' ''Launch,'' ''Launch accident,'' ''Reenter,'' and ''Reentry accident'' by adding ''government astronaut'' to these definitions. A similar change is not being made in §401.7 because the terms ''Human space flight incident,'' ''Launch accident,'' and ''Reentry accident,'' are not defined in §401.7. Instead, these concepts are included in the §401.7 ''Mishap'' definition, and this definition already includes the term ''government astronauts.''

The FAA also proposes to add definitions for ''International partner astronaut'' and ''International Space Station Intergovernmental Agreement'' to §§401.5 and 401.7. The CSLCA added the terms ''International partner astronaut'' and ''International Space Station Intergovernmental Agreement'' to 51 U.S.C. 50902 and specifies that the NASA Administrator designates government astronauts, and that designation may include international partner astronauts. The CSLCA also allows the NASA Administrator to designate a foreign person as a government astronaut. The FAA proposes to define an ''International partner astronaut'' as an individual designated under Article 11 of the International Space Station Intergovernmental Agreement, by a partner to that agreement other than the U.S., as qualified to serve as an ISS crew member. This definition is taken directly from the CSLCA. Although the FAA does not otherwise use these terms in the commercial space regulations, the terms are used in the definition of government astronaut which is being added to §§401.5 and 401.7. The FAA is proposing to add them to §§401.5 and 401.7 to provide clarity to the definition of government astronaut.

D. Changes to Parts 415, 431, 435, and [120]

437—License Application Procedures, Launch License, Launch and Reentry of a Reusable Launch Vehicle (RLV), and Reentry of a Reentry Vehicle Other Than an RLV

The FAA proposes to replace the terms ''crew'' and ''space flight participant'' with the term ''human being'' in §§415.8, 431.8, and 435.8 for applicants seeking a license for operations involving human space flight and that must demonstrate compliance with human space flight requirements. This change would accommodate the creation of the government astronaut category in part 460.

E. Changes to Parts 413 and 437— License Application Procedures and

Experimental Permits

Section 50906 of title 51 provides the Secretary of Transportation with the authority to issue experimental permits consistent with the protection of the public health and safety, safety of property, and national security and foreign policy interests of the United States. The Secretary of Transportation delegated this authority to the FAA, which promulgated 14 CFR part 437 (Experimental permits).[34] An experimental permit provides an alternative to licensing for certain vehicles and operations.[121] The CSLCA expanded the scope of the Secretary's authority to issue experimental permits from reusable suborbital rockets to also include reusable launch vehicles that will be launched into a suborbital trajectory or reentered under that permit.[122] This section discusses the changes made to 51 U.S.C. 50906 by the CLSCA as well as the associated proposed changes to part 437.

The FAA proposes to delete the definition of ''permitted vehicle'' in §437.3 because the term does not appear in part 437. Section 437.3 currently defines ''permitted vehicle'' as a reusable suborbital rocket operated by a launch or reentry operator under an experimental permit. The FAA proposes to add a definition of ''reusable suborbital vehicle'' in §437.3 that includes a reusable suborbital rocket or a reusable launch vehicle that is launched or reentered on a suborbital trajectory. As mentioned above, section 104 (Launch License Flexibility) of the CSLCA revised 51 U.S.C. 50906(d) to authorize the Secretary of Transportation to issue experimental permits for reusable launch vehicles that will be launched into a suborbital trajectory or reentered, in addition to suborbital rockets. The proposed definition of ''reusable suborbital vehicle'' in §437.3 reflects this change to 51 U.S.C. 50906(d). This proposed definition would expand the types of vehicles eligible for a permit, to include vehicles that are not rockets[123] but are launch vehicles that will be launched into a suborbital trajectory or reentered from a suborbital trajectory. This revision is necessary due to the development of technologies for

[120] FR 17019 (Apr. 6, 2007).

[121] Under 51 U.S.C. 50906(d), as revised by the CLSCA, the Secretary may issue an experimental permit solely for research and development to test design concepts, equipment, or operating techniques, showing compliance with requirements as part of the process for obtaining a license under Chapter 509, or crew training for a launch or reentry using the design of the rocket or vehicle for which the permit would be issued.

[122] Public Law 114–90, sec. 104.

[123] Suborbital rocket is defined as a vehicle, rocket-propelled in whole or in part, intended for flight on a suborbital trajectory, and the thrust of which is greater than its lift for the majority of the rocket-powered portion of its ascent. 51 U.S.C. 50902(24); 14 CFR 401.5 and 401.7.

suborbital launch vehicles that do not use rocket propulsion. Vehicles that do not use a rocket for propulsion are excluded from obtaining a permit under current regulations. The revision would allow an operator to research and develop new test designs, concepts, equipment, or operating techniques; show compliance with requirements as part of the process for obtaining a license; or train crews before they receive a license for launch or reentry on a larger group of launch vehicles.

Therefore, the FAA proposes to replace the term ''reusable suborbital rocket'' with ''reusable suborbital vehicle'' in §§437.3, 437.5, 437.7, 437.9, 437.21, 437.23, 437.25, 437.31, 437.33,

437.53, 437.59, 437.61, 437.71, 437.85,
437.91, and 437.95.
The proposed change to the definition of ''permitted vehicle'' would affect §413.3(f), which references part 437. Part 413 addresses the application requirements for a license or experimental permit. Therefore, the FAA also proposes to replace the term ''reusable suborbital rocket'' in §413.3(f) with the term ''reusable suborbital vehicle'' to align with the expanded scope.

Consistent with the changes to part 437, the FAA proposes to replace the term ''reusable suborbital rocket'' with ''reusable suborbital vehicle'' in §440.3. This proposed change would allow inclusion of launch and reentry vehicles on a suborbital trajectory.

The FAA proposes a change to §437.5(a) to be consistent with changes made to 51 U.S.C. 50906(d)(1) by the CSLCA. Section 437.5(a) currently states the FAA will issue an experimental permit to a person to launch or reenter a reusable suborbital rocket only for research and development to test new design concepts, new equipment, or new operating techniques. These eligibility requirements for an experimental permit reflect the eligibility criteria in 51 U.S.C.

50906(d)(1). The CSLCA removed each use of the word ''new'' in 51 U.S.C. 50906(d)(1). Therefore, the FAA is proposing to make the same change to §437.5(a). By removing the term ''new'' from §437.5(a), the regulation would allow research and development of existing design concepts, equipment, or operating techniques, consistent with the CSLCA.

The FAA proposes two changes to §437.21(b)(3) to accommodate changes necessitated by the CSLCA amendments. Current §437.21(b)(3) references the applicable requirements for an applicant proposing launch or reentry with flight crew or a space flight participant on board a reusable suborbital rocket. The FAA proposes to replace the terms ''flight crew'' and ''space flight participant'' in

§437.21(b)(3) with the term ''human being'' to include the addition of government astronauts discussed previously. Furthermore, as discussed earlier, the FAA proposes to revise the application requirements in §437.21(b)(3) to reference §§460.59, 460.61, and 460.67, which contain the proposed requirements in part 460 subparts C and D that would apply to launches and reentries with a government astronaut on board.

F. Changes to Part 440—Financial

Responsibility

The CSLCA necessitates conforming changes to part 440, which governs financial responsibility requirements for title 51 activity. This proposal would make conforming changes to the definition of ''government personnel'' and ''third party,'' add space flight participants to the list of parties protected as additional insureds under a licensee or permittee's liability insurance, require that licensees enter into a reciprocal waiver of claims with space flight participants, move the reciprocal waiver of claims templates from the appendices to an AC, and remove references to the appendices.

Prior to passage of the CSLCA, a licensee or transferee was required by 51 U.S.C. 50914(b) and 14 CFR 440.17 to make a reciprocal waiver of claims with its contractors, subcontractors, and customers, and contractors and subcontractors of the customers, involved in launch services or reentry services under which each party to the waiver agrees to be responsible for property damage or loss it sustains, or for personal injury to, death of, or property damage or loss sustained by its own employees resulting from an activity carried out under the applicable license. Additionally, a licensee or permittee was required to obtain and maintain in effect a policy of liability insurance (or otherwise make a demonstration of financial responsibility) that protected certain persons as additional insureds to the extent of their respective potential liabilities against covered claims by a third party for bodily injury or property damage resulting from a licensed or permitted activity.[38] These persons included (1) the licensee or permittee, its customer, and their respective contractors and subcontractors, and the employees of each, involved in a licensed or permitted activity; (2) the United States, its agencies, and its contractors and subcontractors involved in a licensed or permitted activity; and

(3) Government personnel.[39]
The CSLCA made several changes that affect the financial responsibility requirements under title 51. The CSLCA, in section 112(j), amended the definition of ''third party'' in 51 U.S.C. 50902(26) to exclude government astronauts. The CSLCA, in section 103(a)(1)(A), also requires a licensee or permittee to protect space flight participants as additional insureds under a licensee or permittee's liability insurance. This addition ceases to be effective September 30, 2025, in accordance with section 103(a)(1)(B) of the CSLCA. Finally, section 107 of the CSLCA amends 51 U.S.C. 50914(b)(1) such that it now requires a licensee or transferee to make a reciprocal waiver of claims with space flight participants involved in launch services or reentry services under which each party to the waiver agrees to be responsible for personal injury to, death of, or property damage or loss sustained by it or its own employees resulting from an activity carried out under the applicable license. This provision ceases to be effective September 30, 2025, in accordance with section 107 of the CSLCA.

The FAA is proposing to conform the regulatory definition of ''third party'' with the statute by adding government astronauts to the list of exceptions in the definition of ''third party.'' Current 14 CFR 440.3 does not exclude government astronauts from the definition of third party and states that government personnel as defined in §440.3 are third parties. The CSLCA states that

[38] 51 U.S.C. 50914(a)(4); 14 CFR 440.9(b). [39] *Id.*

government astronauts are not third parties. The FAA, therefore, proposes to exclude government astronauts from the definition of ''third party'' in §440.3 for the purposes of financial responsibility requirements. This proposal would also amend the definition of ''government personnel'' in §440.3 to exclude government astronauts. This change is necessary because §440.3 states that government personnel, as defined in that section, are third parties. While the proposal would exclude government astronauts from the definition of government personnel in §440.3, the FAA notes that this exclusion narrowly applies only to 14 CFR part 440. Furthermore, the defined term ''government personnel'' only appears in §440.9 for the purpose of identifying additional insureds. These changes would align the regulatory definitions in §440.3 with the CSLCA.

The FAA additionally proposes to add space flight participants to the list of parties protected as additional insureds under a licensee or permittee's liability insurance in §440.9(b)(4), as required by the CSLCA in section 103(a)(1)(A). As a result of this proposed change, and in accordance with the statutory requirement, a licensee or permittee would be required by regulation to obtain and maintain in effect a policy or policies of liability insurance to protect space flight participants as additional insureds to the extent of their respective potential liabilities against covered claims by a third party for bodily injury or property damage resulting from a licensed or permitted activity. In other words, if an injured third party brings claims against any party participating in the launch or reentry, the insurance policy would protect involved space flight participants. To comply with this proposed requirement, an operator would have to ensure that its insurance policy covers space flight participants, if it does not currently do so. In accordance with section 103(a)(1)(B) of the CSLCA, the proposed regulatory change would also cease to be effective September 30, 2025. If Congress chooses to extend the September 30, 2025 date, proposed §440.9(b)(4) would remain in effect in accordance with the extension. This proposal would also re-designate §440.17(f) to a new paragraph (g). Section 440.17(f) currently requires that any waiver, release, or other agreement to hold harmless and indemnify under the section does not apply to claims for bodily injury or property damage resulting from willful misconduct of any of the parties to the reciprocal waiver of claims. The FAA proposes to add new §440.17(f), which would require a licensee or permittee to enter into a

reciprocal waiver of claims agreement with each of its space flight participants in accordance with section 107 of the CSLCA. The waivers under the proposed §440.17(f) would solely be between a licensee or permittee and a single space flight participant. Proposed §440.17(f) would not require space flight participants to enter into waivers against one another. This proposed addition is necessary because, as discussed earlier, the CSLCA added space flight participants to the list of entities with whom an operator must execute a reciprocal waiver of claim, which would prevent potential additional litigation between space flight participants and operators.

In accordance with 51 U.S.C. 50914(b) and by omission from the CSLCA, space flight participants would not be required to enter into reciprocal waiver of claims agreements with customers. Furthermore, space flight participants are already required to enter into a reciprocal waiver of claims agreement with the U.S. Government in accordance with §440.17(d)(1). Proposed §440.17(f) would remain in effect until September 30, 2025, as required by the CSLCA. If

Congress chooses to extend the
September 30, 2025, date, proposed §440.17(f) would remain in effect in accordance with the extension.

While no change to regulatory text is needed, the FAA notes that under the CSLCA, government astronauts are not required to sign reciprocal waivers of claims because they are not considered space flight participants or crew, and because the FAA enters into these agreements on behalf of the government and its employees.[40]

The FAA also proposes to remove the reciprocal waiver of claims templates in appendices B through E and place them in AC 440.17–1. The FAA originally included the appendices to provide operators with templates that meet the requirements in part 440. An operator is not required to use the templates provided in the appendices and can use alternate templates provided the alternate templates demonstrate compliance with the regulations. Moving these templates to an AC would allow the FAA to effectuate any needed changes more efficiently and would not require the FAA to undergo an additional rulemaking to provide

[40]While 51 U.S.C. 50904(b) requires space flight participants to waive claims against the U.S. Government, Congress did not require government astronauts to do the same. In fact, the requirement for space flight participants to waive claims against the U.S. Government predates the retirement of the U.S. Space Shuttle and the subsequent development of NASA's Commercial Crew Program. Legal Interpretation to Courtney B. Graham (Dec. 23, 2013).

updated templates that meet the part 440 requirements. Because the templates are not regulatory and are only one means of satisfying the requirements in §440.17, an AC is a more appropriate location than the CFR for the templates. The public can provide comment on any of the templates in the AC or propose a new template for consideration by emailing the Advisory Circular Feedback Form. (OMB control number 2120–0746) located at the end of the AC to *ASTApplications@faa.gov.*

The FAA would also add two new templates to its proposed AC. One proposed template would be for a reciprocal waiver of claims between the licensee, space flight participant, and the licensee's contractors and subcontractors. The other proposed template would be for a waiver of claims between an operator and customers, government customers, the U.S., and each of their respective contractors and subcontractors. The FAA currently uses both templates. These templates were developed for situations where the existing templates in the appendices did not adequately address a proposed launch or reentry operation. The proposed AC containing these two new templates will be placed in the regulatory docket for this rule.

To conform to the proposed removal of the appendices, the FAA proposes to replace the references to Appendices B through E in §440.17(c), (d), and (e) with language specifying that the required reciprocal waiver of claims must be in a form acceptable to the FAA Administrator. This proposed language would provide flexibility with providing a reciprocal waiver of claims under each paragraph, provided any proposed reciprocal waiver of claims is in a form acceptable to the FAA Administrator and complies with all applicable regulations. Finally, the proposed AC would contain language stating that the templates provided in AC 440.17–1 are one means of compliance but not the only means of compliance with requirements in §440.45.

G. Changes to Part 450—Launch and

Reentry License Requirements

The FAA proposes to add §§460.59, 460.61, and 460.67 to the list of regulations in §450.45 with which applicants seeking a launch or reentry license for operations involving human space flight must demonstrate compliance. This change would accommodate the creation of the government astronaut category and ensure government astronaut requirements are addressed in the application. **IV. Regulatory Notices and Analyses**

A. Regulatory Impact Analysis

Federal agencies consider impacts of regulatory actions under a variety of executive orders and other requirements. First, Executive Order 12866 and Executive Order 13563, as amended by Executive Order 14094 (''Modernizing Regulatory Review''), direct each Federal agency to propose or adopt a regulation only upon a reasoned determination that the benefits of the intended regulation justify its costs. Second, the Regulatory Flexibility Act of 1980 (Pub. L. 96–354) requires agencies to analyze the economic impact of regulatory changes on small entities. Third, the Trade Agreements Act (Pub. L. 96–

39) prohibits agencies from setting standards that create unnecessary obstacles to the foreign commerce of the United States. Fourth, the Unfunded Mandates Reform Act of 1995 (Pub. L. 104–4) requires agencies to prepare a written assessment of the costs, benefits, and other effects of proposed or final rules that include a Federal mandate that may result in the expenditure by state, local, and tribal governments, in the aggregate, or by the private sector, of $100,000,000 or more (adjusted annually for inflation) in any 1 year. The current threshold after adjustment for inflation is $177,000,000 using the most current (2022) Implicit Price Deflator for the Gross Domestic Product. This portion of the preamble summarizes the FAA's analysis of the economic impacts of this rule.

In conducting these analyses, the FAA has determined that this rule: would result in benefits that justify costs; is not an economically ''significant regulatory action'' as defined in section 3(f) of Executive Order 12866, as amended; would not have a significant economic impact on a substantial number of small entities; would not create unnecessary obstacles to the foreign commerce of the United States; and would not impose an unfunded mandate on State, local, or tribal governments, or on the private sector.

This proposed rule would amend 14 CFR parts 401, 413, 415, 431, 435, 437, 440, 450, and 460 by incorporating statutory changes resulting from the CSLCA. This proposed rule would add a definition for ''government astronaut'' and would update other definitions to account for that addition. This proposed rule would also update financial responsibility requirements in part 440 to include government astronauts, and would move the templates for reciprocal waiver of claims agreements from part 440 appendices B through E to an AC. This proposed rule would also add two new subparts to part 460 to address operator requirements for government astronauts with safety critical and non- safety-critical roles during launches and reentries. This proposed rule would also add two new subparts to part 460 to address operator requirements for government astronauts with safety- critical and non-safety-critical roles during launches and reentries. In addition, the FAA proposes to replace the terms ''crew'' and ''space flight participant'' with the term ''human being'' in §§415.8, 431.8, and 435.8 for applicants seeking a license for operations involving human space flight and that must demonstrate compliance with human space flight requirements. This proposed change would accommodate the creation of the government astronaut category in part 460.

This proposed rule would affect all U.S. commercial space operators and launches and reentries licensed under title 14 of the Code of Federal Regulations (14 CFR) parts 401, 413, 415, 431, 435, 437, 440, 450, and 460 that will carry a government astronaut on board. Table 1 details the proposed changes in each part.

TABLE 1—PROPOSED CHANGES BY SECTION

Section	Change	Effect of change
§401.5 Definitions	Add definitions for ''Government Astronaut,'' ''International partner astronaut,'' and ''International Space Station Intergovernmental Agreement.'' Revising definitions for ''Human space flight incident,'' ''Launch,'' ''Launch accident,'' ''Reenter,'' ''Reentry accident,'' and ''Space flight participant''.	None. The FAA has been applying these definitions in accordance with the statute since the CSLCA went into effect. This change would now provide regulatory clarity.

TABLE 1—PROPOSED CHANGES BY SECTION—Continued

Section	Change	Effect of change

§401.7 Definitions	Add definitions for "Government Astronaut," "International partner astronaut," and "International Space Station Intergovernmental Agreement." Revising definition for "Space flight participant".	None. The FAA has been applying these definitions in accordance with the statute since the CSLCA went into effect. This change would now provide regulatory clarity.
§413.3(f)	Replace the term "suborbital rocket" with the term "permitted vehicle" to align with the increase in scope from proposed §437.3.	None. The FAA has been applying these definitions in accordance with the statute since the CSLCA went into effect. This change would now provide regulatory clarity.
§415.8 Human Space Flight in Part 415, LAUNCH LICENSE	Remove "crew" and "space flight participant" and add "human being" in their place, to include government astronaut, crew, and space flight participant categories. Add government astronaut requirements.	None. The FAA has been applying these definitions in accordance with the statute since the CSLCA went into effect. This change would now provide regulatory clarity.
§431.8 Human Space Flight in Part 431, LAUNCH AND REENTRY OF A REUSABLE LAUNCH VEHICLE (RLV).	Remove "crew" and "space flight participant" and add "human being" in their place, to include government astronaut, crew, and space flight participant categories. Add government astronaut requirements.	None. The FAA has been applying these definitions in accordance with the statute since the CSLCA went into effect. This change would now provide regulatory clarity.
§435.8 Human Space Flight in PART 435, REENTRY OF A REENTRY VEHICLE OTHER THAN A REUSABLE LAUNCH VEHICLE (RLV).	Remove "crew" and "space flight participant" and add "human being" in their place, to include government astronaut, crew, and space flight participant categories. Add government astronaut requirements.	None. The FAA has been applying these definitions in accordance with the statute since the CSLCA went into effect. This change would now provide regulatory clarity.
§437.3 Definitions in Part 437, EXPERIMENTAL PERMITS	Add a reusable launch vehicle that will be launched into a suborbital trajectory or reentered that is operated by a launch or reentry operator under an experimental permit to the definition of "permitted vehicle".	None. The FAA has been applying these definitions in accordance with the statute since the CSLCA went into effect. This change would now provide regulatory clarity.
§§437.5, 437.7, 437.9, 437.21, 437.23, 437.25, 437.31, 437.33, 437.53, 437.57, 437.59, 437.61, 437.71, 437.85, 437.91, and 437.95.	Replace "suborbital rocket" with "permitted vehicle".	None. The FAA has been applying these definitions in accordance with the statute since the CSLCA went into effect. This change would now provide regulatory clarity.
§437.5(a)	Remove "new" to allow research and development of existing design concepts, equipment, or operating techniques.	None. The FAA has been applying these definitions in accordance with the statute since the CSLCA went into effect. This change would now provide regulatory clarity.
§437.21 General	Remove "crew" and "space flight participant" and add "human being" in their place, to include government astronaut, crew, and space flight participant categories. Add government astronaut requirements.	None. The FAA has been applying these definitions in accordance with the statute since the CSLCA went into effect. This change would now provide regulatory clarity.
Move appendices B–E in PART 440, FINANCIAL RESPONSIBILITY, to an AC.		None.
§440.9(b)	Add space flight participants to the list in which a licensee or permittee must obtain and maintain in effect a policy or policies of liability insurance to protect their respective potential liabilities against covered claims by a third party for bodily injury or property damage resulting from a licensed or permitted activity.	None. The FAA has been applying these definitions in accordance with the statute since the CSLCA went into effect. This change would now provide regulatory clarity.
§440.9(f)	Add language to require the licensee or permitee to enter into a reciprocal waiver of claims agreement with each space flight participant.	None. The FAA has been applying these definitions in accordance with the statute since the CSLCA went into effect. This change would now provide regulatory clarity.
§450.45(e)(5)	Add requirements for government astronauts	None. The FAA has been applying these requirements in accordance with the statute since the CSLCA went into effect. This change would now provide regulatory clarity.
Add Subpart C, Launch and Reentry with a Government Astronaut with a Safety-Critical Role, after Subpart B in §460 Scope, HUMAN SPACE FLIGHT REQUIREMENTS.	Add requirements applicable to government astronauts with a safety-critical role.	None. Operators have been training government astronauts in order to satisfy NASA contractual requirements. This change would make some of that training required by regulation.
Add Subpart D, Launch and Reentry with a Government Astronaut Without a Safety-Critical Role after Subpart C in §460 Scope, HUMAN SPACE FLIGHT REQUIREMENTS.	Add requirements applicable to government astronauts without a safety-critical role.	None. Operators have been training government astronauts in order to satisfy NASA contractual requirements. This change would make some of that training required by regulation.

The proposed changes would have a minimal impact on licensed commercial space activity with government astronauts because the changes would align the regulations with the current statutory requirements for crew, for space flight participants, and with current practices. The FAA has been applying the statutory changes since they went into effect in 2015.

B. Regulatory Flexibility Act

The Regulatory Flexibility Act of 1980 (Pub. L. 96–354) (RFA) establishes ''as a principle of regulatory issuance that agencies shall endeavor, consistent with the objectives of the rule and of applicable statutes, to fit regulatory and informational requirements to the scale of the businesses, organizations, and governmental jurisdictions subject to regulation. To achieve this principle, agencies are required to solicit and consider flexible regulatory proposals and to explain the rationale for their actions to assure that such proposals are given serious consideration.'' The RFA covers a wide range of small entities, including small businesses, not-for- profit organizations, and small governmental jurisdictions.

Agencies must perform a review to determine whether a proposed or final rule would have a significant economic impact on a substantial number of small entities. If the determination is that it would, the agency must prepare a regulatory flexibility analysis as described in the RFA.

This proposed rule would update definitions relating to commercial space launch and reentry vehicles and occupants to reflect current statutory definitions and requirements, as well as implement clarifications to financial responsibility requirements in accordance with the CSLCA. Therefore, the FAA believes that this proposed rule would not have a significant economic impact on small commercial space operators because it is current practice.

If an agency determines that a rulemaking would not result in a significant economic impact on a substantial number of small entities, the head of the agency may so certify under section 605(b) of the RFA. Therefore, as provided in section 605(b), the head of the FAA certifies that this proposed rulemaking would not result in a significant economic impact on a substantial number of small entities.

C. International Trade Impact

Assessment

The Trade Agreements Act of 1979 (Pub. L. 96–39), as amended by the Uruguay Round Agreements Act (Pub.

L. 103–465), prohibits Federal agencies from establishing standards or engaging in related activities that create unnecessary obstacles to the foreign commerce of the United States. Pursuant to these Acts, the establishment of standards is not considered an unnecessary obstacle to the foreign commerce of the U.S., if the standard has a legitimate domestic objective, such as the protection of safety, and does not operate in a manner that excludes imports that meet this objective. The statute also requires consideration of international standards and, where appropriate, that they serve as the basis for U.S. standards. The FAA has assessed the potential effect of this proposed rule and determined that it will not create unnecessary obstacles to the foreign commerce of the United States.

D. Unfunded Mandates Assessment

Title II of the Unfunded Mandates Reform Act of 1995 (Pub. L. 104–4) requires each Federal agency to prepare a written statement assessing the effects of any Federal mandate in a proposed or final rule that may result in an expenditure of 100 million or more (in 1995 dollars) in any one year by State, local, and tribal governments, in the aggregate, or by the private sector; such a mandate is deemed to be a ''significant regulatory action.'' The threshold after adjustment for inflation is $177 million using the most current annual (2022) Implicit Price Deflator for Gross Domestic Product from the U.S. Bureau of Economic Analysis. This proposed rule does not contain such a mandate; therefore, the requirements of title II of the Act do not apply.

E. Paperwork Reduction Act

The Paperwork Reduction Act of 1995 (44 U.S.C. 3507(d)) requires that the FAA consider the impact of paperwork and other information collection burdens imposed on the public. According to the 1995 amendments to the Paperwork Reduction Act (5 CFR 1320.8(b)(2)(vi)), an agency may not collect or sponsor the collection of information, nor may it impose an information collection requirement, unless it displays a currently valid Office of Management and Budget

(OMB) control number.

The FAA has determined that there is no new requirement for information collection associated with this proposed rule.

F. Environmental Analysis

FAA Order 1050.1 identifies FAA actions that are categorically excluded from preparation of an environmental assessment or environmental impact statement under the National Environmental Policy Act in the absence of extraordinary circumstances. The FAA has determined this proposed rulemaking action qualifies for the categorical exclusion identified in paragraph 5–6.6f for regulations and involves no extraordinary circumstances. **V. Executive Order Determinations**

A. Executive Order 13132, Federalism

The FAA has analyzed this proposed rule under the principles and criteria of Executive Order (E.O.) 13132,

Federalism. The FAA has determined

that this action would not have a substantial direct effect on the States, or the relationship between the Federal Government and the States, or on the distribution of power and responsibilities among the various levels of government, and, therefore, would not have federalism implications.

B. Executive Order 13175, Consultation and Coordination With Indian Tribal Governments

Consistent with Executive Order 13175, Consultation and Coordination with Indian Tribal Governments,[41] and FAA Order 1210.20, American Indian and Alaska Native Tribal Consultation Policy and Procedures,[42] the FAA ensures that Federally Recognized Tribes (Tribes) are given the opportunity to provide meaningful and timely input regarding proposed Federal actions that have the potential to affect uniquely or significantly their respective Tribes. At this point, the FAA has not identified any unique or significant effects, environmental or otherwise, on tribes resulting from this proposed rule.

C. Executive Order 13211, Regulations

That Significantly Affect Energy Supply, Distribution, or Use

The FAA analyzed this proposed rule under E.O. 13211, Actions Concerning Regulations that Significantly Affect

Energy Supply, Distribution, or Use (May 18, 2001). The FAA has determined that it would not be a ''significant energy action'' under the Executive order and would not be likely to have a significant adverse effect on the supply, distribution, or use of energy.

D. Executive Order 13609, Promoting

International Regulatory Cooperation

Executive Order 13609, Promoting International Regulatory Cooperation, promotes international regulatory cooperation to meet shared challenges involving health, safety, labor, security, environmental, and other issues and to reduce, eliminate, or prevent unnecessary differences in regulatory requirements. The FAA has analyzed this action under the policies and agency responsibilities of E.O. 13609 and has determined that this action would have no effect on international regulatory cooperation.

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[41] 65 FR 67249 (Nov. 6, 2000).

[42] FAA Order No. 1210.20 (Jan. 28, 2004), available at *www.faa.gov/documentLibrary/media/ 1210.pdf.*

VI. Additional Information

A. Comments Invited

The FAA invites interested persons to participate in this rulemaking by submitting written comments, data, or views. The FAA also invites comments relating to the economic, environmental, energy, or federalism impacts that might result from adopting the proposals in this document. The most helpful comments reference a specific portion of the proposal, explain the reason for any recommended change, and include supporting data. To ensure the docket does not contain duplicate comments, commenters should submit only one time if comments are filed electronically, or commenters should send only one copy of written comments if comments are filed in writing.

The FAA will file in the docket all comments it receives, as well as a report summarizing each substantive public contact with FAA personnel concerning this proposed rulemaking. Before acting on this proposal, the FAA will consider all comments it receives on or before the closing date for comments. The FAA will consider comments filed after the comment period has closed if it is possible to do so without incurring expense or delay. The FAA may change this proposal in light of the comments it receives.

B. Confidential Business Information

Confidential Business Information (CBI) is commercial or financial information that is both customarily and actually treated as private by its owner. Under the Freedom of Information Act (FOIA) (5 U.S.C. 552), CBI is exempt from public disclosure. If your comments responsive to this NPRM contain commercial or financial information that is customarily treated as private, that you actually treat as private, and that is relevant or responsive to this NPRM, it is important that you clearly designate the submitted comments as CBI. Please mark each page of your submission containing CBI as ''PROPIN.'' The FAA will treat such marked submissions as confidential under the FOIA, and they will not be placed in the public docket of this

NPRM. Submissions containing CBI should be sent to the person in the **FOR FURTHER INFORMATION CONTACT** section of this document. Any commentary that the FAA receives which is not specifically designated as CBI will be placed in the public docket for this rulemaking.

C. Electronic Access and Filing

A copy of this NPRM, all comments received, any final rule, and all background material may be viewed online at *www.regulations.gov* using the docket number listed above. A copy of this proposed rule will be placed in the docket. Electronic retrieval help and guidelines are available on the website. It is available 24 hours each day, 365 days each year. An electronic copy of this document may also be downloaded from the Office of the **Federal Register's** website at *www.federalregister.gov* and the Government Publishing Office's website at *www.govinfo.gov.* A copy may also be found at the FAA's Regulations and Policies website at *www.faa.gov/regulations_policies.*

Copies may also be obtained by sending a request to the Federal Aviation Administration, Office of

Rulemaking, ARM–1, 800 Independence Avenue SW, Washington, DC 20591, or by calling (202) 267–9677. Commenters must identify the docket or notice number of this rulemaking.

All documents the FAA considered in developing this proposed rule, including economic analyses and technical reports, may be accessed in the electronic docket for this rulemaking.

D. Small Business Regulatory

Enforcement Fairness Act

The Small Business Regulatory
Enforcement Fairness Act (SBREFA) of 1996 requires the FAA to comply with small entity requests for information or advice about compliance with statutes and regulations within its jurisdiction. A small entity with questions regarding this document may contact its local FAA official, or the person listed under the **FOR FURTHER INFORMATION CONTACT** heading at the beginning of the preamble. To find out more about SBREFA on the internet, visit *www.faa.gov/regulations_policies/ rulemaking/sbre_act/.*

1. Rulemaking Documents

An electronic copy of a rulemaking document may be obtained by using the internet— 1. Search the Federal eRulemaking

Portal (www.regulations.gov);

2. Visit the FAA's Regulations and Policies web page at *www.faa.gov/ regulations_policies/*; or
3. Access the Government Printing

Office's web page at *www.GovInfo.gov.*

Copies may also be obtained by sending a request (identified by notice or docket number of this proposed rulemaking) to the Federal Aviation Administration, Office of Rulemaking, ARM–1, 800 Independence Avenue SW, Washington, DC 20591, or by calling (202) 267–9680.

2. Comments Submitted to the Docket

Comments received may be viewed by going to *www.regulations.gov* and following the online instructions to search the docket number for this action. Anyone may search the electronic form of all comments received into any of the FAA's dockets by the name of the individual submitting the comment (or signing the comment, if submitted on behalf of an association, business, labor union, etc.).

3. Small Business Regulatory Enforcement Fairness Act

The Small Business Regulatory Enforcement Fairness Act (SBREFA) of 1996 requires the FAA to comply with small entity requests for information or advice about compliance with statutes and regulations within its jurisdiction. A small entity with questions regarding this document, may contact its local FAA official, or the person listed under the FOR FURTHER INFORMATION CONTACT heading at the beginning of the preamble. To find out more about SBREFA on the internet, visit *www.faa.gov/regulations_policies/ rulemaking/sbre_act/.* **List of Subjects**

14 CFR Part 401

Organization and functions (Government agencies), Space transportation and exploration.

14 CFR Part 413

Confidential business information, Space transportation and exploration.

14 CFR Part 415

Aviation safety, Environmental protection, Investigations, Reporting and recordkeeping requirements, Space transportation and exploration.

14 CFR Part 431

Launch and reentry safety, Aviation safety, Reporting and recordkeeping requirements, Rockets, Space transportation and exploration.

14 CFR Part 435

Launch and reentry safety, Aviation safety, Reporting and recordkeeping requirements, Rockets, Space transportation and exploration.

14 CFR Part 437

Aircraft, Aviation safety, Reporting and recordkeeping requirements, Space transportation and exploration.

14 CFR Part 440

Indemnity payments, Insurance, Reporting and recordkeeping requirements, Space transportation and exploration.

14 CFR Part 450

Aircraft, Aviation safety,

Environmental protection, Investigations, Reporting and recordkeeping requirements, Space transportation and exploration.

14 CFR Part 460

Aircraft, Reporting and recordkeeping requirements, Space transportation and exploration.

The Proposed Amendments

In consideration of the foregoing, the Federal Aviation Administration proposes to amend chapter III of title 14, Code of Federal Regulations as follows:

PART 401—ORGANIZATION AND DEFINITIONS

! 1. The authority citation for part 401 continues to read as follows:

Authority: 51 U.S.C. 50901–50923.

! 2. Amend §401.5 by—

! a. Adding in alphabetical order a definition for ''Government astronaut''; ! b. Revising the definition of ''Human space flight incident''; ! c. Adding in alphabetical order definitions for ''International partner astronaut'', and ''International Space Station Intergovernmental Agreement''; and

! d. Revising the definitions of

''Launch'', ''Launch accident'', ''Reenter; reentry'', ''Reentry accident'', and ''Space flight participant'';

The additions and revisions read as follows:

§401.5 Definitions.

* * * * *

Government astronaut means an individual who—

(1) Is designated by the National Aeronautics and Space Administration under Title 51, United States Code,
Section 20113(n);

(2) Is carried within a launch vehicle or reentry vehicle in the course of their employment, which may include performance of activities directly relating to the launch, reentry, or other operation of the launch vehicle or reentry vehicle; and

(3) Is either— (i) An employee of the United States Government, including the uniformed services, engaged in the performance of a Federal function under authority of law or an Executive act; or

(ii) An international partner astronaut.

* * * * *

Human space flight incident means an unplanned event that poses a high risk of causing a serious or fatal injury to a space flight participant, crew, or government astronaut.

* * * * *

International partner astronaut means an individual designated under Article 11 of the International Space Station Intergovernmental Agreement, by a partner to that agreement other than the United States, as qualified to serve as an International Space Station crew member.

International Space Station

Intergovernmental Agreement means the Agreement Concerning Cooperation on the International Space Station, signed in Washington, DC, on January 29, 1998 (TIAS 12927).

*   *   *   *   *

Launch means to place or try to place a launch vehicle or reentry vehicle and any payload or human being from Earth in a suborbital trajectory, in Earth orbit in outer space, or otherwise in outer space, and includes preparing a launch vehicle for flight at a launch site in the United States. Launch includes the flight of a launch vehicle and includes pre- and post-flight ground operations as follows:

(1) *Beginning of launch.* (i) Under a license, launch begins with the arrival of a launch vehicle or payload at a U.S. launch site.

(ii) Under a permit, launch begins when any pre-flight ground operation at a U.S. launch site meets all of the following criteria:

(A) Is closely proximate in time to flight,
(B) Entails critical steps preparatory to initiating flight,
(C) Is unique to space launch, and
(D) Is inherently so hazardous as to warrant the FAA's regulatory oversight.

(2) *End of launch.* (i) For launch of an orbital expendable launch vehicle (ELV), launch ends after the licensee's last exercise of control over its launch vehicle.

(ii) For launch of an orbital reusable launch vehicle (RLV) with a payload, launch ends after deployment of the payload. For any other orbital RLV, launch ends upon completion of the first sustained, steady-state orbit of an RLV at its intended location.

(iii) For a suborbital ELV or RLV launch, launch ends after reaching apogee if the flight includes a reentry, or otherwise after vehicle landing or impact on Earth, and after activities necessary to return the vehicle to a safe condition on the ground.

Launch accident means—

(1) An event that causes a fatality or serious injury (as defined in 49 CFR 830.2) to any person who is not associated with the flight;

(2) An event that causes damage estimated to exceed $25,000 to property not associated with the flight that is not located at the launch site or designated recovery area;

(3) An unplanned event occurring during the flight of a launch vehicle resulting in the impact of a launch vehicle, its payload or any component thereof:

(i) For an expendable launch vehicle, outside designated impact limit lines; and
(ii) For a reusable launch vehicle, outside a designated landing site.

(4) For a launch that takes place with a person on board, a fatality or serious injury to a space flight participant, crew, or government astronaut.

*   *   *   *   *

Reenter; reentry means to return or attempt to return, purposefully, a reentry vehicle and its payload or human being, if any, from Earth orbit or from outer space to Earth. The term ''reenter; reentry'' includes activities conducted in Earth orbit or outer space to determine reentry readiness and that are critical to ensuring public health and safety and the safety of property during reentry flight. The term ''reenter; reentry'' also includes activities conducted on the ground after vehicle landing on Earth to ensure the reentry vehicle does not pose a threat to public health and safety or the safety of property.

Reentry accident means—

(1) Any unplanned event occurring during the reentry of a reentry vehicle resulting in the impact of the reentry vehicle, its payload, or any component thereof, outside a designated reentry site;

(2) An event that causes a fatality or serious injury (as defined in 49 CFR 830.2) to any person who is not associated with the reentry;

(3) An event that causes damage estimated to exceed $25,000 to property not associated with the reentry and not located within a designated reentry site; and

(4) For a reentry that takes place with a person on board, a fatality or serious injury to a space flight participant, crew, or government astronaut.

* * * * *

Space flight participant means an individual, who is not crew or a government astronaut, carried aboard a launch vehicle or reentry vehicle.

* * * * *

! 3. Amend §401.7 by—

! a. Adding in alphabetical order definitions for ''Government astronaut'', ''International partner astronaut'', and ''International Space Station Intergovernmental Agreement''; and ! b. Revising the definition of ''Space flight participant''.

The additions and revision read as follows:

§401.7 Definitions.

* * * * *

Government astronaut means an individual who—

(1) Is designated by the National Aeronautics and Space Administration under Title 51, United States Code, Section 20113(n);

(2) Is carried within a launch vehicle or reentry vehicle in the course of their employment, which may include performance of activities directly relating to the launch, reentry, or other operation of the launch vehicle or reentry vehicle; and

(3) Is either— (i) An employee of the United States Government, including the uniformed services, engaged in the performance of a Federal function under authority of law or an Executive act; or

(ii) An international partner astronaut.

* * * * *

International partner astronaut means an individual designated under Article 11 of the International Space Station Intergovernmental Agreement, by a partner to that agreement other than the United States, as qualified to serve as an International Space Station crew member.

International Space Station

Intergovernmental Agreement means the Agreement Concerning Cooperation on the International Space Station, signed in Washington, DC, on January 29, 1998 (TIAS 12927).

* * * * *

Space flight participant means an individual, who is not crew or a government astronaut, carried aboard a launch vehicle or reentry vehicle.

* * * * *

PART 413—LICENSE APPLICATION PROCEDURES

! 4. The authority citation for part 413 continues to read as follows:

Authority: 51 U.S.C. 50901–50923.

! 5. Amend §413.3 by revising paragraph (f) to read as follows:

§413.3 Who must obtain a license or permit.

* * * * *

(f) A person, individual, or foreign entity otherwise requiring a license under this section may instead obtain an experimental permit to launch or reenter a reusable suborbital vehicle under part 437 of this chapter.

PART 415—LAUNCH LICENSE

! 6. The authority citation for part 415 continues to read as follows:

Authority: 51 U.S.C. 50901–50923.

! 7. Revise §415.8 to read as follows:

§415.8 Human space flight.

To obtain a launch license, an applicant proposing to conduct a launch with a human being on board must demonstrate compliance with §§460.5, 460.7, 460.11, 460.13, 460.15, 460.17, 460.51, 460.53, 460.59, 460.61, and 460.67 of this subchapter.

PART 431—LAUNCH AND REENTRY

OF A REUSABLE LAUNCH VEHICLE (RLV)

! 8. The authority citation for part 431 continues to read as follows:

Authority: 51 U.S.C. 50901–50923.

! 9. Revise §431.8 to read as follows:

§431.8 Human space flight.

To obtain a launch license, an applicant proposing to conduct a reusable launch vehicle mission with a human being on board must demonstrate compliance with §§460.5, 460.7, 460.11, 460.13, 460.15, 460.17, 460.51, 460.53, 460.59, 460.61, and 460.67 of this subchapter.

PART 435—REENTRY OF A REENTRY

VEHICLE OTHER THAN A REUSABLE LAUNCH VEHICLE (RLV)

! 10. The authority citation for part 435 continues to read as follows:

Authority: 51 U.S.C. 50901–50923.

! 11. Revise §435.8 to read as follows:

§435.8 Human space flight.

To obtain a reentry license, an applicant proposing to conduct a reentry with a human being on board the vehicle must demonstrate compliance with §§460.5, 460.7, 460.11, 460.13, 460.15, 460.17, 460.51, 460.53, 460.59, 460.61, and 460.67 of this subchapter.

PART 437—EXPERIMENTAL PERMITS

! 12. The authority citation for part 437 continues to read as follows:

Authority: 51 U.S.C. 50901–50923.

! 13. Revise §437.3 to read as follows:

§437.3 Definitions.

Envelope expansion means any portion of a flight where planned

operations will subject a reusable suborbital vehicle to the effects of altitude, velocity, acceleration, or burn duration that exceed a level or duration successfully verified during an earlier flight.

Exclusion area means an area, within an operating area, that a reusable suborbital vehicle's instantaneous impact point may not traverse.

Operating area means a three- dimensional region where permitted flights may take place.

Permitted vehicle means a reusable suborbital rocket or a reusable launch vehicle that will be launched into a suborbital trajectory or reentered that is operated by a launch or reentry operator under an experimental permit.

Reentry impact point means the location of a reusable suborbital vehicle's instantaneous impact point during its unpowered exoatmospheric suborbital flight. ! 14. Revise §437.5 to read as follows:

§437.5 Eligibility for an experimental permit.

The FAA will issue an experimental permit to a person to launch or reenter a reusable suborbital vehicle only for—

(a) Research and development to test design concepts, equipment, or operating techniques;
(b) A showing of compliance with requirements for obtaining a license under this subchapter; or
(c) Crew training for a launch or reentry using the design of the reusable suborbital vehicle for which the permit would be issued. ! 15. Amend §437.7 by revising the introductory text and paragraph (b) to read as follows:

§437.7 Scope of an experimental permit. An experimental permit authorizes launch or reentry of a reusable suborbital vehicle. The authorization includes pre- and post-flight ground operations as defined in this section.

* * * * *

(b) A post-flight ground operation includes each operation necessary to return the reusable suborbital vehicle to a safe condition after it lands or impacts.

! 16. Revise §437.9 to read as follows:

§437.9 Issuance of an experimental permit.

The FAA issues an experimental permit authorizing an unlimited number of launches or reentries for a reusable suborbital vehicle design for the uses described in §437.5. ! 17. Amend §437.21 by revising paragraphs (b)(1)(i) and (iv), (b)(3), (c), and (d) to read as follows:

§437.21 General.

* * * * *

(b) * * *

(1) * * *

(i) *General.* The FAA is responsible for complying with the procedures and policies of the National Environmental Policy Act (NEPA) and other applicable environmental laws, regulations, and Executive Orders to consider and document the potential environmental effects associated with proposed reusable suborbital vehicle launches or reentries. An applicant must provide the FAA with information needed to comply with such requirements. The FAA will consider and document the potential environmental effects associated with proposed reusable suborbital vehicle launches or reentries.

* * * * *

(iv) Information requirements. An application must include an approved FAA Environmental Assessment, Environmental Impact Statement, categorical exclusion determination, or written re-evaluation covering all planned permitted activities in compliance with NEPA and the Council on Environmental Quality Regulations for Implementing the Procedural Provisions of NEPA.

* * * * *

(3) *Human space flight.* An applicant proposing to conduct a permitted operation with a human being on board a reusable suborbital vehicle must demonstrate compliance with §§460.5, 460.7, 460.11, 460.13, 460.15, 460.17, 460.51, 460.53, 460.59, 460.61, and 460.67 of this subchapter.

(c) *Use of a safety element approval.* If an applicant proposes to use any reusable suborbital vehicle, safety system, process, service, or personnel for which the FAA has issued a safety element approval under part 414 of this chapter, the FAA will not reevaluate that safety element to the extent its use is within its approved scope. As part of the application process, the FAA will evaluate the integration of that safety element into vehicle systems or operations.

(d) *Inspection before issuing a permit.* Before the FAA issues an experimental permit, an applicant must make each reusable suborbital vehicle planned to be flown available to the FAA for inspection. The FAA will determine whether each reusable suborbital vehicle is built as represented in the application.

* * * * *

! 18. Amend §437.23 by revising paragraphs (a) and (b) to read as follows:

§437.23 Program description.

(a) An applicant must provide—

(1) Dimensioned three-view drawings or photographs of the reusable suborbital vehicle; and

(2) Gross liftoff weight and thrust profile of the reusable suborbital vehicle.

(b) An applicant must describe—

(1) All reusable suborbital vehicle systems, including any structural, flight control, thermal, pneumatic, hydraulic, propulsion, electrical, environmental control, software and computing systems, avionics, and guidance systems used in the reusable suborbital vehicle;

(2) The types and quantities of all propellants used in the reusable suborbital vehicle;

(3) The types and quantities of any hazardous materials used in the reusable suborbital vehicle;

(4) The purpose for which a reusable suborbital vehicle is to be flown; and

* * * * *

! 19. Amend §437.25 by revising paragraph (c) to read as follows:

§437.25 Flight test plan.

* * * * *

(c) For each operating area, provide the planned maximum altitude of the reusable suborbital vehicle.

! 20. Amend §437.31 by revising paragraphs (a) introductory text, (a)(1), and (b), to read as follows:

§437.31 Verification of operating area containment and key flight-safety event limitations.

(a) An applicant must identify, describe, and provide verification evidence of the methods and systems used to meet the requirement of §437.57(a) to contain its reusable suborbital vehicle's instantaneous impact point within an operating area and outside any exclusion area. The description must include, at a minimum—

(1) Proof of physical limits on the ability of the reusable suborbital vehicle to leave the operating area; or

* * * * *

(b) An applicant must identify, describe, and provide verification evidence of the methods and systems used to meet the requirements of §437.59 to conduct any key flight-safety event so that the reusable suborbital vehicle's instantaneous impact point, including its expected dispersions, is over unpopulated or sparsely populated areas, and to conduct each reusable suborbital vehicle flight so that the reentry impact point does not loiter over a populated area.

! 21. Revise §437.33 to read as follows:

§437.33 Landing and impact locations.

An applicant must demonstrate that each location for nominal landing or any contingency abort landing of the reusable suborbital vehicle, and each location for any nominal or contingency impact or landing of a component of that reusable suborbital vehicle, satisfies §437.61. ! 22. Amend §437.53 by revising the introductory text to read as follows:

§437.53 Pre-flight and post-flight operations.

A permittee must protect the public from adverse effects of hazardous operations and systems in preparing a reusable suborbital vehicle for flight at a launch site in the United States and returning the reusable suborbital vehicle and any support equipment to a safe condition after flight. At a minimum, a permittee must—

* * * * *

! 23. Amend §437.57 by revising paragraphs (a) and (c) to read as follows:

§437.57 Operating area containment.

(a) During each permitted flight, a permittee must contain its reusable suborbital vehicle's instantaneous impact point within an operating area determined in accordance with paragraph (b) and outside any exclusion area defined by the FAA in accordance with paragraph (c) of this section.

* * * * *

(c) The FAA may prohibit a reusable suborbital vehicle's instantaneous impact point from traversing certain areas within an operating area by designating one or more areas as exclusion areas, if necessary to protect public health and safety, safety of property, or foreign policy or national security interests of the United States. An exclusion area may be confined to a specific phase of flight.

! 24. Amend §437.59 by revising paragraph (a) introductory text and (b) to read as follows:

§437.59 Key flight-safety event limitations.

(a) A permittee must conduct any key flight-safety event so that the reusable suborbital vehicle's instantaneous impact point, including its expected dispersion, is over an unpopulated or sparsely populated area. At a minimum, a key flight-safety event includes:

*   *   *   *   *

(b) A permittee must conduct each reusable suborbital vehicle flight so that the reentry impact point does not loiter over a populated area. ! 25. Amend §437.61 by revising the introductory text to read as follows:

§437.61 Landing and impact locations. For a nominal or any contingency abort landing of a reusable suborbital vehicle, or for any nominal or contingency impact or landing of a component of that reusable suborbital vehicle, a permittee must use a location that—

*   *   *   *   *

! 26. Amend §437.71 by revising paragraphs (a), (c), (d), and (e) to read as follows:

§437.71 Flight rules.

(a) Before initiating flight, a permittee must confirm that all systems and operations necessary to ensure that safety measures derived from §§437.55, 437.57, 437.59, 437.61, 437.63, 437.65, 437.67, and 437.69 are within acceptable limits.

*   *   *   *   *

(c) A permittee may not operate a reusable suborbital vehicle in a careless or reckless manner that would endanger any member of the public during any phase of flight.

(d) A permittee may not operate a reusable suborbital vehicle in areas designated in a Notice to Airmen under 14 CFR 91.137, 91.138, 91.141, or 91.145, unless authorized by:

(1) Air Traffic Control; or

(2) A Flight Standards Certificate of Waiver or Authorization.

(e) For any phase of flight where a permittee operates a reusable suborbital vehicle like an aircraft in the National Airspace System, a permittee must comply with the provisions of 14 CFR part 91 specified in an experimental permit issued under this part. ! 27. Amend §437.85 by revising paragraph (a) to read as follows:

§437.85 Allowable design changes; modification of an experimental permit.

(a) The FAA will identify in the experimental permit the type of changes that the permittee may make to the reusable suborbital vehicle design without invalidating the permit.

*   *   *   *   *

! 28. Revise §437.91 to read as follows:

§437.91 For hire prohibition.

No permittee may carry any property or human being for compensation or hire on a reusable suborbital vehicle. ! 29. Revise §437.95 to read as follows:

§437.95 Inspection of additional reusable suborbital vehicles.

A permittee may launch or reenter additional reusable suborbital vehicles of the same design under the permit after the FAA inspects each additional reusable suborbital vehicle.

PART 440—FINANCIAL RESPONSIBILITY

! 30. The authority citation for part 440 continues to read as follows:

Authority: 51 U.S.C. 50901–50923.

! 31. Amend §440.3 by revising the definitions of ''Government personnel'', ''Permit'', ''Permitted activity'', and ''Third party'' to read as follows:

§440.3 Definitions.

* * * * *

Government personnel means employees of the United States, its agencies, and its contractors and subcontractors, involved in launch or reentry services for an activity authorized by an FAA license or permit. Employees of the United States include members of the Armed Forces of the United States. Government personnel exclude government astronauts.

* * * * *

Permit means an authorization the FAA issues under this subchapter for the launch or reentry of a reusable suborbital vehicle.

Permitted activity means the launch or reentry of a reusable suborbital vehicle conducted under a permit issued by the FAA.

* * * * *

Third party means— (1) Any person other than:

(i) The United States, any of its agencies, and its contractors and subcontractors involved in launch or reentry services for a licensed or permitted activity;

(ii) A licensee, permittee, and its contractors and subcontractors involved in launch or reentry services for a licensed or permitted activity;

(iii) A customer and its contractors and subcontractors involved in launch or reentry services for a licensed or permitted activity;

(iv) A member of a crew;

(v) A space flight participant; and (vi) A government astronaut.

(2) Government personnel, as defined in this section, are third parties.

* * * * *

! 32. Amend §440.9 by revising paragraph (b)(2), (3), and (4) to read as follows:

§440.9 Insurance requirements for licensed or permitted activities.

* * * * *

(b) * * *

(2) The United States, its agencies, and its contractors and subcontractors involved in a licensed or permitted activity;

(3) Government personnel; and

(4) Space flight participants. This paragraph (b)(4) shall cease to be effective on September 30, 2025, unless public law modifies the limitation in section 50914 of Title 51 of the U.S. Code.

* * * * *

! 33. Amend §440.17 by revising paragraphs (c) introductory text, (d) introductory text, (e) introductory text, and (f) and adding paragraph (g) to read as follows:

§440.17 Reciprocal waiver of claims requirements.

* * * * *

(c) For each licensed or permitted activity in which the United States, or its contractors and subcontractors, is involved or where property insurance is required under §440.9(d), the Federal Aviation Administration of the Department of Transportation, the licensee or permittee, and each first-tier customer must enter into a reciprocal waiver of claims agreement. The reciprocal waiver of claims must be in a form acceptable to the Administrator and must provide that:

* * * * *

(d) For each licensed or permitted activity in which the United States or its contractors and subcontractors are involved, the Federal Aviation Administration of the Department of Transportation and each space flight participant must enter into or have in place a reciprocal waiver of claims agreement. The reciprocal waiver of claims must be in a form acceptable to the Administrator.

* * * * *

(e) For each licensed or permitted activity in which the United States or its contractors and subcontractors is involved, the Federal Aviation Administration of the Department of Transportation and each crew member must enter into or have in place a reciprocal waiver of claims agreement. The reciprocal waiver of claims must be in a form acceptable to the Administrator.

* * * * *

(f) The licensee or permittee and each space flight participant must enter into a reciprocal waiver of claims agreement under which each party waives and releases claims against the other party to the waiver, and agrees to assume financial responsibility for property damage it sustains and for bodily injury or property damage, and to hold harmless and indemnify each other from bodily injury or property damage, resulting from a licensed or permitted activity, regardless of fault. This paragraph (f) shall cease to be effective as of September 30, 2025, unless public law modifies the limitation in section 50914 of Title 51 of the U.S. Code.

(g) Any waiver, release, assumption of responsibility or agreement to hold harmless and indemnify pursuant to this section does not apply to claims for bodily injury or property damage resulting from willful misconduct of any of the parties to the reciprocal waiver of claims, the contractors and subcontractors of any of the parties to the reciprocal waiver of claims, and in the case of licensee or permittee and customers and the contractors and subcontractors of each of them, the directors, officers, agents and employees of any of the foregoing, and in the case of the United States, its agents.

Appendix B Through E to Part 440— [Removed]

! 34. Remove appendices B through E to part 440.

PART 450—LAUNCH AND REENTRY LICENSE REQUIREMENTS

! 35. The authority citation for part 450 continues to read as follows:

Authority: 51 U.S.C. 50901–50923.

! 36. Amend §450.45 by revising paragraphs (e)(3)(ii)(E) and (e)(5) to read as follows:

§450.45 Safety review and approval.

*   *   *   *   *

(e) * * * (3) * * *

(ii) * * *

(E) For an unguided suborbital launch vehicle, the location of the vehicle's center of pressure in relation to its center of gravity for the entire flight profile.

*   *   *   *   *

(5) *Human space flight.* For a proposed launch or reentry with a human being on board a vehicle, an applicant must demonstrate compliance with §§460.5, 460.7, 460.11, 460.13, 460.15, 460.17, 460.51, 460.53, 460.59, 460.61, and 460.67 of this chapter.

*   *   *   *   *

PART 460—HUMAN SPACE FLIGHT

REQUIREMENTS

! 37. The authority citation for part 460 continues to read as follows:

Authority: 51 U.S.C. 50901–50923.

! 38. Add subpart C to read as follows:

Subpart C—Launch and Reentry With a
Government Astronaut With a Safety- Critical Role Sec.

Subpart C—Launch and Reentry With a Government Astronaut With a Safety- Critical Role

§460.55 Scope.

This subpart establishes requirements for operators and applicants whose licensed or permitted operations involve government astronauts on board a vehicle.

§460.57 Applicability.

This subpart applies to:

(a) An applicant for a license or permit under this chapter who proposes to have a government astronaut with a safety-critical role on board a vehicle.

(b) An operator licensed or permitted under this chapter who has a government astronaut without a safety- critical role on board a vehicle.

§460.59 Operator training of government astronauts with a safety-critical role.

(a) An operator must train each government astronaut with a safety- critical role on—

(1) How to carry out their safety- critical role on board or on the ground so that the vehicle will not harm the public; and

(2) Their role in nominal and non- nominal conditions, including abort scenarios and emergency operations, to the extent that performance of their role could impact public safety.

(b) An operator must ensure any government astronaut who has the ability to control, in real time, a launch or reentry vehicle's flight path during a phase of flight capable of endangering the public:

(1) Receives vehicle and mission- specific training for each phase of flight capable of endangering the public and over which the government astronaut has the ability to control the vehicle by using one or more of the following:

(i) A method or device that simulates the flight;
(ii) An aircraft whose characteristics are similar to the vehicle or that has similar phases of flight to the vehicle;
(iii) Flight testing; or
(iv) An equivalent method of training approved by the FAA through the license process.
(2) Trains for each mode of control or propulsion, including any transition between modes, such that the government astronaut is able to control the vehicle.
(3) Possesses aeronautical knowledge, experience, and skills necessary to pilot and control the launch or reentry vehicle that will operate in the National Airspace System (NAS). Aeronautical experience may include hours in flight, ratings, and training.

(c) With respect to training device fidelity, an operator must:

(1) Ensure that any government astronaut training device used to meet the training requirements realistically represents the vehicle's configuration and mission; or,
(2) Inform the government astronaut being trained of the differences between the training device and the vehicle's configuration and mission.

(d) An operator must update the government astronaut training continually to ensure that the training incorporates lessons learned from training and operational missions including—

(1) Tracking each revision and updating in writing; and
(2) Documenting the completed training for each government astronaut and maintaining the documentation for each active government astronaut. (e) An operator must establish a recurrent training schedule and ensure that all training of government astronauts performing safety-critical roles is current before launch or reentry.

§460.61 Environmental control and life support systems.

(a) An operator must provide atmospheric conditions adequate to sustain life and consciousness for all inhabited areas within a vehicle that house a government astronaut. The operator must monitor and control the following atmospheric conditions in the inhabited areas or demonstrate through the license or permit process that an alternate means provides an equivalent level of safety—

(1) Composition of the atmosphere, which includes oxygen and carbon dioxide, and any revitalization;
(2) Pressure, temperature and humidity;
(3) Contaminants that include particulates and any harmful or hazardous concentrations of gases, or vapors; and
(4) Ventilation and circulation.
(b) An operator must provide an adequate redundant or secondary oxygen supply for any government astronaut with a safety-critical role.
(c) An operator must provide a redundant means of preventing cabin depressurization; or prevent incapacitation of any government astronaut with a safety-critical role in the event of loss of cabin pressure. ! 39. Add subpart D to read as follows:

Subpart D—Launch and Reentry With a Government Astronaut Without a Safety- Critical Role Sec.

460.67 Operator training of government astronauts without a safety-critical role.

Subpart D—Launch and Reentry With a Government Astronaut Without a Safety-Critical Role

§460.63 Scope.

This subpart establishes requirements for operators and applicants whose licensed or permitted operations involve government astronauts on board a vehicle without a safety-critical role.

§460.65 Applicability.

This subpart applies to:

(a) An applicant for a license or permit under this chapter who proposes to have a government astronaut without a safety-critical role on board a vehicle. (b) An operator licensed or permitted under this chapter who has a government astronaut without a safety- critical role on board a vehicle.

§460.67 Operator training of government astronauts without a safety-critical role.

An operator must train each government astronaut without a safety- critical role on how to respond to emergency situations, including smoke, fire, loss of cabin pressure, and emergency exit.

Issued under authority provided by 49 U.S.C. 106(f) and 51 U.S.C. Chapter 509 in Washington, DC.

Kelvin B. Coleman, *Associate Administrator, Office of Commercial Space Transportation.*

[FR Doc. 2023–16858 Filed 8–17–23; 8:45 am]
BILLING CODE 4910–13–P

PENSION BENEFIT GUARANTY CORPORATION

29 CFR Parts 4022, 4044, 4050, 4262 and 4281

RIN 1212–AA55

Valuation Assumptions and Methods

AGENCY: Pension Benefit Guaranty Corporation.

ACTION: Proposed rule.

SUMMARY: This proposed rule would update the interest, mortality, and expense assumptions used to determine the present value of benefits for a single- employer pension plan under subpart B of the Pension Benefit Guaranty Corporation's regulation on Allocation of Assets in Single-Employer Plans, to determine components of mass withdrawal liability for a multiemployer pension plan, and for other purposes.

DATES: Comments must be submitted on or before October 17, 2023 to be assured of consideration.

ADDRESSES: Comments may be submitted by any of the following methods:

- *Federal eRulemaking Portal: https://www.regulations.gov.* Follow the instructions for sending comments.
- *Email: reg.comments@pbgc.gov.* Refer to RIN 1212–AA55 in the subject line.
- *Mail or Hand Delivery:* Regulatory

Affairs Division, Office of the General

Counsel, Pension Benefit Guaranty Corporation, 445 12th Street SW, Washington, DC 20024–2101.

Commenters are strongly encouraged to submit comments electronically. Commenters who submit comments on paper by mail should allow sufficient time for mailed comments to be received before the close of the comment period. All submissions must include the agency's name (Pension Benefit Guaranty Corporation or PBGC), the title for this rulemaking (Valuation Assumptions and Methods), and the Regulation Identifier Number for this rulemaking (RIN 1212–AA55). Comments received will be posted without change to PBGC's website, *www.pbgc.gov,* including any personal information provided. Do not submit comments that include any personally identifiable information or confidential business information.

Copies of comments may also be obtained by writing to Disclosure Division, Office of the General Counsel,

Pension Benefit Guaranty Corporation,
445 12th Street SW, Washington, DC 20024–2101, or calling 202–326–4040 during normal business hours. If you are deaf or hard of hearing, or have a speech disability, please dial 7–1–1 to access telecommunications relay services.

FOR FURTHER INFORMATION CONTACT: Gregory M. Katz (*katz.gregory@ pbgc.gov*), Attorney, Regulatory Affairs Division, Office of the General Counsel,

Pension Benefit Guaranty Corporation,
445 12th Street SW, Washington, DC 20024–2101; 202–229–3829. If you are deaf or hard of hearing, or have a speech disability, please dial 7–1–1 to access telecommunications relay services.

SUPPLEMENTARY INFORMATION:

Executive Summary

Purpose and Authority

This proposed rule would update the actuarial assumptions used to determine the present value of a single-employer plan's benefits when it terminates in a distress or involuntary termination, to determine the present value of multiemployer plan benefits in certain withdrawal liability calculations, and for other purposes.

Legal authority for this action comes from section 4002(b)(3) of the Employee Retirement Income Security Act of 1974 (ERISA), which authorizes the Pension Benefit Guaranty Corporation (PBGC) to issue regulations to carry out the purposes of title IV of ERISA; section 4044 of ERISA (Allocation of Assets); section 4010 of ERISA (Authority to Require Certain Information); section

4022 of ERISA (Single-Employer Plan
Benefits Guaranteed); section 4041 of
ERISA (Termination of Single-Employer
Plans); section 4041A of ERISA (Termination of Multiemployer Plans); section 4043 of ERISA (Reportable Events); section 4062 of ERISA (Liability for Termination of Single-Employer Plans Under a Distress Termination or a

Termination by Corporation); section 4050 of ERISA (Missing Participants); section 4219 of ERISA (Notice, Collection, Etc., of Withdrawal

Liability); section 4262 of ERISA
(Special Financial Assistance by the
Corporation); and section 4281 of ERISA (Benefits Under Certain Terminated Plans).

Major Provisions

This proposed rule would modify the interest, mortality, and expense assumptions for valuing benefits under subpart B to PBGC's regulation on Allocation of Assets in Single-Employer Plans (''benefits valuation regulation'')

(29 CFR part 4044) to:

- Modernize the interest assumption structure by adopting a yield curve approach;
- Enable the use of market interest rates as of the date of liability measurement (*i.e.,* the valuation date) as the basis for the interest assumption; • Increase transparency by using a procedure based on publicly available yield curves as of the valuation date;
- Adopt a more recent mortality table along with a generational mortality improvement projection; and
- Simplify the expense assumption.

Because the assumptions for valuing benefits are incorporated by reference in other regulations, the changes to these assumptions would affect PBGC's regulations on Notice, Collection, and Redetermination of Withdrawal

Liability (29 CFR part 4219); Special Financial Assistance by PBGC (29 CFR part 4262); Duties of Plan Sponsor Following Mass Withdrawal (29 CFR part 4281); Annual Financial and Actuarial Information Reporting (29

CFR part 4010); Missing Participants (29 CFR part 4050); and other regulations.

Background

The Pension Benefit Guaranty
Corporation (PBGC) administers two

Proposed Rules

DEPARTMENT OF TRANSPORTATION

Federal Aviation Administration

14 CFR Parts 401, 413, 415, 431, 435, 437, 440, 450, and 460

[Docket No.: FAA–2023–1656; Notice No. 23–11]

RIN 2120–AL19

U.S. Commercial Space Launch Competitiveness Act Incorporation

AGENCY: Federal Aviation Administration (FAA), Department of Transportation (DOT).

ACTION: Notice of proposed rulemaking (NPRM).

SUMMARY: This proposed rule would incorporate various changes required by the United States Commercial Space Launch Competitiveness Act of November 2015. This proposed rule would provide regulatory clarity to applicants seeking licenses for space flight operations involving government astronauts by adding two new subparts to the human space flight regulations containing requirements for operators with government astronauts with and without safety-critical roles on board vehicles. The proposed rule would also require an operator to demonstrate any government astronauts on board can perform their role in safety-critical tasks. This proposed requirement would maintain public safety by ensuring operators provide mission specific training on safety-critical tasks to government astronauts, as has been done in the NASA Commercial Crew Program. The proposed rule would also update definitions relating to commercial space launch and reentry vehicles and occupants to reflect current legislative definitions, expand applicability of permitted operations for reusable suborbital rockets to include reusable launch vehicles that will be launched into a suborbital trajectory or reentered from a suborbital trajectory, as well as implement clarifications to financial responsibility requirements in accordance with the United States Commercial Space Launch Competitiveness Act. Finally, this proposed rule would move the templates for waiver of claims to an advisory circular. **DATES:** Comments are due on or before October 17, 2023. **ADDRESSES:** Send comments identified by docket number FAA–2023–1656 using any of the following methods:

- *Federal eRulemaking Portal:* Go to *www.regulations.gov* and follow the online instructions for sending your comments electronically.
- *Mail:* Send comments to Docket Operations, M–30; U.S. Department of Transportation (DOT), 1200 New Jersey Avenue SE, Room W12–140, West Building Ground Floor, Washington, DC 20590–0001.
- *Hand Delivery or Courier:* Take comments to Docket Operations in Room W12–140 of the West Building Ground Floor at 1200 New Jersey Avenue SE, Washington, DC, between 9 a.m. and 5 p.m., Monday through Friday, except Federal holidays.
- *Fax:* Fax comments to Docket Operations at (202) 493–2251.

Privacy: In accordance with 5 U.S.C. 553(c), DOT solicits comments from the public to better inform its rulemaking process. DOT posts these comments, without edits, including any personal information the commenter provides, to *www.regulations.gov,* as described in the system of records notice (DOT/ALL–14 FDMS), which can be reviewed at *www.dot.gov/privacy.*

Docket: Background documents or comments received may be read at *www.regulations.gov* at any time. Follow the online instructions for accessing the docket or go to the Docket Operations in Room W12–140 of the West Building Ground Floor at 1200

New Jersey Avenue SE, Washington, DC, between 9 a.m. and 5 p.m., Monday through Friday, except Federal holidays.

FOR FURTHER INFORMATION CONTACT: Charles Huet, Space Policy Division,

Space Regulations and Standards
Branch, ASZ–210, Federal Aviation
Administration, 800 Independence Avenue SW, Washington, DC 20591; telephone (202) 306–9069; email *charles.huet@faa.gov.*

SUPPLEMENTARY INFORMATION:

Federal Register

Vol. 88, No. 159

Friday, August 18, 2023

Authority for This Rulemaking

The Commercial Space Launch Act of 1984, as amended and codified at 51 U.S.C. 50901–50923 (the Act), authorizes the Secretary of Transportation to oversee, license, and regulate commercial launch and reentry activities, and the operation of launch and reentry sites within the United States (U.S.) or as carried out by U.S. citizens. Section 50905 directs the Secretary to exercise this responsibility consistent with public health and safety, safety of property, and the national security and foreign policy interests of the U.S. In addition, section 50903 directs the Secretary to encourage, facilitate, and promote private sector commercial space launches and reentries. As codified in 49 CFR 1.83(b), the Secretary has delegated authority to the FAA Administrator to carry out these functions.

I. Overview

This proposed rule would amend title 14 of the Code of Federal Regulations (14 CFR) parts 401, 413, 415, 431, 435, 437, 440, 450, and 460 by incorporating statutory changes resulting from the United States Commercial Space

Launch Competitiveness Act (CSLCA).[124] This rule proposes to add definitions for ''Government astronaut,'' ''International partner astronaut,'' and ''International Space Station Intergovernmental Agreement'' and would also revise other definitions required to address the addition of ''Government

[124] Public Law 114–90, sections 103, 104, 107, and 112.

astronaut.'' This proposed rule would also: (1) expand applicability of permitted operations for suborbital rockets to suborbital launch and reentry vehicles (2) revise the human space flight sections of parts 415, 431, 435, 437, and 450 to include the term ''human being'' in order to incorporate government astronauts; (3) update the financial responsibility requirements in part 440 to exclude government astronauts from the definitions of ''Third party'' and ''Government personnel'' in part 440; (4) add space flight participants to the insurance requirements in §440.9, and the reciprocal waiver of claims requirements in §440.17; and (5) remove the templates for waiver of claims and assumption of responsibilities in appendices B through E of part 440 from the regulations and place them in a separate advisory circular (AC). Finally, this rule would create two new subparts in 14 CFR part 460 to include proposed requirements for operators and applicants whose licensed or permitted operations involve government astronauts with and without safety-critical roles on board a vehicle.

II. Background

A. National Aeronautics and Space Administration's Commercial Crew

Program

The National Aeronautics and Space Administration (NASA) Commercial Crew Program provides human transportation between the U.S. and the International Space Station (ISS) through the purchase of transportation services from American commercial launch providers. It has resulted in NASA astronauts flying on board licensed commercial vehicles to or from the ISS since 2020. A new generation of spacecraft and launch systems capable of carrying government astronauts to low-Earth orbit and the ISS provides expanded utility, additional research time, and broader opportunities for discovery on the ISS. The Commercial Crew Program represents a revolutionary approach to government and commercial collaborations for the advancement of space exploration.

NASA—including Johnson Space Center and Kennedy Space Center—and the FAA have previously discussed the statutory and regulatory definitions that apply to NASA astronauts riding on board Commercial Crew Program- provided spacecraft and the associated roles and responsibilities of both agencies. These discussions led NASA and the FAA to establish the NASA– FAA Joint Legal Working Group in January 2012. This working group eventually contributed to a series of recommendations NASA provided to Congress in proposed legislation. As detailed below, title 51 did not effectively accommodate NASA astronauts flying on commercially owned and operated spacecraft. NASA and the FAA jointly determined that the legal definitions for crew and space flight participants were insufficient to accommodate the role of government astronauts on board Commercial Crew missions. The agencies agreed that a change to legislation would be needed to support the success of its Commercial Crew Program and to support commercial human space flight endeavors in general.[125][126]

B. Issues With Categorizing NASA Astronauts as ''Space Flight

Participants'' or ''Crew''

Before the passage of the CSLCA in 2015, title 51—and by extension FAA regulations codifying the statutes—only contemplated two categories of persons carried on board FAA-licensed launch and reentry vehicles: ''crew'' and ''space flight participants.'' These designations were problematic for

[125] *Interpretation Concerning Involvement of NASA Astronauts During a Licensed Launch or Reentry.* 78 FR 72011 (2013).
[126] U.S.C. 50902 (2014).

NASA astronauts for several reasons. ''Crew'' was defined as any employee of a licensee or transferee, or of a contractor or subcontractor of a licensee or transferee, who performs activities in the course of that employment directly relating to the launch, reentry, or other operation of or in a launch vehicle or reentry vehicle that carries human beings.[3] A ''space flight participant'' was defined as an individual, who is not crew, carried within a launch vehicle or reentry vehicle.[127][128] FAA regulations mirror these two definitions.[5] One of the NASA– FAA Joint Legal Working Group's concerns in 2012 was that the professionally trained and experienced NASA astronauts could not be appropriately categorized either as ''space flight participants'' or ''crew'' as then defined in title 51.

Before passage of the CSLCA, government astronauts were categorized as space flight participants because they were not employees of the licensee or transferee or of a contractor or subcontractor of a licensee or transferee. The FAA could not categorize government astronauts as crew for the same reason. This categorization, however, presented multiple issues.

First, 51 U.S.C. 50914(b) requires space flight participants to sign waivers of claims against the U.S. Government for personal injury, death, or property damage when participating in FAA- licensed launches and reentries. On the other hand, in Legal Interpretation to Courtney B. Graham (December 23, 2013), the FAA explained that NASA astronauts may not sign reciprocal waivers of claims because doing so would conflict with various federal statutes, including the Federal Employees Compensation Act and the

Military Personnel and Civilian
Employees Claims Act.[6]

Second, NASA expressed concerns regarding the requirement in 51 U.S.C. 50905(b)(5) for operators to inform space flight participants of the risks of licensed activity and obtain written informed consent from space flight participants. However, unlike space flight participants, government astronauts are already familiar with the particular risks involved in space flight and should not need to provide informed consent. Nevertheless, because the informed consent requirements for space flight participants did not conflict with federal statutes, unlike reciprocal waivers of claims, the government astronauts would have been required to comply with the requirements. Accordingly, the FAA issued a legal interpretation stating that NASA and international partner astronauts are space flight participants and therefore must provide informed consent in accordance with the statute and 14 CFR 460.45;[129] however, it was deemed not necessary when flying as a government astronaut.

Finally, NASA sought clarification on whether a government astronaut, as a space flight participant, could perform operational functions during a commercial space launch or reentry under license from the FAA.[130] In 2013, the FAA issued a legal interpretation stating that, while the applicable statute and

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127 *Id.*

128 CFR 401.5 and 401.7.

129 Legal Interpretation to Courtney B. Graham (July 9, 2014) (requesting a legal interpretation on whether the holder of a license or permit under 51 U.S.C. Ch. 509 must obtain written informed consent from a space flight participant who is a NASA astronaut and a U.S. Government employee, either as a civil servant or a member of the U.S. armed forces; and whether a licensee or permittee must obtain informed consent from a space flight participant who is an astronaut employed by one of NASA's international partners).

130 Whereas the definition of crew in title 51 expressly acknowledges a crew member's ability to perform activities directly relating to operation of the vehicle, the definition of space flight participant contains no express authority to do so. *See* Legal Interpretation to

regulations did not limit a space flight participant's conduct or operations during launch or reentry, the FAA was concerned with space flight participants interacting with a launch or reentry vehicle based on the possibility that space flight participants would not have the proper vehicle and mission- specific training.[131] The interpretation noted, however, that NASA astronauts must meet rigorous medical and training requirements, which include training specific to each mission, launch vehicle, and reentry vehicle.[132][133]

C. United States Commercial Space

Launch Competitiveness Act

NASA and the FAA submitted a joint legislative request to Congress in 2013 to address the discussed above. In response, Congress passed the CSLCA in 2015 and included a definition of a new category of person on board an FAA- licensed launch or reentry vehicle: government astronaut. Under 51 U.S.C. 50902, government astronaut is defined as an individual who is designated by the National Aeronautics and Space Administration Administrator under section 51 U.S.C. 20113(n), is carried within a launch vehicle or reentry vehicle in the course of his or her employment, which may include performance of activities directly relating to the launch, reentry, or other operation of the launch vehicle or reentry vehicle, and is either an employee of the United States Government, including the uniformed services, engaged in the performance of a Federal function under authority of law or an Executive act, or an international partner astronaut. Per 51 U.S.C. 20113(n), for purposes of a license issued or transferred by the Secretary of Transportation under chapter 509 to launch a launch vehicle or to reenter a reentry vehicle carrying a government astronaut (as defined in section 50902), NASA designates a government astronaut in accordance with requirements prescribed by NASA.[11] The FAA accepts any NASA designation of government astronaut.

In addition to adding a new definition of government astronaut, the CSLCA added launch and reentry vehicles on a suborbital trajectory to permitted operations in 51 U.S.C. 50902.[134] The CSLCA also added space flight participants to the insurance requirements and reciprocal waiver of claims requirements in 51 U.S.C. 50914 and the paying claims exceeding liability insurance and financial responsibility requirements in 51 U.S.C. 50915.

III. Discussion of the Proposed Rule

A. Summary

In this rulemaking, the FAA proposes to add the statutory definition of ''government astronaut'' to its regulations to conform to the CSLCA. In addition to incorporating the title 51 definition of ''government astronaut,'' this rulemaking would also create two new subparts to part 460 to address the varying responsibilities government astronauts might have during a launch or reentry. One subpart would address requirements for government astronauts whose actions have the ability to impact public safety because they perform a safety-critical role, and one subpart would address requirements for

Courtney B. Graham (Dec. 23, 2013) in which the FAA answers NASA questions regarding whether the space transportation regulations would restrict NASA astronauts from performing operational functions during a commercial space launch or reentry under license from the FAA.

131 Legal Interpretation to Courtney B. Graham (Dec. 2, 2013) (78 FR 72011).

132 *Id.*

133 U.S.C. 20113(n).

134 Prior to the CSLCA, only reusable suborbital rockets qualified for a permit.

government astronauts that do not play a safety-critical role during licensed or permitted activity. The proposed rule is not intended to conflict with NASA vehicle certification and safety processes.

Other changes proposed by this rulemaking would align various related definitions and regulations with the addition of ''government astronaut,'' such as replacing the terms ''crew'' and ''space flight participant'' with the term ''human being'' in order to encompass all three categories of persons carried on board a vehicle. The proposed addition of the ''government astronaut'' category would further require revisions to part 440 to exclude ''government astronauts'' from the definitions of ''Third party'' and ''Government personnel.'' Furthermore, this rulemaking proposes additional changes to the financial responsibility requirements in part 440 as required by the CSLCA. More specifically, this rulemaking would add space flight participants to the insurance requirements in §440.9 and the reciprocal waiver of claims requirements in §440.17. This rulemaking would remove the templates for waiver of claims and assumption of responsibilities in appendices B through E of part 440 from the regulations, which the Agency proposes to relocate in a separate AC.

B. Changes to Part 460—Human Space

Flight Requirements

Current part 460 contains requirements for launches involving human space flight. Subpart A of part 460 contains requirements for launches and reentries with crew on board, including requirements for crew training, informing crew about risk, and waiver of claims against the U.S. Government. Subpart B of part 460 contains requirements for launches and reentries with human space flight participants on board, including requirements for informed consent, training space flight participants for an emergency scenario, security, and waiver of claims against the U.S.

Government.

In this NPRM, the FAA proposes to add subparts C and D to part 460 to create requirements for operators conducting licensed or permitted

operations carrying government astronauts. Proposed subpart C of part 460 would contain operator requirements for licensed or permitted operations with government astronauts who perform a safety-critical role during launch or reentry. Consistent with the definition of ''safety critical'' in §§401.5 and 401.7, a role is safety-critical if it is essential to safe performance or operation.[135] As the FAA regulates for public safety, a government astronaut performs a safety-critical role because of their ability to control in real time, a launch or reentry vehicle's flight path during a phase of flight capable of endangering the public. Proposed subpart D of part 460 would contain operator requirements for licensed or permitted operations with government astronauts who do not perform a safety- critical role during launch or reentry.

1. Proposed Subpart C—Government
Astronauts With Safety-Critical Roles

[135] ''Safety critical'' for purposes of part 460
''means essential to safe performance or operation. A safety-critical system, subsystem, component, condition, event, operation, process, or item is one whose proper recognition, control, performance, or tolerance is essential to ensuring public safety. Something that is a safety-critical item creates a safety hazard or provides protection from a safety hazard.'' 14 CFR 401.5.

To protect public safety, the FAA is proposing to require operators to provide training and establish environmental controls for operations involving government astronauts with a safety-critical role. As with crew, the FAA finds that government astronauts likewise would need to be protected from atmospheric conditions and receive training that is necessary for the safety of members of the public, including those on the ground, in the air, and in space.[136] Previously, the FAA has determined that in a piloted vehicle, the vehicle's flight crew is an integral part of its flight safety system. This determination is based on the fact that they are in a position to respond to risk to the public, such as aborting the flight or maneuvering a vehicle away from populated areas.[137] Similarly, government astronauts may be in a position to respond to risk to the public; therefore, the FAA is proposing a number of training requirements, not intended to duplicate, conflict with, or replace NASA's training requirements for government astronauts, if they are identified by the operator as having safety critical roles. Training provides government astronauts the knowledge and skill necessary to perform safety- critical tasks. Government astronauts with a safety-critical role would be required to be trained to successfully carry out their role on the vehicle.

The FAA proposes in §460.57 to specify the groups to which subpart C would apply. Section 460.57(a) and (b) would state that subpart C would apply to an applicant for a license or permit and a licensed or permitted operator who intends to have a government astronaut with a safety-critical role on board a vehicle. In order to determine which government astronauts would need additional vehicle-specific training to meet the proposed requirements of subpart C, the operator would identify during the licensing process safety- critical tasks that require qualified personnel and whether a government astronaut would be performing any of those tasks.[138] The operator would then be responsible for ensuring that those government astronauts identified as performing safety-critical tasks receive additional vehicle-specific training in accordance with proposed subpart C.

The FAA proposes in §460.59(a)(1) to require an operator to train a government astronaut to carry out any safety-critical role on board so that the vehicle will not endanger the public. As stated above, the FAA is proposing this requirement because government astronauts with a safety-critical role can affect risk to the public. A government astronaut with a safety-critical role may have the ability to affect public safety, for example, through control of the trajectory of the vehicle, and must therefore be trained on how to carry out his or her mission-specific role on board the vehicle. Operators are in the best position to train government astronauts on particular aspects of the vehicle and mission that can affect public safety because they are most familiar with the vehicle and its operation. This training has been current practice on all Commercial Crew Program flights to date because NASA has required it from the operator through contract. The FAA proposes the following training requirements for those matters that affect public safety under its authority to issue regulations to license commercial space launch and reentry consistent with public safety.[139][140]

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[136] As further discussed, the FAA proposes adding §460.61 to require operators to provide an environment adequate to sustain life and consciousness for all inhabited areas within a vehicle that house a government astronaut with a safety-critical role.

[137] Human Space Flight Requirements for Crew and Space Flight Participants, NPRM, 70 FR 77262, 77265 (Dec. 29, 2005).

[138] In accordance with §450.149, an applicant must identify safety-critical tasks that require qualified personnel, ensure that those personnel are trained, qualified, and capable of performing their safety-critical tasks, and provide internal training and currency requirements, or any other means for demonstrating compliance. Similar requirements can also be found in §§417.105, 417.311, and 415.113.

[139] The FAA notes that, while operators and NASA may establish mission-specific training of government astronauts through contract, the FAA has broader responsibility to issue regulations to protect public health and safety during licensed activity.

[140] CFR 460.5(b). [19]14 CFR 460.5(e).

The FAA proposes to require an operator to provide government astronauts who perform safety-critical roles a training program similar to the training program required for crew. Because crew and government astronauts with a safety-critical role could be responsible for accomplishing the same tasks on board a vehicle, this rule would require the operator to provide them with similar training on the unique aspects of each vehicle and mission so they can successfully perform their roles on board.

While the requirements this rule proposes for government astronauts are similar to crew requirements, they are not identical. Current crew qualification and training requirements include a demonstration of the ability to withstand the stresses of space in sufficient condition to safely carry out his or her duties so that the vehicle will not harm the public.[18] Each crew member with a safety-critical role is also required to possess and carry an FAA second-class medical certificate.[19] The proposed rule would not require government astronauts with a safety- critical role to demonstrate an ability to withstand the stresses of space or to possess and carry an FAA medical certificate because the underlying concerns addressed by these crew requirements are satisfied by the NASA designation process for government astronauts.[141][142]

The FAA proposes in §460.59(a)(2) to require an operator to train government astronauts (either directly or through another entity) with a safety-critical role on their roles in nominal and non- nominal conditions related to the launch or reentry vehicle, including abort scenarios and emergency operations, to the extent that performance of their role could endanger public safety. This vehicle-specific training has been current practice on all Commercial Crew Program flights to date, by contract between NASA and the operator. This requirement would be the same as the current crew training requirements in subpart A of part 460.[21] In order to meet the proposed training requirement, the operator would be responsible for conducting a safety analysis in accordance with §450.149 to identify which government astronaut tasks could endanger public safety.[143] As previously mentioned, this analysis is necessary because government astronauts may be in a position to affect risk to the public and should be aware of and receive training on the tasks specific to their mission which could impact public safety. The operator would then need to ensure that the government astronaut is trained to successfully conduct those tasks. For missions where crew and government astronauts are on board, an operator may need to train government astronauts with crew as a team if safety- critical tasks require that government astronauts and crew work together. If a government astronaut does not have a role in

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[141] For crew members to demonstrate a basic level of health within 12 months of launch or reentry, the FAA requires that each crew member with a safety- critical role must possess and carry an FAA second- class airman medical certificate. Human Space Flight Requirements for Crew and Space Flight Participants, Final Rule, 71 FR 75616, 75620 (Dec. 15, 2006). The FAA finds that such a requirement would be unnecessary for government astronauts because to achieve a government astronaut designation, NASA has verified a basic level of health during its training process. Additionally, any government astronaut designated by NASA has been trained by NASA to withstand the stresses of space flight while performing their duties. For example, Commercial Crew Transportation contractual requirements CCT–PLN–1120 section 6.3.1, and CCT–STD–1150 section 5.0 (Operations Training) ensure government astronauts can withstand the stresses of space flight while performing safety-critical tasks. See *https://ntrs.nasa.gov/api/citations/20150010760/ downloads/20150010760.pdf, https://ntrs.nasa.gov/api/citations/20150010761/downloads/ 20150010761.pdf.*

[142] CFR 460.5(a)(2).

[143] Section 450.149 requires an operator to ensure that its safety-critical personnel are trained, qualified, and capable of performing their safety- critical tasks, and that their training is current. The FAA would consider any task that may have an effect on public safety and meets the definition of safety-critical found in §401.5 subject to the requirements of §450.149. These tasks would include, but are not limited to, operating and installing flight safety system hardware, operating safety support systems, monitoring vehicle performance, performing flight safety analysis, conducting launch operations, controlling public access, surveillance, and emergency response. With the many different kinds of operations currently underway, an operator is in the best position to identify the operations, personnel, and training needed for its operation. See Streamlined Launch and Reentry Licensing Requirements, NPRM, 84 FR 15332 (Apr. 15, 2019).

nominal or non-nominal conditions to the extent that performance of their role could endanger public safety, then no additional training would be required.

The FAA proposes in §460.59(b)(1) that an operator would ensure any government astronaut who has the ability to control, in real time, a launch or reentry vehicle's flight path during a phase of flight capable of endangering the public, receives vehicle specific training for each phase of flight capable of endangering the public and over which the government astronaut has the ability to control the vehicle. Although government astronauts may have been trained on other vehicles, each vehicle has specific safety features that should be familiar to the person operating it. Under proposed §460.59(b)(1), the training could be achieved by a method or device that simulates the flight, by an aircraft whose characteristics are similar to the vehicle or has similar phases of flight to the vehicle, by flight testing, or by an equivalent method of training approved by the FAA. The first three methods would ensure the government astronaut has familiarity with the vehicle and its operation by requiring means that are sufficiently similar to actual operations. The final method would provide flexibility and allow an operator to demonstrate that an alternative method would achieve the training objective. This familiarity would ensure the government astronaut is capable of operating the vehicle safely. This proposed requirement is the same as the requirement for crew in §460.5(b)(3).

Proposed §460.59(b)(2) would require an operator to train a government astronaut who can control the vehicle for each mode of control or propulsion, including any transition between modes, such that the government astronaut is able to control the vehicle in all phases of flight, including transitions between phases, that can endanger the public. This proposed requirement is the same as the requirement for crew in §460.5(c)(5).[144]

The training device fidelity requirement that the FAA proposes in §460.59(c) would ensure that any government astronaut training device used to meet the training requirements realistically represents the vehicle's configuration and mission or the operator informs the government astronaut being trained of the differences between the training device and the vehicle's configuration and mission. This proposed requirement would be the same as the requirement in §460.7(b) for crew.[145]

Because they have the ability to control a vehicle's flight path in real time, crew who are pilots[146] or remote operators[147] are also required to satisfy a number of additional requirements including requirements to possess and carry an FAA pilot certificate with an instrument rating and possess aeronautical knowledge, experience, and skills necessary to pilot and control the launch or reentry vehicle that will operate in the National Airspace System (NAS).[148] For those government astronauts who have the ability to control the vehicle's flight path, the FAA proposes in §460.59(b)(3) to require operators to ensure that such government astronauts possess aeronautical knowledge, experience, and

[144] A pilot would have to undergo training in procedures that direct the vehicle away from the public in the event the flight crew had to abandon the vehicle during flight. The FAA emphasizes the importance of an operator training in each mode of control or propulsion, including any transition between modes, so that the pilot would be able to control the vehicle throughout the flight regime to protect the public. See Human Space Flight Requirements for Crew and Space Flight Participants, NPRM, 70 FR 77267 (Dec. 29, 2005).

[145] See Human Space Flight Requirements for Crew and Space Flight Participants, Final Rule, 71 FR 75621 (Dec. 15, 2006). Device fidelity speaks to the degree of realism achieved.

[146] Section 401.5 defines ''pilot'' as a flight crew member who has the ability to control, in real time, a launch or reentry vehicle's flight path.

[147] Section 401.5 defines ''remote operator'' as a crew member who (1) has the ability to control, in real time, a launch or reentry vehicle's flight path, and (2) is not on board the controlled vehicle.

[148] Section 460.5(d) permits a pilot or a remote operator to demonstrate an equivalent level of safety to FAA airman certification through the license or permit process.

skills necessary to pilot and control the launch or reentry vehicle in the NAS. Aeronautical experience may include hours in flight, ratings, and training.[149] The FAA notes that this requirement would ensure that government astronauts with the ability to control a launch or reentry vehicle's flight path have the knowledge, experience, and skills to operate the vehicle safely in the NAS, which could potentially impact the public.

The FAA proposes in §460.59(d) to require an operator to update government astronaut vehicle-specific training continually to ensure that the training would incorporate lessons learned from training and operational launches and reentries. An operator would be required to track each revision, document the completed training for each government astronaut, and maintain the documentation for each active government astronaut who performs a safety-critical role. This proposed requirement is vital for maintaining proficiency of any government astronaut performing safety- critical roles and would be the same as the requirement in §460.7(c) for crew. As with the crew requirement, this proposed requirement would incorporate events and anomalies into the training as they are experienced so that government astronauts are trained on how to respond going forward.

The FAA proposes in §460.59(e) that an operator would be required to establish a recurrent training schedule and ensure that all training of government astronauts performing safety-critical roles is current before launch or reentry. This proposed requirement is vital for maintaining currency of any government astronaut performing safety-critical roles and would be the same as the requirement in §460.7(d) for crew.[150] The FAA notes that, for such performance-based requirements, the operator must carry out the method of compliance chosen in its application because the method an operator describes in its application has the same legal effect as a prescriptive requirement.[151]

In addition to the proposed training requirements, the FAA proposes in §460.61 that an operator would be required to provide an environment that sustains life and prevents incapacitation for government astronauts because a failure to control the environment, even for a short duration, could lead to a loss of life or serious injury to members of the public. The proper functioning of government astronauts in safety critical roles is necessary for protection of the public. Therefore, it would be vital that the launch or reentry operator maintains an environment that supports life and consciousness. The environmental requirements proposed in §460.61 would be the same as the requirements for crew in §460.11.

The FAA proposes to add a reference to proposed §§460.59 and 450.61 to the application requirements for safety review and approval in §450.45(e). As such, the FAA acknowledges that government astronaut training is part of the broader review to determine that licensed activity would not jeopardize

[149] The FAA explained that pilots and remote operators should hold a pilot certificate with an instrument rating because a pilot or remote operator should be educated in the rules of operating in the NAS and should demonstrate an appropriate level of instrument skills and competency to pilot various launch and reentry vehicles. Human Space Flight Requirements for Crew and Space Flight Participants, NPRM, 70 FR 77262, 77265 (Dec. 29, 2005). The proposed training requirements for government astronauts with a safety-critical role are tailored to ensure that an operator trains a government astronaut to successfully carry out his or her role. These proposed requirements include possessing the knowledge, experience, and skills necessary to pilot the vehicle in the NAS. The FAA is not proposing to require government astronauts to hold pilot certificates with an instrument rating because NASA astronaut requirements currently include at least two years of related professional experience obtained after degree completion or at least 1,000 hours pilot-in-command time on jet aircraft. *Astronaut Requirements;* March 4, 2020; *www.nasa.gov/audience/forstudents/postsecondary/features/F_Astronaut_ Requirements.html* (last viewed 3/6/2023). These requirements effectively meet the equivalent level of safety provision crew are allowed to leverage in place of holding a pilot certificate under §460.5(d).

[150] See Human Space Flight Requirements for Crew and Space Flight Participants, Final Rule, 71 FR 75621 (Dec. 15, 2006).

[151] See 14 CFR 450.5(b), 417.11(a), 431.9(b), and 437.83.

public safety. To that end, the FAA would evaluate and determine whether the license applicant's training and environmental control and life support systems for government astronauts with safety-critical roles are sufficient to protect public safety.[31]

The FAA expects that a safety review of the training requirements under proposed §460.59 would include an evaluation of the operator training program for government astronauts to verify that all personnel with safety- critical roles are adequately trained and fully capable of performing their mission specific safety critical duties. Furthermore, under §450.149, an operator is already required to ensure safety-critical personnel are trained, qualified, and capable of performing their safety-critical tasks, and that their training is current. Additionally, §450.149 requires an applicant to provide internal training and currency requirements, completion standards, or any other means of demonstrating compliance with the regulation and to describe the process for tracking currency.

2. Proposed Subpart D—Government

Astronauts Without Safety-Critical Roles Proposed §460.65 would specify the groups to which subpart D would apply. Section 460.65 (a) and (b) would state that subpart D would apply to both an applicant for a license or permit and a licensed or permitted operator who proposes to have a government astronaut without a safety-critical role on board a vehicle.

[31] If an operator met the contractual requirements in CCT–PLN–1120 and CCT–REQ–1130, or similar requirements for other NASA programs they would satisfy this proposed requirement. Therefore, the FAA would consider CCT–PLN–1120 and CCT– REQ–1130, and similar requirements applicable to other NASA programs, a means of compliance with this proposed requirement. CCT–PLN–1120 is the Joint Program Management Plan (PMP) between the National Aeronautics and Space Administration (NASA) Commercial Crew Program (CCP) and the Federal Aviation Administration (FAA) Office of Commercial Space Transportation (AST) and describes the partnership of these respective agencies for licensing the CCP missions for launch and reentry operations. The ISS Crew Transportation and Services Requirements Document (CCT–REQ–1130) contains all technical, safety, and crew health medical requirements that are mandatory for achieving a Crew Transportation System Certification that will allow for International Space Station delivery and return of NASA crew and limited cargo. The FAA defers to NASA as the expert on training government astronauts to perform their duties. Therefore, an operator should not be placing requirements on NASA. Rather, an operator would demonstrate adequate training for government astronauts by leveraging the training NASA requires through its contracts with commercial providers.

Proposed §460.67 would require that an operator train each government astronaut without a safety-critical role on how to respond to emergency situations, including smoke, fire, loss of cabin pressure, and emergency exits. This would be the only proposed requirement for government astronauts without a safety-critical role, and it would be the same requirement currently levied on space flight participants in §460.51. As with space flight participants, the FAA would require this training for government astronauts without a safety-critical role because, if a government astronaut did not receive this training, he or she might interfere with the ability of the crew and government astronauts with safety-critical roles to perform duties necessary to protect public safety.

The FAA considered requiring operators to impose security requirements on government astronauts that do not have a safety-critical role, similar to those in current §460.53. However, the FAA determined that such a requirement would be unnecessary because government astronauts and international partner astronauts undergo extensive screening and training.[32] Furthermore, the FAA expects that NASA's designation of government astronaut would include similar security requirements because NASA is responsible for the safety of the government astronauts and mission assurance.[33] Other requirements contained in subpart B of part 460, such as informed consent and waiver of claims, do not apply to government astronauts, as previously explained.

C. Changes to Part 401—Definitions

The FAA proposes to define the term

''government astronaut'' to align §§401.5 and 401.7 (Definitions) with the CSLCA's addition of the term ''government astronaut'' to 51 U.S.C. 50902. By defining the term in part 401, the definition will inform the use of the term throughout the FAA's commercial

[32]To ensure mission success, NASA identifies the best qualified candidates who then undergo additional reviews through tests and two rounds of interviews, in addition to two years of basic astronaut training including robotics training, flight training, and extravehicular activities. NASA's Management of Its Astronaut Corps, Report No. IG– 22–007 (Jan. 11, 2022).

[33]NASA is responsible for managing overall mission success by ensuring certification and astronaut safety requirements are being met. The FAA serves to protect the public health and safety, safety of property, and the national security and foreign policy interests of the U.S. during commercial launch and reentry activities. National Aeronautics and Space Administration and Federal Aviation Administration Joint Program Management Plan for the Commercial Crew Program, CCT–PLN–1020, section 3.0 Roles and Responsibilities (April 1, 2016).

space regulations, including part 460. The same definition of ''Government astronaut'' would be added to both sections because definitions in §401.5 apply to parts 415, 417, 431, 435, 440, and 460, and definitions in §401.7 apply to parts 440, 450, and 460.

Furthermore, the FAA proposes to revise the definition of ''Space flight participant'' in §§401.5 and 401.7 to align with the statutory definition by expressly excluding government astronauts from the category of space flight participant. As revised, ''space flight participant'' would be defined as ''an individual, who is not crew or a government astronaut, carried within a launch vehicle or reentry vehicle.''

The FAA also proposes to amend §401.5 by revising the definitions of ''Human space flight incident,'' ''Launch,'' ''Launch accident,'' ''Reenter,'' and ''Reentry accident'' by adding ''government astronaut'' to these definitions. A similar change is not being made in §401.7 because the terms ''Human space flight incident,'' ''Launch accident,'' and ''Reentry accident,'' are not defined in §401.7. Instead, these concepts are included in the §401.7 ''Mishap'' definition, and this definition already includes the term ''government astronauts.''

The FAA also proposes to add definitions for ''International partner astronaut'' and ''International Space Station Intergovernmental Agreement'' to §§401.5 and 401.7. The CSLCA added the terms ''International partner astronaut'' and ''International Space Station Intergovernmental Agreement'' to 51 U.S.C. 50902 and specifies that the NASA Administrator designates government astronauts, and that designation may include international partner astronauts. The CSLCA also allows the NASA Administrator to designate a foreign person as a government astronaut. The FAA proposes to define an ''International partner astronaut'' as an individual designated under Article 11 of the International Space Station Intergovernmental Agreement, by a partner to that agreement other than the U.S., as qualified to serve as an ISS crew member. This definition is taken directly from the CSLCA. Although the FAA does not otherwise use these terms in the commercial space regulations, the terms are used in the definition of government astronaut which is being added to §§401.5 and 401.7. The FAA is proposing to add them to §§401.5 and 401.7 to provide clarity to the definition of government astronaut.

D. Changes to Parts 415, 431, 435, and [152]

437—License Application Procedures, Launch License, Launch and Reentry of a Reusable Launch Vehicle (RLV), and Reentry of a Reentry Vehicle Other Than an RLV

The FAA proposes to replace the terms ''crew'' and ''space flight participant'' with the term ''human being'' in §§415.8, 431.8, and 435.8 for applicants seeking a license for operations involving human space flight and that must demonstrate compliance with human space flight requirements. This change would accommodate the creation of the government astronaut category in part 460.

E. Changes to Parts 413 and 437— License Application Procedures and

Experimental Permits

Section 50906 of title 51 provides the Secretary of Transportation with the authority to issue experimental permits consistent with the protection of the public health and safety, safety of property, and national security and foreign policy interests of the United States. The Secretary of Transportation delegated this authority to the FAA, which promulgated 14 CFR part 437 (Experimental permits).[34] An experimental permit provides an alternative to licensing for certain vehicles and operations.[153] The CSLCA expanded the scope of the Secretary's authority to issue experimental permits from reusable suborbital rockets to also include reusable launch vehicles that will be launched into a suborbital trajectory or reentered under that permit.[154] This section discusses the changes made to 51 U.S.C. 50906 by the CLSCA as well as the associated proposed changes to part 437.

The FAA proposes to delete the definition of ''permitted vehicle'' in §437.3 because the term does not appear in part 437. Section 437.3 currently defines ''permitted vehicle'' as a reusable suborbital rocket operated by a launch or reentry operator under an experimental permit. The FAA proposes to add a definition of ''reusable suborbital vehicle'' in §437.3 that includes a reusable suborbital rocket or a reusable launch vehicle that is launched or reentered on a suborbital trajectory. As mentioned above, section 104 (Launch License Flexibility) of the CSLCA revised 51 U.S.C. 50906(d) to authorize the Secretary of Transportation to issue experimental permits for reusable launch vehicles that will be launched into a suborbital trajectory or reentered, in addition to suborbital rockets. The proposed definition of ''reusable suborbital vehicle'' in §437.3 reflects this change to 51 U.S.C. 50906(d). This proposed definition would expand the types of vehicles eligible for a permit, to include vehicles that are not rockets[155] but are launch vehicles that will be launched into a suborbital trajectory or reentered from a suborbital trajectory. This revision is necessary due to the development of technologies for suborbital launch vehicles that do not use rocket propulsion. Vehicles that do not use a rocket for propulsion are excluded from obtaining a permit under current regulations. The revision would allow an operator to research and develop new test designs, concepts, equipment, or operating techniques;

[152] FR 17019 (Apr. 6, 2007).

[153] Under 51 U.S.C. 50906(d), as revised by the CLSCA, the Secretary may issue an experimental permit solely for research and development to test design concepts, equipment, or operating techniques, showing compliance with requirements as part of the process for obtaining a license under Chapter 509, or crew training for a launch or reentry using the design of the rocket or vehicle for which the permit would be issued.

[154] Public Law 114–90, sec. 104.

[155] Suborbital rocket is defined as a vehicle, rocket-propelled in whole or in part, intended for flight on a suborbital trajectory, and the thrust of which is greater than its lift for the majority of the rocket-powered portion of its ascent. 51 U.S.C. 50902(24); 14 CFR 401.5 and 401.7.

show compliance with requirements as part of the process for obtaining a license; or train crews before they receive a license for launch or reentry on a larger group of launch vehicles.

Therefore, the FAA proposes to replace the term ''reusable suborbital rocket'' with ''reusable suborbital vehicle'' in §§437.3, 437.5, 437.7, 437.9, 437.21, 437.23, 437.25, 437.31, 437.33,

437.53, 437.59, 437.61, 437.71, 437.85,
437.91, and 437.95.
The proposed change to the definition of ''permitted vehicle'' would affect §413.3(f), which references part 437. Part 413 addresses the application requirements for a license or experimental permit. Therefore, the FAA also proposes to replace the term ''reusable suborbital rocket'' in §413.3(f) with the term ''reusable suborbital vehicle'' to align with the expanded scope.

Consistent with the changes to part 437, the FAA proposes to replace the term ''reusable suborbital rocket'' with ''reusable suborbital vehicle'' in §440.3. This proposed change would allow inclusion of launch and reentry vehicles on a suborbital trajectory.

The FAA proposes a change to §437.5(a) to be consistent with changes made to 51 U.S.C. 50906(d)(1) by the CSLCA. Section 437.5(a) currently states the FAA will issue an experimental permit to a person to launch or reenter a reusable suborbital rocket only for research and development to test new design concepts, new equipment, or new operating techniques. These eligibility requirements for an experimental permit reflect the eligibility criteria in 51 U.S.C.

50906(d)(1). The CSLCA removed each use of the word ''new'' in 51 U.S.C. 50906(d)(1). Therefore, the FAA is proposing to make the same change to §437.5(a). By removing the term ''new'' from §437.5(a), the regulation would allow research and development of existing design concepts, equipment, or operating techniques, consistent with the CSLCA.

The FAA proposes two changes to §437.21(b)(3) to accommodate changes necessitated by the CSLCA amendments. Current §437.21(b)(3) references the applicable requirements for an applicant proposing launch or reentry with flight crew or a space flight participant on board a reusable suborbital rocket. The FAA proposes to replace the terms ''flight crew'' and ''space flight participant'' in

§437.21(b)(3) with the term ''human being'' to include the addition of government astronauts discussed previously. Furthermore, as discussed earlier, the FAA proposes to revise the application requirements in §437.21(b)(3) to reference §§460.59, 460.61, and 460.67, which contain the proposed requirements in part 460 subparts C and D that would apply to launches and reentries with a government astronaut on board.

F. Changes to Part 440—Financial

Responsibility

The CSLCA necessitates conforming changes to part 440, which governs financial responsibility requirements for title 51 activity. This proposal would make conforming changes to the definition of ''government personnel'' and ''third party,'' add space flight participants to the list of parties protected as additional insureds under a licensee or permittee's liability insurance, require that licensees enter into a reciprocal waiver of claims with space flight participants, move the reciprocal waiver of claims templates from the appendices to an AC, and remove references to the appendices.

Prior to passage of the CSLCA, a licensee or transferee was required by 51 U.S.C. 50914(b) and 14 CFR 440.17 to make a reciprocal waiver of claims with its contractors, subcontractors, and customers, and contractors and subcontractors of the customers, involved in launch services or reentry services under which each party to the waiver agrees to be responsible for property damage or loss it sustains, or for personal injury to, death of, or property damage or loss sustained by its own employees resulting from an activity carried out under the applicable license. Additionally, a licensee or permittee was required to obtain and maintain in effect a policy of liability insurance (or otherwise make a demonstration of financial responsibility) that protected certain persons as additional insureds to the extent of their respective potential liabilities against covered claims by a third party for bodily injury or property damage resulting from a licensed or permitted activity.[38] These persons included (1) the licensee or permittee, its customer, and their respective contractors and subcontractors, and the employees of each, involved in a licensed or permitted activity; (2) the United States, its agencies, and its contractors and subcontractors involved in a licensed or permitted activity; and

(3) Government personnel.[39]

The CSLCA made several changes that affect the financial responsibility requirements under title 51. The CSLCA, in section 112(j), amended the definition of ''third party'' in 51 U.S.C. 50902(26) to exclude government astronauts. The CSLCA, in section 103(a)(1)(A), also requires a licensee or permittee to protect space flight participants as additional insureds under a licensee or permittee's liability insurance. This addition ceases to be effective September 30, 2025, in accordance with section 103(a)(1)(B) of the CSLCA. Finally, section 107 of the CSLCA amends 51 U.S.C. 50914(b)(1) such that it now requires a licensee or transferee to make a reciprocal waiver of claims with space flight participants involved in launch services or reentry services under which each party to the waiver agrees to be responsible for personal injury to, death of, or property damage or loss sustained by it or its own employees resulting from an activity carried out under the applicable license. This provision ceases to be effective September 30, 2025, in accordance with section 107 of the CSLCA.

The FAA is proposing to conform the regulatory definition of ''third party'' with the statute by adding government astronauts to the list of exceptions in the definition of ''third party.'' Current 14 CFR 440.3 does not exclude government astronauts from the definition of third party and states that government personnel as defined in §440.3 are third parties. The CSLCA states that government astronauts are not third parties. The FAA, therefore, proposes to exclude government astronauts from the definition of ''third party'' in §440.3 for the purposes of financial responsibility requirements. This proposal would also amend the definition of ''government personnel'' in §440.3 to exclude government astronauts. This change is necessary because §440.3 states that government personnel, as defined in that section, are third parties. While the proposal would exclude government astronauts from the definition of government personnel in §440.3, the FAA notes that this exclusion narrowly applies only to 14 CFR part 440. Furthermore, the defined term ''government personnel'' only appears in §440.9 for the purpose of identifying additional insureds. These changes would align the regulatory definitions in §440.3 with the CSLCA.

The FAA additionally proposes to add space flight participants to the list of parties protected as additional insureds under a licensee or permittee's liability insurance in §440.9(b)(4), as required by the CSLCA in section 103(a)(1)(A). As a result of this proposed change, and in accordance with the statutory

[38] 51 U.S.C. 50914(a)(4); 14 CFR 440.9(b). [39] *Id.*

requirement, a licensee or permittee would be required by regulation to obtain and maintain in effect a policy or policies of liability insurance to protect space flight participants as additional insureds to the extent of their respective potential liabilities against covered claims by a third party for bodily injury or property damage resulting from a licensed or permitted activity. In other words, if an injured third party brings claims against any party participating in the launch or reentry, the insurance policy would protect involved space flight participants. To comply with this proposed requirement, an operator would have to ensure that its insurance policy covers space flight participants, if it does not currently do so. In accordance with section 103(a)(1)(B) of the CSLCA, the proposed regulatory change would also cease to be effective September 30, 2025. If Congress chooses to extend the September 30, 2025 date, proposed §440.9(b)(4) would remain in effect in accordance with the extension. This proposal would also re-designate §440.17(f) to a new paragraph (g). Section 440.17(f) currently requires that any waiver, release, or other agreement to hold harmless and indemnify under the section does not apply to claims for bodily injury or property damage resulting from willful misconduct of any of the parties to the reciprocal waiver of claims. The FAA proposes to add new §440.17(f), which would require a licensee or permittee to enter into a

reciprocal waiver of claims agreement with each of its space flight participants in accordance with section 107 of the CSLCA. The waivers under the proposed §440.17(f) would solely be between a licensee or permittee and a single space flight participant. Proposed §440.17(f) would not require space flight participants to enter into waivers against one another. This proposed addition is necessary because, as discussed earlier, the CSLCA added space flight participants to the list of entities with whom an operator must execute a reciprocal waiver of claim, which would prevent potential additional litigation between space flight participants and operators.

In accordance with 51 U.S.C. 50914(b) and by omission from the CSLCA, space flight participants would not be required to enter into reciprocal waiver of claims agreements with customers. Furthermore, space flight participants are already required to enter into a reciprocal waiver of claims agreement with the U.S. Government in accordance with §440.17(d)(1). Proposed §440.17(f) would remain in effect until September 30, 2025, as required by the CSLCA. If

Congress chooses to extend the
September 30, 2025, date, proposed §440.17(f) would remain in effect in accordance with the extension.

While no change to regulatory text is needed, the FAA notes that under the CSLCA, government astronauts are not required to sign reciprocal waivers of claims because they are not considered space flight participants or crew, and because the FAA enters into these agreements on behalf of the government and its employees.[40]

The FAA also proposes to remove the reciprocal waiver of claims templates in appendices B through E and place them in AC 440.17–1. The FAA originally included the appendices to provide operators with templates that meet the requirements in part 440. An operator is not required to use the templates provided in the appendices and can use alternate templates provided the alternate templates demonstrate compliance with the regulations. Moving these templates to an AC would allow the FAA to effectuate any needed changes more efficiently and would not require the FAA to undergo an additional rulemaking to provide

[40] While 51 U.S.C. 50904(b) requires space flight participants to waive claims against the U.S. Government, Congress did not require government astronauts to do the same. In fact, the requirement for space flight participants to waive claims against the U.S. Government predates the retirement of the U.S. Space Shuttle and the subsequent development of NASA's Commercial Crew Program. Legal Interpretation to Courtney B. Graham (Dec. 23, 2013).

updated templates that meet the part 440 requirements. Because the templates are not regulatory and are only one means of satisfying the requirements in §440.17, an AC is a more appropriate location than the CFR for the templates. The public can provide comment on any of the templates in the AC or propose a new template for consideration by emailing the Advisory Circular Feedback Form. (OMB control number 2120–0746) located at the end of the AC to *ASTApplications@faa.gov.*

The FAA would also add two new templates to its proposed AC. One proposed template would be for a reciprocal waiver of claims between the licensee, space flight participant, and the licensee's contractors and subcontractors. The other proposed template would be for a waiver of claims between an operator and customers, government customers, the U.S., and each of their respective contractors and subcontractors. The FAA currently uses both templates. These templates were developed for situations where the existing templates in the appendices did not adequately address a proposed launch or reentry operation. The proposed AC containing these two new templates will be placed in the regulatory docket for this rule.

To conform to the proposed removal of the appendices, the FAA proposes to replace the references to Appendices B through E in §440.17(c), (d), and (e) with language specifying that the required reciprocal waiver of claims must be in a form acceptable to the FAA Administrator. This proposed language would provide flexibility with providing a reciprocal waiver of claims under each paragraph, provided any proposed reciprocal waiver of claims is in a form acceptable to the FAA Administrator and complies with all applicable regulations. Finally, the proposed AC would contain language stating that the templates provided in AC 440.17–1 are one means of compliance but not the only means of compliance with requirements in §440.45.

G. Changes to Part 450—Launch and

Reentry License Requirements

The FAA proposes to add §§460.59, 460.61, and 460.67 to the list of regulations in §450.45 with which applicants seeking a launch or reentry license for operations involving human space flight must demonstrate compliance. This change would accommodate the creation of the government astronaut category and ensure government astronaut requirements are addressed in the application. **IV. Regulatory Notices and Analyses**

A. Regulatory Impact Analysis

Federal agencies consider impacts of regulatory actions under a variety of executive orders and other requirements. First, Executive Order 12866 and Executive Order 13563, as amended by Executive Order 14094 (''Modernizing Regulatory Review''), direct each Federal agency to propose or adopt a regulation only upon a reasoned determination that the benefits of the intended regulation justify its costs. Second, the Regulatory Flexibility Act of 1980 (Pub. L. 96–354) requires agencies to analyze the economic impact of regulatory changes on small entities. Third, the Trade Agreements Act (Pub. L. 96–39) prohibits agencies from setting standards that create unnecessary obstacles to the foreign commerce of the United States. Fourth, the Unfunded Mandates Reform Act of 1995 (Pub. L. 104–4) requires agencies to prepare a written assessment of the costs, benefits, and other effects of proposed or final rules that include a Federal mandate that may result in the expenditure by state, local, and tribal governments, in the aggregate, or by the private sector, of $100,000,000 or more (adjusted annually for inflation) in any 1 year. The current threshold after adjustment for inflation is $177,000,000 using the most current (2022) Implicit Price Deflator for the Gross Domestic Product. This portion of the preamble summarizes the FAA's analysis of the economic impacts of this rule.

In conducting these analyses, the FAA has determined that this rule: would result in benefits that justify costs; is not an economically ''significant regulatory action'' as defined in section 3(f) of Executive Order 12866, as amended; would not have a significant economic impact on a substantial number of small entities; would not create unnecessary obstacles to the foreign commerce of the United States; and would not impose an unfunded mandate on State, local, or tribal governments, or on the private sector.

This proposed rule would amend 14

CFR parts 401, 413, 415, 431, 435, 437, 440, 450, and 460 by incorporating statutory changes resulting from the CSLCA. This proposed rule would add a definition for ''government astronaut'' and would update other definitions to account for that addition. This proposed rule would also update financial responsibility requirements in part 440 to include government astronauts, and would move the templates for reciprocal waiver of claims agreements from part 440 appendices B through E to an AC. This proposed rule would also add two new subparts to part 460 to address operator requirements for government astronauts with safety critical and non- safety-critical roles during launches and reentries. This proposed rule would also add two new subparts to part 460 to address operator requirements for government astronauts with safety- critical and non-safety-critical roles during launches and reentries. In addition, the FAA proposes to replace the terms ''crew'' and ''space flight participant'' with the term ''human being'' in §§415.8, 431.8, and 435.8 for applicants seeking a license for operations involving human space flight and that must demonstrate compliance with human space flight requirements. This proposed change would accommodate the creation of the government astronaut category in part 460.

This proposed rule would affect all U.S. commercial space operators and launches and reentries licensed under title 14 of the Code of Federal Regulations (14 CFR) parts 401, 413, 415, 431, 435, 437, 440, 450, and 460 that will carry a government astronaut on board. Table 1 details the proposed changes in each part.

TABLE 1—PROPOSED CHANGES BY SECTION

Section	Change	Effect of change
§401.5 Definitions	Add definitions for ''Government Astronaut,'' ''International partner astronaut,'' and ''International Space Station Intergovernmental Agreement.'' Revising definitions for ''Human space flight incident,'' ''Launch,'' ''Launch accident,'' ''Reenter,'' ''Reentry accident,'' and ''Space flight participant''.	None. The FAA has been applying these definitions in accordance with the statute since the CSLCA went into effect. This change would now provide regulatory clarity.

TABLE 1—PROPOSED CHANGES BY SECTION—Continued

Section	Change	Effect of change
§401.7 Definitions	Add definitions for ''Government Astronaut,'' ''International partner astronaut,'' and ''International Space Station Intergovernmental Agreement.'' Revising definition for ''Space flight participant''.	None. The FAA has been applying these definitions in accordance with the statute since the CSLCA went into effect. This change would now provide regulatory clarity.

§413.3(f)	Replace the term "suborbital rocket" with the term "permitted vehicle" to align with the increase in scope from proposed §437.3.	None. The FAA has been applying these definitions in accordance with the statute since the CSLCA went into effect. This change would now provide regulatory clarity.
§415.8 Human Space Flight in Part 415, LAUNCH LICENSE	Remove "crew" and "space flight participant" and add "human being" in their place, to include government astronaut, crew, and space flight participant categories. Add government astronaut requirements.	None. The FAA has been applying these definitions in accordance with the statute since the CSLCA went into effect. This change would now provide regulatory clarity.
§431.8 Human Space Flight in Part 431, LAUNCH AND REENTRY OF A REUSABLE LAUNCH VEHICLE (RLV).	Remove "crew" and "space flight participant" and add "human being" in their place, to include government astronaut, crew, and space flight participant categories. Add government astronaut requirements.	None. The FAA has been applying these definitions in accordance with the statute since the CSLCA went into effect. This change would now provide regulatory clarity.
§435.8 Human Space Flight in PART 435, REENTRY OF A REENTRY VEHICLE OTHER THAN A REUSABLE LAUNCH VEHICLE (RLV).	Remove "crew" and "space flight participant" and add "human being" in their place, to include government astronaut, crew, and space flight participant categories. Add government astronaut requirements.	None. The FAA has been applying these definitions in accordance with the statute since the CSLCA went into effect. This change would now provide regulatory clarity.
§437.3 Definitions in Part 437, EXPERIMENTAL PERMITS	Add a reusable launch vehicle that will be launched into a suborbital trajectory or reentered that is operated by a launch or reentry operator under an experimental permit to the definition of "permitted vehicle".	None. The FAA has been applying these definitions in accordance with the statute since the CSLCA went into effect. This change would now provide regulatory clarity.
§§437.5, 437.7, 437.9, 437.21, 437.23, 437.25, 437.31, 437.33, 437.53, 437.57, 437.59, 437.61, 437.71, 437.85, 437.91, and 437.95.	Replace "suborbital rocket" with "permitted vehicle".	None. The FAA has been applying these definitions in accordance with the statute since the CSLCA went into effect. This change would now provide regulatory clarity.
§437.5(a)	Remove "new" to allow research and development of existing design concepts, equipment, or operating techniques.	None. The FAA has been applying these definitions in accordance with the statute since the CSLCA went into effect. This change would now provide regulatory clarity.
§437.21 General	Remove "crew" and "space flight participant" and add "human being" in their place, to include government astronaut, crew, and space flight participant categories. Add government astronaut requirements.	None. The FAA has been applying these definitions in accordance with the statute since the CSLCA went into effect. This change would now provide regulatory clarity.
Move appendices B–E in PART 440, FINANCIAL RESPONSIBILITY, to an AC.		None.
§440.9(b)	Add space flight participants to the list in which a licensee or permittee must obtain and maintain in effect a policy or policies of liability insurance to protect their respective potential liabilities against covered claims by a third party for bodily injury or property damage resulting from a licensed or permitted activity.	None. The FAA has been applying these definitions in accordance with the statute since the CSLCA went into effect. This change would now provide regulatory clarity.
§440.9(f)	Add language to require the licensee or permitee to enter into a reciprocal waiver of claims agreement with each space flight participant.	None. The FAA has been applying these definitions in accordance with the statute since the CSLCA went into effect. This change would now provide regulatory clarity.
§450.45(e)(5)	Add requirements for government astronauts	None. The FAA has been applying these requirements in accordance with the statute since the CSLCA went into effect. This change would now provide regulatory clarity.
Add Subpart C, Launch and Reentry with a Government Astronaut with a Safety-Critical Role, after Subpart B in §460 Scope, HUMAN SPACE FLIGHT REQUIREMENTS.	Add requirements applicable to government astronauts with a safety-critical role.	None. Operators have been training government astronauts in order to satisfy NASA contractual requirements. This change would make some of that training required by regulation.
Add Subpart D, Launch and Reentry with a Government Astronaut Without a Safety-Critical Role after Subpart C in §460 Scope, HUMAN SPACE FLIGHT REQUIREMENTS.	Add requirements applicable to government astronauts without a safety-critical role.	None. Operators have been training government astronauts in order to satisfy NASA contractual requirements. This change would make some of that training required by regulation.

The proposed changes would have a minimal impact on licensed commercial space activity with government astronauts because the changes would align the regulations with the current statutory requirements for crew, for space flight participants, and with current practices. The FAA has been applying the statutory changes since they went into effect in 2015.

B. Regulatory Flexibility Act

The Regulatory Flexibility Act of 1980 (Pub. L. 96–354) (RFA) establishes ''as a principle of regulatory issuance that agencies shall endeavor, consistent with the objectives of the rule and of applicable statutes, to fit regulatory and informational requirements to the scale of the businesses, organizations, and governmental jurisdictions subject to regulation. To achieve this principle, agencies are required to solicit and consider flexible regulatory proposals and to explain the rationale for their actions to assure that such proposals are given serious consideration.'' The RFA covers a wide range of small entities, including small businesses, not-for- profit organizations, and small governmental jurisdictions.

Agencies must perform a review to determine whether a proposed or final rule would have a significant economic impact on a substantial number of small entities. If the determination is that it would, the agency must prepare a regulatory flexibility analysis as described in the RFA.

This proposed rule would update definitions relating to commercial space launch and reentry vehicles and occupants to reflect current statutory definitions and requirements, as well as implement clarifications to financial responsibility requirements in accordance with the CSLCA. Therefore, the FAA believes that this proposed rule would not have a significant economic impact on small commercial space operators because it is current practice.

If an agency determines that a rulemaking would not result in a significant economic impact on a substantial number of small entities, the head of the agency may so certify under section 605(b) of the RFA. Therefore, as provided in section 605(b), the head of the FAA certifies that this proposed rulemaking would not result in a significant economic impact on a substantial number of small entities.

C. International Trade Impact

Assessment

The Trade Agreements Act of 1979 (Pub. L. 96–39), as amended by the Uruguay Round Agreements Act (Pub.

L. 103–465), prohibits Federal agencies from establishing standards or engaging in related activities that create unnecessary obstacles to the foreign commerce of the United States. Pursuant to these Acts, the establishment of standards is not considered an unnecessary obstacle to the foreign commerce of the U.S., if the standard has a legitimate domestic objective, such as the protection of safety, and does not operate in a manner that excludes imports that meet this objective. The statute also requires consideration of international standards and, where appropriate, that they serve as the basis for U.S. standards. The FAA has assessed the potential effect of this proposed rule and determined that it will not create unnecessary obstacles to the foreign commerce of the United States.

D. Unfunded Mandates Assessment

Title II of the Unfunded Mandates Reform Act of 1995 (Pub. L. 104–4) requires each Federal agency to prepare a written statement assessing the effects of any Federal mandate in a proposed or final rule that may result in an expenditure of 100 million or more (in 1995 dollars) in any one year by State, local, and tribal governments, in the aggregate, or by the private sector; such a mandate is deemed to be a ''significant regulatory action.'' The threshold after adjustment for inflation is $177 million using the most current annual (2022) Implicit Price Deflator for Gross Domestic Product from the U.S. Bureau of Economic Analysis. This proposed rule does not contain such a mandate; therefore, the requirements of title II of the Act do not apply.

E. Paperwork Reduction Act

The Paperwork Reduction Act of 1995 (44 U.S.C. 3507(d)) requires that the FAA consider the impact of paperwork and other information collection burdens imposed on the public. According to the 1995 amendments to the Paperwork Reduction Act (5 CFR 1320.8(b)(2)(vi)), an agency may not collect or sponsor the collection of information, nor may it impose an information collection requirement, unless it displays a currently valid Office of Management and Budget

(OMB) control number.

The FAA has determined that there is no new requirement for information collection associated with this proposed rule.

F. Environmental Analysis

FAA Order 1050.1 identifies FAA actions that are categorically excluded from preparation of an environmental assessment or environmental impact statement under the National Environmental Policy Act in the absence of extraordinary circumstances. The FAA has determined this proposed rulemaking action qualifies for the categorical exclusion identified in paragraph 5–6.6f for regulations and involves no extraordinary circumstances. **V. Executive Order Determinations**

A. Executive Order 13132, Federalism

The FAA has analyzed this proposed rule under the principles and criteria of Executive Order (E.O.) 13132,

Federalism. The FAA has determined

that this action would not have a substantial direct effect on the States, or the relationship between the Federal Government and the States, or on the distribution of power and responsibilities among the various levels of government, and, therefore, would not have federalism implications.

B. Executive Order 13175, Consultation and Coordination With Indian Tribal Governments

Consistent with Executive Order 13175, Consultation and Coordination with Indian Tribal Governments,[41] and FAA Order 1210.20, American Indian and Alaska Native Tribal Consultation Policy and Procedures,[42] the FAA ensures that Federally Recognized Tribes (Tribes) are given the opportunity to provide meaningful and timely input regarding proposed Federal actions that have the potential to affect uniquely or significantly their respective Tribes. At this point, the FAA has not identified any unique or significant effects, environmental or otherwise, on tribes resulting from this proposed rule.

C. Executive Order 13211, Regulations

That Significantly Affect Energy Supply, Distribution, or Use

The FAA analyzed this proposed rule under E.O. 13211, Actions Concerning Regulations that Significantly Affect

Energy Supply, Distribution, or Use (May 18, 2001). The FAA has determined that it would not be a ''significant energy action'' under the Executive order and would not be likely to have a significant adverse effect on the supply, distribution, or use of energy.

D. Executive Order 13609, Promoting

International Regulatory Cooperation

Executive Order 13609, Promoting International Regulatory Cooperation, promotes international regulatory cooperation to meet shared challenges involving health, safety, labor, security, environmental, and other issues and to reduce, eliminate, or prevent unnecessary differences in regulatory requirements. The FAA has analyzed this action under the policies and agency responsibilities of E.O. 13609 and has determined that this action would have no effect on international regulatory cooperation.

[41] 65 FR 67249 (Nov. 6, 2000).

[42] FAA Order No. 1210.20 (Jan. 28, 2004), available at *www.faa.gov/documentLibrary/media/ 1210.pdf*.

VI. Additional Information

A. Comments Invited

The FAA invites interested persons to participate in this rulemaking by submitting written comments, data, or views. The FAA also invites comments relating to the economic, environmental, energy, or federalism impacts that might result from adopting the proposals in this document. The most helpful comments reference a specific portion of the proposal, explain the reason for any recommended change, and include supporting data. To ensure the docket does not contain duplicate comments, commenters should submit only one time if comments are filed electronically, or commenters should send only one copy of written comments if comments are filed in writing.

The FAA will file in the docket all comments it receives, as well as a report summarizing each substantive public contact with FAA personnel concerning this proposed rulemaking. Before acting on this proposal, the FAA will consider all comments it receives on or before the closing date for comments. The FAA will consider comments filed after the comment period has closed if it is possible to do so without incurring expense or delay. The FAA may change this proposal in light of the comments it receives.

B. Confidential Business Information

Confidential Business Information (CBI) is commercial or financial information that is both customarily and actually treated as private by its owner. Under the Freedom of Information Act (FOIA) (5 U.S.C. 552), CBI is exempt from public disclosure. If your comments responsive to this NPRM contain commercial or financial information that is customarily treated as private, that you actually treat as private, and that is relevant or responsive to this NPRM, it is important that you clearly designate the submitted comments as CBI. Please mark each page of your submission containing CBI as ''PROPIN.'' The FAA will treat such marked submissions as confidential under the FOIA, and they will not be placed in the public docket of this

NPRM. Submissions containing CBI should be sent to the person in the **FOR FURTHER INFORMATION CONTACT** section of this document. Any commentary that the FAA receives which is not specifically designated as CBI will be placed in the public docket for this rulemaking.

C. Electronic Access and Filing

A copy of this NPRM, all comments received, any final rule, and all background material may be viewed online at *www.regulations.gov* using the docket number listed above. A copy of this proposed rule will be placed in the docket. Electronic retrieval help and guidelines are available on the website. It is available 24 hours each day, 365 days each year. An electronic copy of this document may also be downloaded from the Office of the **Federal Register's** website at *www.federalregister.gov* and the Government Publishing Office's website at *www.govinfo.gov.* A copy may also be found at the FAA's Regulations and Policies website at *www.faa.gov/regulations_policies.*

Copies may also be obtained by sending a request to the Federal Aviation Administration, Office of

Rulemaking, ARM–1, 800 Independence Avenue SW, Washington, DC 20591, or by calling (202) 267–9677. Commenters must identify the docket or notice number of this rulemaking.

All documents the FAA considered in developing this proposed rule, including economic analyses and technical reports, may be accessed in the electronic docket for this rulemaking.

D. Small Business Regulatory

Enforcement Fairness Act

The Small Business Regulatory
Enforcement Fairness Act (SBREFA) of 1996 requires the FAA to comply with small entity requests for information or advice about compliance with statutes and regulations within its jurisdiction. A small entity with questions regarding this document may contact its local FAA official, or the person listed under the **FOR FURTHER INFORMATION CONTACT** heading at the beginning of the preamble. To find out more about SBREFA on the internet, visit *www.faa.gov/regulations_policies/ rulemaking/sbre_act/.*

1. Rulemaking Documents

An electronic copy of a rulemaking document may be obtained by using the internet— 1. Search the Federal eRulemaking

Portal (www.regulations.gov);

2. Visit the FAA's Regulations and Policies web page at *www.faa.gov/ regulations_policies*/; or
3. Access the Government Printing

Office's web page at *www.GovInfo.gov.*

Copies may also be obtained by sending a request (identified by notice or docket number of this proposed rulemaking) to the Federal Aviation Administration, Office of Rulemaking, ARM–1, 800 Independence Avenue SW, Washington, DC 20591, or by calling (202) 267–9680.

2. Comments Submitted to the Docket

Comments received may be viewed by going to *www.regulations.gov* and following the online instructions to search the docket number for this action. Anyone may search the electronic form of all comments received into any of the FAA's dockets by the name of the individual submitting the comment (or signing the comment, if submitted on behalf of an association, business, labor union, etc.).

3. Small Business Regulatory Enforcement Fairness Act

The Small Business Regulatory Enforcement Fairness Act (SBREFA) of 1996 requires the FAA to comply with small entity requests for information or advice about compliance with statutes and regulations within its jurisdiction. A small entity with questions regarding this document, may contact its local FAA official, or the person listed under the FOR FURTHER INFORMATION CONTACT heading at the beginning of the preamble. To find out more about SBREFA on the internet, visit *www.faa.gov/regulations_policies/ rulemaking/sbre_act/.* **List of Subjects**

14 CFR Part 401

Organization and functions (Government agencies), Space transportation and exploration.

14 CFR Part 413

Confidential business information, Space transportation and exploration.

14 CFR Part 415

Aviation safety, Environmental protection, Investigations, Reporting and recordkeeping requirements, Space transportation and exploration.

14 CFR Part 431

Launch and reentry safety, Aviation safety, Reporting and recordkeeping requirements, Rockets, Space transportation and exploration.

14 CFR Part 435

Launch and reentry safety, Aviation safety, Reporting and recordkeeping requirements, Rockets, Space transportation and exploration.

14 CFR Part 437

Aircraft, Aviation safety, Reporting and recordkeeping requirements, Space transportation and exploration.

14 CFR Part 440

Indemnity payments, Insurance, Reporting and recordkeeping requirements, Space transportation and exploration.

14 CFR Part 450

Aircraft, Aviation safety,

Environmental protection, Investigations, Reporting and recordkeeping requirements, Space transportation and exploration.

14 CFR Part 460

Aircraft, Reporting and recordkeeping requirements, Space transportation and exploration.

The Proposed Amendments

In consideration of the foregoing, the Federal Aviation Administration proposes to amend chapter III of title 14, Code of Federal Regulations as follows:

PART 401—ORGANIZATION AND DEFINITIONS

! 1. The authority citation for part 401 continues to read as follows:

Authority: 51 U.S.C. 50901–50923.

! 2. Amend §401.5 by—

! a. Adding in alphabetical order a definition for ''Government astronaut''; ! b. Revising the definition of ''Human space flight incident''; ! c. Adding in alphabetical order definitions for ''International partner astronaut'', and ''International Space Station Intergovernmental Agreement''; and
! d. Revising the definitions of
''Launch'', ''Launch accident'', ''Reenter; reentry'', ''Reentry accident'', and ''Space flight participant'';

The additions and revisions read as follows:

§401.5 Definitions.

* * * * *

Government astronaut means an individual who—

(1) Is designated by the National Aeronautics and Space Administration under Title 51, United States Code,
Section 20113(n);

(2) Is carried within a launch vehicle or reentry vehicle in the course of their employment, which may include performance of activities directly relating to the launch, reentry, or other operation of the launch vehicle or reentry vehicle; and

(3) Is either— (i) An employee of the United States Government, including the uniformed services, engaged in the performance of a Federal function under authority of law or an Executive act; or
(ii) An international partner astronaut.

* * * * *

Human space flight incident means an unplanned event that poses a high risk of causing a serious or fatal injury to a space flight participant, crew, or government astronaut.

* * * * *

International partner astronaut means an individual designated under Article 11 of the International Space Station Intergovernmental Agreement, by a partner to that agreement other than the United States, as qualified to serve as an International Space Station crew member.

International Space Station Intergovernmental Agreement means the Agreement Concerning Cooperation on the International Space Station, signed in Washington, DC, on January 29, 1998 (TIAS 12927).

*   *   *   *   *

Launch means to place or try to place a launch vehicle or reentry vehicle and any payload or human being from Earth in a suborbital trajectory, in Earth orbit in outer space, or otherwise in outer space, and includes preparing a launch vehicle for flight at a launch site in the United States. Launch includes the flight of a launch vehicle and includes pre- and post-flight ground operations as follows:

(1) *Beginning of launch.* (i) Under a license, launch begins with the arrival of a launch vehicle or payload at a U.S. launch site.

(ii) Under a permit, launch begins when any pre-flight ground operation at a U.S. launch site meets all of the following criteria:

(A) Is closely proximate in time to flight,
(B) Entails critical steps preparatory to initiating flight,
(C) Is unique to space launch, and
(D) Is inherently so hazardous as to warrant the FAA's regulatory oversight.

(2) *End of launch.* (i) For launch of an orbital expendable launch vehicle (ELV), launch ends after the licensee's last exercise of control over its launch vehicle.

(ii) For launch of an orbital reusable launch vehicle (RLV) with a payload, launch ends after deployment of the payload. For any other orbital RLV, launch ends upon completion of the first sustained, steady-state orbit of an RLV at its intended location.

(iii) For a suborbital ELV or RLV launch, launch ends after reaching apogee if the flight includes a reentry, or otherwise after vehicle landing or impact on Earth, and after activities necessary to return the vehicle to a safe condition on the ground.

Launch accident means—

(1) An event that causes a fatality or serious injury (as defined in 49 CFR 830.2) to any person who is not associated with the flight;

(2) An event that causes damage estimated to exceed $25,000 to property not associated with the flight that is not located at the launch site or designated recovery area;

(3) An unplanned event occurring during the flight of a launch vehicle resulting in the impact of a launch vehicle, its payload or any component thereof:

(i) For an expendable launch vehicle, outside designated impact limit lines; and
(ii) For a reusable launch vehicle, outside a designated landing site.

(4) For a launch that takes place with a person on board, a fatality or serious injury to a space flight participant, crew, or government astronaut.

*   *   *   *   *

Reenter; reentry means to return or attempt to return, purposefully, a reentry vehicle and its payload or human being, if any, from Earth orbit or from outer space to Earth. The term ''reenter; reentry'' includes activities conducted in Earth orbit or outer space to determine reentry readiness and that are critical to ensuring public health and safety and the safety of property during reentry flight. The term ''reenter; reentry'' also includes activities conducted on the ground after vehicle landing on Earth to ensure the reentry vehicle does not pose a threat to public health and safety or the safety of property.

Reentry accident means—

(1) Any unplanned event occurring during the reentry of a reentry vehicle resulting in the impact of the reentry vehicle, its payload, or any component thereof, outside a designated reentry site;

(2) An event that causes a fatality or serious injury (as defined in 49 CFR 830.2) to any person who is not associated with the reentry;

(3) An event that causes damage estimated to exceed $25,000 to property not associated with the reentry and not located within a designated reentry site; and

(4) For a reentry that takes place with a person on board, a fatality or serious injury to a space flight participant, crew, or government astronaut.

* * * * *

Space flight participant means an individual, who is not crew or a government astronaut, carried aboard a launch vehicle or reentry vehicle.

* * * * *

! 3. Amend §401.7 by—

! a. Adding in alphabetical order definitions for ''Government astronaut'', ''International partner astronaut'', and ''International Space Station Intergovernmental Agreement''; and ! b. Revising the definition of ''Space flight participant''.

The additions and revision read as follows:

§401.7 Definitions.

* * * * *

Government astronaut means an individual who—

(1) Is designated by the National Aeronautics and Space Administration under Title 51, United States Code, Section 20113(n);

(2) Is carried within a launch vehicle or reentry vehicle in the course of their employment, which may include performance of activities directly relating to the launch, reentry, or other operation of the launch vehicle or reentry vehicle; and

(3) Is either— (i) An employee of the United States Government, including the uniformed services, engaged in the performance of a Federal function under authority of law or an Executive act; or

(ii) An international partner astronaut.

* * * * *

International partner astronaut means an individual designated under Article 11 of the International Space Station Intergovernmental Agreement, by a partner to that agreement other than the United States, as qualified to serve as an International Space Station crew member.

International Space Station

Intergovernmental Agreement means the Agreement Concerning Cooperation on the International Space Station, signed in Washington, DC, on January 29, 1998 (TIAS 12927).

* * * * *

Space flight participant means an individual, who is not crew or a government astronaut, carried aboard a launch vehicle or reentry vehicle.

* * * * *

PART 413—LICENSE APPLICATION PROCEDURES

! 4. The authority citation for part 413 continues to read as follows:

Authority: 51 U.S.C. 50901–50923.

! 5. Amend §413.3 by revising paragraph (f) to read as follows:

§413.3 Who must obtain a license or permit.

* * * * *

(f) A person, individual, or foreign entity otherwise requiring a license under this section may instead obtain an experimental permit to launch or reenter a reusable suborbital vehicle under part 437 of this chapter.

PART 415—LAUNCH LICENSE

! 6. The authority citation for part 415 continues to read as follows:

Authority: 51 U.S.C. 50901–50923.

! 7. Revise §415.8 to read as follows:

§415.8 Human space flight.

To obtain a launch license, an applicant proposing to conduct a launch with a human being on board must demonstrate compliance with §§460.5, 460.7, 460.11, 460.13, 460.15, 460.17, 460.51, 460.53, 460.59, 460.61, and 460.67 of this subchapter.

PART 431—LAUNCH AND REENTRY

OF A REUSABLE LAUNCH VEHICLE (RLV)

! 8. The authority citation for part 431 continues to read as follows:

Authority: 51 U.S.C. 50901–50923.

! 9. Revise §431.8 to read as follows:

§431.8 Human space flight.

To obtain a launch license, an applicant proposing to conduct a reusable launch vehicle mission with a human being on board must demonstrate compliance with §§460.5, 460.7, 460.11, 460.13, 460.15, 460.17, 460.51, 460.53, 460.59, 460.61, and 460.67 of this subchapter.

PART 435—REENTRY OF A REENTRY

VEHICLE OTHER THAN A REUSABLE LAUNCH VEHICLE (RLV)

! 10. The authority citation for part 435 continues to read as follows:

Authority: 51 U.S.C. 50901–50923.

! 11. Revise §435.8 to read as follows:

§435.8 Human space flight.

To obtain a reentry license, an applicant proposing to conduct a reentry with a human being on board the vehicle must demonstrate compliance with §§460.5, 460.7, 460.11, 460.13, 460.15, 460.17, 460.51, 460.53, 460.59, 460.61, and 460.67 of this subchapter.

PART 437—EXPERIMENTAL PERMITS

! 12. The authority citation for part 437 continues to read as follows:

Authority: 51 U.S.C. 50901–50923.

! 13. Revise §437.3 to read as follows:

§437.3 Definitions.

Envelope expansion means any portion of a flight where planned

operations will subject a reusable suborbital vehicle to the effects of altitude, velocity, acceleration, or burn duration that exceed a level or duration successfully verified during an earlier flight.

Exclusion area means an area, within an operating area, that a reusable suborbital vehicle's instantaneous impact point may not traverse.

Operating area means a three- dimensional region where permitted flights may take place.

Permitted vehicle means a reusable suborbital rocket or a reusable launch vehicle that will be launched into a suborbital trajectory or reentered that is operated by a launch or reentry operator under an experimental permit.

Reentry impact point means the location of a reusable suborbital vehicle's instantaneous impact point during its unpowered exoatmospheric suborbital flight. ! 14. Revise §437.5 to read as follows:

§437.5 Eligibility for an experimental permit.

The FAA will issue an experimental permit to a person to launch or reenter a reusable suborbital vehicle only for—

(a) Research and development to test design concepts, equipment, or operating techniques;
(b) A showing of compliance with requirements for obtaining a license under this subchapter; or
(c) Crew training for a launch or reentry using the design of the reusable suborbital vehicle for which the permit would be issued. ! 15. Amend §437.7 by revising the introductory text and paragraph (b) to read as follows:

§437.7 Scope of an experimental permit. An experimental permit authorizes launch or reentry of a reusable suborbital vehicle. The authorization includes pre- and post-flight ground operations as defined in this section.

* * * * *

(b) A post-flight ground operation includes each operation necessary to return the reusable suborbital vehicle to a safe condition after it lands or impacts.

! 16. Revise §437.9 to read as follows:

§437.9 Issuance of an experimental permit.

The FAA issues an experimental permit authorizing an unlimited number of launches or reentries for a reusable suborbital vehicle design for the uses described in §437.5. ! 17. Amend §437.21 by revising paragraphs (b)(1)(i) and (iv), (b)(3), (c), and (d) to read as follows:

§437.21 General.

* * * * *

(b) * * *

(1) * * *

(i) *General.* The FAA is responsible for complying with the procedures and policies of the National Environmental Policy Act (NEPA) and other applicable environmental laws, regulations, and Executive Orders to consider and document the potential environmental effects associated with proposed reusable suborbital vehicle launches or reentries. An applicant must provide the FAA with information needed to comply with such requirements. The FAA will consider and document the potential environmental effects associated with proposed reusable suborbital vehicle launches or reentries.

* * * * *

(iv) Information requirements. An application must include an approved FAA Environmental Assessment, Environmental Impact Statement, categorical exclusion determination, or written re-evaluation covering all planned permitted activities in compliance with NEPA and the Council on Environmental Quality Regulations for Implementing the Procedural Provisions of NEPA.

* * * * *

(3) *Human space flight.* An applicant proposing to conduct a permitted operation with a human being on board a reusable suborbital vehicle must demonstrate compliance with §§460.5, 460.7, 460.11, 460.13, 460.15, 460.17, 460.51, 460.53, 460.59, 460.61, and 460.67 of this subchapter.

(c) *Use of a safety element approval.* If an applicant proposes to use any reusable suborbital vehicle, safety system, process, service, or personnel for which the FAA has issued a safety element approval under part 414 of this chapter, the FAA will not reevaluate that safety element to the extent its use is within its approved scope. As part of the application process, the FAA will evaluate the integration of that safety element into vehicle systems or operations.

(d) *Inspection before issuing a permit.* Before the FAA issues an experimental permit, an applicant must make each reusable suborbital vehicle planned to be flown available to the FAA for inspection. The FAA will determine whether each reusable suborbital vehicle is built as represented in the application.

* * * * *

! 18. Amend §437.23 by revising paragraphs (a) and (b) to read as follows:

§437.23 Program description.

(a) An applicant must provide—

(1) Dimensioned three-view drawings or photographs of the reusable suborbital vehicle; and

(2) Gross liftoff weight and thrust profile of the reusable suborbital vehicle.

(b) An applicant must describe—

(1) All reusable suborbital vehicle systems, including any structural, flight control, thermal, pneumatic, hydraulic, propulsion, electrical, environmental control, software and computing systems, avionics, and guidance systems used in the reusable suborbital vehicle;

(2) The types and quantities of all propellants used in the reusable suborbital vehicle;

(3) The types and quantities of any hazardous materials used in the reusable suborbital vehicle;

(4) The purpose for which a reusable suborbital vehicle is to be flown; and

* * * * *

! 19. Amend §437.25 by revising paragraph (c) to read as follows:

§437.25 Flight test plan.

* * * * *

(c) For each operating area, provide the planned maximum altitude of the reusable suborbital vehicle.

! 20. Amend §437.31 by revising paragraphs (a) introductory text, (a)(1), and (b), to read as follows:

§437.31 Verification of operating area containment and key flight-safety event limitations.

(a) An applicant must identify, describe, and provide verification evidence of the methods and systems used to meet the requirement of §437.57(a) to contain its reusable suborbital vehicle's instantaneous impact point within an operating area and outside any exclusion area. The description must include, at a minimum—

(1) Proof of physical limits on the ability of the reusable suborbital vehicle to leave the operating area; or

* * * * *

(b) An applicant must identify, describe, and provide verification evidence of the methods and systems used to meet the requirements of §437.59 to conduct any key flight-safety event so that the reusable suborbital vehicle's instantaneous impact point, including its expected dispersions, is over unpopulated or sparsely populated areas, and to conduct each reusable suborbital vehicle flight so that the reentry impact point does not loiter over a populated area.

! 21. Revise §437.33 to read as follows:

§437.33 Landing and impact locations.

An applicant must demonstrate that each location for nominal landing or any contingency abort landing of the reusable suborbital vehicle, and each location for any nominal or contingency impact or landing of a component of that reusable suborbital vehicle, satisfies §437.61. ! 22. Amend §437.53 by revising the introductory text to read as follows:

§437.53 Pre-flight and post-flight operations.

A permittee must protect the public from adverse effects of hazardous operations and systems in preparing a reusable suborbital vehicle for flight at a launch site in the United States and returning the reusable suborbital vehicle and any support equipment to a safe condition after flight. At a minimum, a permittee must—

* * * * *

! 23. Amend §437.57 by revising paragraphs (a) and (c) to read as follows:

§437.57 Operating area containment.

(a) During each permitted flight, a permittee must contain its reusable suborbital vehicle's instantaneous impact point within an operating area determined in accordance with paragraph (b) and outside any exclusion area defined by the FAA in accordance with paragraph (c) of this section.

* * * * *

(c) The FAA may prohibit a reusable suborbital vehicle's instantaneous impact point from traversing certain areas within an operating area by designating one or more areas as exclusion areas, if necessary to protect public health and safety, safety of property, or foreign policy or national security interests of the United States. An exclusion area may be confined to a specific phase of flight.

! 24. Amend §437.59 by revising paragraph (a) introductory text and (b) to read as follows:

§437.59 Key flight-safety event limitations.

(a) A permittee must conduct any key flight-safety event so that the reusable suborbital vehicle's instantaneous impact point, including its expected dispersion, is over an unpopulated or sparsely populated area. At a minimum, a key flight-safety event includes:

* * * * *

(b) A permittee must conduct each reusable suborbital vehicle flight so that the reentry impact point does not loiter over a populated area. ! 25. Amend §437.61 by revising the introductory text to read as follows:

§437.61 Landing and impact locations. For a nominal or any contingency abort landing of a reusable suborbital vehicle, or for any nominal or contingency impact or landing of a component of that reusable suborbital vehicle, a permittee must use a location that—

* * * * *

! 26. Amend §437.71 by revising paragraphs (a), (c), (d), and (e) to read as follows:

§437.71 Flight rules.

(a) Before initiating flight, a permittee must confirm that all systems and operations necessary to ensure that safety measures derived from §§437.55, 437.57, 437.59, 437.61, 437.63, 437.65, 437.67, and 437.69 are within acceptable limits.

* * * * *

(c) A permittee may not operate a reusable suborbital vehicle in a careless or reckless manner that would endanger any member of the public during any phase of flight.

(d) A permittee may not operate a reusable suborbital vehicle in areas designated in a Notice to Airmen under 14 CFR 91.137, 91.138, 91.141, or 91.145, unless authorized by:

(1) Air Traffic Control; or

(2) A Flight Standards Certificate of Waiver or Authorization.

(e) For any phase of flight where a permittee operates a reusable suborbital vehicle like an aircraft in the National Airspace System, a permittee must comply with the provisions of 14 CFR part 91 specified in an experimental permit issued under this part. ! 27. Amend §437.85 by revising paragraph (a) to read as follows:

§437.85 Allowable design changes; modification of an experimental permit.

(a) The FAA will identify in the experimental permit the type of changes that the permittee may make to the reusable suborbital vehicle design without invalidating the permit.

* * * * *

! 28. Revise §437.91 to read as follows:

§437.91 For hire prohibition.

No permittee may carry any property or human being for compensation or hire on a reusable suborbital vehicle. ! 29. Revise §437.95 to read as follows:

§437.95 Inspection of additional reusable suborbital vehicles.

A permittee may launch or reenter additional reusable suborbital vehicles of the same design under the permit after the FAA inspects each additional reusable suborbital vehicle.

PART 440—FINANCIAL RESPONSIBILITY

! 30. The authority citation for part 440 continues to read as follows:

Authority: 51 U.S.C. 50901–50923.

! 31. Amend §440.3 by revising the definitions of ''Government personnel'', ''Permit'', ''Permitted activity'', and ''Third party'' to read as follows:

§440.3 Definitions.

* * * * *

Government personnel means employees of the United States, its agencies, and its contractors and subcontractors, involved in launch or reentry services for an activity authorized by an FAA license or permit. Employees of the United States include members of the Armed Forces of the United States. Government personnel exclude government astronauts.

* * * * *

Permit means an authorization the FAA issues under this subchapter for the launch or reentry of a reusable suborbital vehicle.

Permitted activity means the launch or reentry of a reusable suborbital vehicle conducted under a permit issued by the FAA.

* * * * *

Third party means— (1) Any person other than:

(i) The United States, any of its agencies, and its contractors and subcontractors involved in launch or reentry services for a licensed or permitted activity;

(ii) A licensee, permittee, and its contractors and subcontractors involved in launch or reentry services for a licensed or permitted activity;

(iii) A customer and its contractors and subcontractors involved in launch or reentry services for a licensed or permitted activity;

(iv) A member of a crew;

(v) A space flight participant; and (vi) A government astronaut.

(2) Government personnel, as defined in this section, are third parties.

* * * * *

! 32. Amend §440.9 by revising paragraph (b)(2), (3), and (4) to read as follows:

§440.9 Insurance requirements for licensed or permitted activities.

* * * * *

(b) * * *

(2) The United States, its agencies, and its contractors and subcontractors involved in a licensed or permitted activity;

(3) Government personnel; and

(4) Space flight participants. This paragraph (b)(4) shall cease to be effective on September 30, 2025, unless public law modifies the limitation in section 50914 of Title 51 of the U.S. Code.

* * * * *

! 33. Amend §440.17 by revising paragraphs (c) introductory text, (d) introductory text, (e) introductory text, and (f) and adding paragraph (g) to read as follows:

§440.17 Reciprocal waiver of claims requirements.

* * * * *

(c) For each licensed or permitted activity in which the United States, or its contractors and subcontractors, is involved or where property insurance is required under §440.9(d), the Federal Aviation Administration of the Department of Transportation, the licensee or permittee, and each first-tier customer must enter into a reciprocal waiver of claims agreement. The reciprocal waiver of claims must be in a form acceptable to the Administrator and must provide that:

* * * * *

(d) For each licensed or permitted activity in which the United States or its contractors and subcontractors are involved, the Federal Aviation Administration of the Department of Transportation and each space flight participant must enter into or have in place a reciprocal waiver of claims agreement. The reciprocal waiver of claims must be in a form acceptable to the Administrator.

* * * * *

(e) For each licensed or permitted activity in which the United States or its contractors and subcontractors is involved, the Federal Aviation Administration of the Department of Transportation and each crew member must enter into or have in place a reciprocal waiver of claims agreement. The reciprocal waiver of claims must be in a form acceptable to the Administrator.

* * * * *

(f) The licensee or permittee and each space flight participant must enter into a reciprocal waiver of claims agreement under which each party waives and releases claims against the other party to the waiver, and agrees to assume financial responsibility for property damage it sustains and for bodily injury or property damage, and to hold harmless and indemnify each other from bodily injury or property damage, resulting from a licensed or permitted activity, regardless of fault. This paragraph (f) shall cease to be effective as of September 30, 2025, unless public law modifies the limitation in section 50914 of Title 51 of the U.S. Code.

(g) Any waiver, release, assumption of responsibility or agreement to hold harmless and indemnify pursuant to this section does not apply to claims for bodily injury or property damage resulting from willful misconduct of any of the parties to the reciprocal waiver of claims, the contractors and subcontractors of any of the parties to the reciprocal waiver of claims, and in the case of licensee or permittee and customers and the contractors and subcontractors of each of them, the directors, officers, agents and employees of any of the foregoing, and in the case of the United States, its agents.

Appendix B Through E to Part 440— [Removed]

! 34. Remove appendices B through E to part 440.

PART 450—LAUNCH AND REENTRY LICENSE REQUIREMENTS

! 35. The authority citation for part 450 continues to read as follows:

Authority: 51 U.S.C. 50901–50923.

! 36. Amend §450.45 by revising paragraphs (e)(3)(ii)(E) and (e)(5) to read as follows:

§450.45 Safety review and approval.

*   *   *   *   *

(e) * * * (3) * * *

(ii) * * *

(E) For an unguided suborbital launch vehicle, the location of the vehicle's center of pressure in relation to its center of gravity for the entire flight profile.

*   *   *   *   *

(5) *Human space flight.* For a proposed launch or reentry with a human being on board a vehicle, an applicant must demonstrate compliance with §§460.5, 460.7, 460.11, 460.13, 460.15, 460.17, 460.51, 460.53, 460.59, 460.61, and 460.67 of this chapter.

*   *   *   *   *

PART 460—HUMAN SPACE FLIGHT

REQUIREMENTS

! 37. The authority citation for part 460 continues to read as follows:

Authority: 51 U.S.C. 50901–50923.

! 38. Add subpart C to read as follows:

Subpart C—Launch and Reentry With a Government Astronaut With a Safety- Critical Role Sec.

460.55 Scope.
460.57 Applicability.
460.59 Operator training of government astronauts with a safety-critical role.
460.61 Environmental control and life support systems.

Subpart C—Launch and Reentry With a Government Astronaut With a Safety- Critical Role

§460.55 Scope.

This subpart establishes requirements for operators and applicants whose licensed or permitted operations involve government astronauts on board a vehicle.

§460.57 Applicability.

This subpart applies to:

(a) An applicant for a license or permit under this chapter who proposes to have a government astronaut with a safety-critical role on board a vehicle.

(b) An operator licensed or permitted under this chapter who has a government astronaut without a safety- critical role on board a vehicle.

§460.59 Operator training of government astronauts with a safety-critical role.

(a) An operator must train each government astronaut with a safety- critical role on—

(1) How to carry out their safety- critical role on board or on the ground so that the vehicle will not harm the public; and

(2) Their role in nominal and non- nominal conditions, including abort scenarios and emergency operations, to the extent that performance of their role could impact public safety.

(b) An operator must ensure any government astronaut who has the ability to control, in real time, a launch or reentry vehicle's flight path during a phase of flight capable of endangering the public:

(1) Receives vehicle and mission- specific training for each phase of flight capable of endangering the public and over which the government astronaut has the ability to control the vehicle by using one or more of the following:

(i) A method or device that simulates the flight;
(ii) An aircraft whose characteristics are similar to the vehicle or that has similar phases of flight to the vehicle;
(iii) Flight testing; or
(iv) An equivalent method of training approved by the FAA through the license process.
(2) Trains for each mode of control or propulsion, including any transition between modes, such that the government astronaut is able to control the vehicle.
(3) Possesses aeronautical knowledge, experience, and skills necessary to pilot and control the launch or reentry vehicle that will operate in the National Airspace System (NAS). Aeronautical experience may include hours in flight, ratings, and training.

(c) With respect to training device fidelity, an operator must:

(1) Ensure that any government astronaut training device used to meet the training requirements realistically represents the vehicle's configuration and mission; or,
(2) Inform the government astronaut being trained of the differences between the training device and the vehicle's configuration and mission.
(d) An operator must update the government astronaut training continually to ensure that the training incorporates lessons learned from training and operational missions including—

(1) Tracking each revision and updating in writing; and
(2) Documenting the completed training for each government astronaut and maintaining the documentation for each active government astronaut. (e) An operator must establish a recurrent training schedule and ensure that all training of government astronauts performing safety-critical roles is current before launch or reentry.

§460.61 Environmental control and life support systems.

(a) An operator must provide atmospheric conditions adequate to sustain life and consciousness for all inhabited areas within a vehicle that house a government astronaut. The operator must monitor and control the following atmospheric conditions in the inhabited areas or demonstrate through the license or permit process that an alternate means provides an equivalent level of safety—

(1) Composition of the atmosphere, which includes oxygen and carbon dioxide, and any revitalization;
(2) Pressure, temperature and humidity;
(3) Contaminants that include particulates and any harmful or hazardous concentrations of gases, or vapors; and
(4) Ventilation and circulation.
(b) An operator must provide an adequate redundant or secondary oxygen supply for any government astronaut with a safety-critical role.
(c) An operator must provide a redundant means of preventing cabin depressurization; or prevent incapacitation of any government astronaut with a safety-critical role in the event of loss of cabin pressure. ! 39. Add subpart D to read as follows:

Subpart D—Launch and Reentry With a Government Astronaut Without a Safety- Critical Role Sec.

460.67 Operator training of government astronauts without a safety-critical role.

Subpart D—Launch and Reentry With a Government Astronaut Without a Safety-Critical Role

§460.63 Scope.

This subpart establishes requirements for operators and applicants whose licensed or permitted operations involve government astronauts on board a vehicle without a safety-critical role.

§460.65 Applicability.

This subpart applies to:

(a) An applicant for a license or permit under this chapter who proposes to have a government astronaut without a safety-critical role on board a vehicle. (b) An operator licensed or permitted under this chapter who has a government astronaut without a safety- critical role on board a vehicle.

§460.67 Operator training of government astronauts without a safety-critical role.

An operator must train each government astronaut without a safety- critical role on how to respond to emergency situations, including smoke, fire, loss of cabin pressure, and emergency exit.

Issued under authority provided by 49 U.S.C. 106(f) and 51 U.S.C. Chapter 509 in Washington, DC.

Kelvin B. Coleman, *Associate Administrator, Office of Commercial Space Transportation.*

[FR Doc. 2023–16858 Filed 8–17–23; 8:45 am]
BILLING CODE 4910–13–P

PENSION BENEFIT GUARANTY CORPORATION

29 CFR Parts 4022, 4044, 4050, 4262 and 4281

RIN 1212–AA55

Valuation Assumptions and Methods

AGENCY: Pension Benefit Guaranty Corporation.

ACTION: Proposed rule.

SUMMARY: This proposed rule would update the interest, mortality, and expense assumptions used to determine the present value of benefits for a single- employer pension plan under subpart B of the Pension Benefit Guaranty Corporation's regulation on Allocation of Assets in Single-Employer Plans, to determine components of mass withdrawal liability for a multiemployer pension plan, and for other purposes.

DATES: Comments must be submitted on or before October 17, 2023 to be assured of consideration.

ADDRESSES: Comments may be submitted by any of the following methods:

- *Federal eRulemaking Portal: https://www.regulations.gov.* Follow the instructions for sending comments.
- *Email: reg.comments@pbgc.gov.* Refer to RIN 1212–AA55 in the subject line.
- *Mail or Hand Delivery:* Regulatory Affairs Division, Office of the General Counsel, Pension Benefit Guaranty Corporation, 445 12th Street SW, Washington, DC 20024–2101.

Commenters are strongly encouraged to submit comments electronically. Commenters who submit comments on paper by mail should allow sufficient time for mailed comments to be received before the close of the comment period. All submissions must include the agency's name (Pension Benefit Guaranty Corporation or PBGC), the title for this rulemaking (Valuation Assumptions and Methods), and the Regulation Identifier Number for this rulemaking (RIN 1212–AA55). Comments received will be posted without change to PBGC's website, *www.pbgc.gov,* including any personal information provided. Do not submit comments that include any personally identifiable information or confidential business information.

Copies of comments may also be obtained by writing to Disclosure Division, Office of the General Counsel,

Pension Benefit Guaranty Corporation,
445 12th Street SW, Washington, DC 20024–2101, or calling 202–326–4040 during normal business hours. If you are deaf or hard of hearing, or have a speech disability, please dial 7–1–1 to access telecommunications relay services.

FOR FURTHER INFORMATION CONTACT: Gregory M. Katz (*katz.gregory@ pbgc.gov*), Attorney, Regulatory Affairs Division, Office of the General Counsel,

Unweaving the Tangled Web: The Due Regard Obligation Under Article IX of the Outer Space Treaty

Elena Carpanelli[156]

This article assesses the content and reach of the due regard obligation under Article IX of the Outer Space Treaty (OST). It first investigates if its substance might be spelled out despite its flexible and context-dependent nature. It then focuses on the 'reach' of the obligation, by examining, on the one hand, its practical 'playing field' vis-à-vis other 'competing' rules and, on the other, its potential application beyond Article IX OST. It concludes that, while it is possible to partially substantiate the content of this obligation, its status under international law remains uncertain and its implementation would be further supported by the adoption of more precise operationalizing frameworks at the multilateral level.

Keywords: due diligence, consultations, cooperation, impact assessment, Artemis Accords

1 INTRODUCTION

According to Article IX of the Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies (hereinafter OST)[157]:

> In the exploration and use of outer space, including the moon and other celestial bodies, States parties to the Treaty shall be guided by the principle of co-operation and mutual assistance and shall conduct their activities in outer space, including the moon and other celestial bodies, with due regard to the corresponding interests of all other States parties to the Treaty.[158][159]

The obligation of 'due regard' is commonly acknowledged as one of the essential pillars of the OST's architecture and a key feature of the international legal framework governing outer space. What is more, it has increasingly come under the spotlight in recent years, being invoked by scholars concerning a multitude of challenges that the expansion in exploration and use of outer space raises,[160] such as, inter alia, space debris,[161] space resource utilization,[162] and the preservation of outer space

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[157] London, Moscow, Washington, 27 Jan. 1967, entered into force 10 Oct. 1967, 610 UNTS 205.

[158] Emphasis added. On this provision generally see among others, S. Marchisio, Article IX, in Cologne Commentary on Space Law, vol. 1 169–182 (S. Hobe, B. Schmidt-Tedd & K-U Schrogl eds, Cologne
[159]).

Carpanelli, Elena. 'Unweaving the Tangled Web: The Due Regard Obligation Under Article IX of the Outer Space Treaty'. Air & Space Law 49, no. 1 (2024): 35–58.

[160] For some of the key issues that the increasing use of outer space raises see the special issue on Space Sustainability, Safety and Security (C. Johnson & T. Masson-Zwaan eds, 48 special issue Air & Space Law, 2023).

[161] See for instance, L. Li, Space Debris Mitigation as an International Law Obligation: A Critical Analysis with Reference to States Practice and Treaty Obligation, 17(3) Int'l Community L. Rev. 297–335, at 322 (2015), doi: 10.1163/18719732-12341307 and Y. Radi, Clearing Up the Space Junk – On the Flaws and Potential of International Space Law to Tackle the Space Debris Problem, 12(2) ESIL Reflections 1-12 (2023), https:// esil-sedi.eu/esil-reflection-clearing-up-the-space-junk-on-the-flaws-and-potential-of-internationalspace-law-to-tackle-the-space-debris-problem/ (accessed 5 Dec. 2023).

[162] See inter alia, Building Blocks for the Development of an International Framework for the Governance of Space Resource Activities. A Commentary 54 ff (O. Bittencourt, M. Hofmann, T. Masson-Zwaan & D. Stefoudi eds, The Hague 2020).

heritage.[163] More recently, its role has also been questioned with respect to the use of electromagnetic pulses, highpowered lasers, high-powered microwaves, and cyber capabilities against space systems.[164] This renewed interest is the result of several factors, such as the intensification of the use of outer space, the growing congestion in orbit and the expanding antagonism among relevant actors, which make it urgent to pay attention to what has been commonly regarded as a 'limitation to the freedom of exploration and use of outer space' upheld in Article I OST[165] or – to borrow a successful expression coined for another branch of international law – as a tool to ensure 'coexistence

between equally legitimate activities in a given [...] area'.[166]

Yet, despite the rising interest that surrounds the due regard obligation, its nature, content and modalities of operation remain unclear. The meaning of the expression 'due regard', in particular, is all but a settled issue given the lack of a specific definition contained in the OST. Likewise, Article IX lacks clarity insofar as it does not single out what other states' 'corresponding interests' are. These expressions, for which no definition is provided, are examples of that open-texture language that often characterizes international agreements.[167]

It comes therefore as no surprise that the Open-Ended Working Group on Reducing Space Threats through Norms, Rules and Principles of Responsible Behaviours (hereinafter OEWG), convened by the UN General Assembly in December 2021, has been seen by some states as a well-suited forum for clarifying the meaning and scope of the duty of due regard.[168] The Canadian representative, for example, noted that: 'all States have expressed, in some form, agreement with the principle of due regard, and it is now just a matter of understanding what this means and how it translates into conducts and behaviours'.[169]

This article aims to contribute to the scholarly debate concerning the content and scope of the obligation of due regard contained in Article IX OST.[170] To this purpose, the article is divided into two parts. Section 2 attempts to reduce the indeterminateness surrounding the content of the obligation of

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163 R. Deplano, The Artemis Accords: Evolution or Revolution in International Space Law?, 70(3) Int'l & Comp. L. Q. 798-819, at 812 (2021), doi: 10.1017/S0020589321000142. See also M. Hanlon, 'Due regard' for Commercial Space Must Start with Historic Preservation, 9(1) The Global Bus. L. Rev. 130–156 (2021).

164 See the statement of Australia's representative within the Open-Ended Working Group on Reducing Space Threats through Norms, Rules and Principles of Responsible Behaviours on 10 May 2022. On the work of the Open-Ended Working Group, convened with resolution 76/231 of the UN General Assembly (UN Doc. A/RES/76/231 of 30 Dec. 2021), see inter alia, A. Azcarate Ortega & H. Lagos Koller, The Open-Ended Working Group on Reducing Space Threats Through Norms, Rules and Principles of Responsible Behaviours: The Journey So Far, and the Road Ahead, 48 special issue Air & Space L. 19–40 (2023), doi: 10.54648/AILA2023029.

165 See again Marchisio, supra n. 2, at 175.

166 T. Treves, 'Due Regard' Obligation under the 1982 UN Convention on the Law of the Sea: The Laying Cables and Activities in the Area, 34(2) Int'l J. Marine & Coastal L. 168 (2019), doi: 10.1163/1571808523421085.

167 See e.g., J. Gaunce, On the Interpretation of the General Duty of 'Due Regard', 32(1) Ocean Yearbook 27– 59 (2018), doi: 10.1163/22116001-03201003.

168 See e.g., the statement of the Philippines of 12 May 2022, under agenda item 6(a), according to which 'the clarification of the duty of due regard is essential to the work of this Group'.

169 Statement of 13 May 2022. Conversely, the Netherlands stressed that: 'what constitutes due regard is different for each situation. Therefore, my delegation would not be inclined to enter into an exercise of defining the scope of the obligation of due regard'. See the statement by the Netherlands in the context of the exchange of views on the outcome of the first session. See also the USA's statement of 30 Jan. 2023: 'There have been discussions at the OEWG on elaborating what terms like "due regard" or "harmful interference" mean. There have been several working papers, including one by the Philippines, that have referenced these issues. We do not believe it would be advisable to re-open any of the four core space treaties, or that this the correct forum to engage in a definitional exercise'.

170 On the subject see inter alia, N. Palkovitz, Exploring the Boundaries of the Free Exploration and Use of Outer Space. Article IX and the Principle of Due Regard. Some Contemporary Issues, Proceedings of the International Institute of Space Law 93–105 (2015) and M. Mineiro, Article IX's Principle of Due Regard and International Consultations: An Assessment in Light of the European Draft Space Code of Conduct, Proceedings of the International Institute of Space Law 674-686 (2010).

due regard in Article IX by clarifying which interests should be taken into account and by identifying several sub-duties arising therefrom. In doing so, the section also engages with the issue of the nature of this obligation. Section 3 examines the 'reach' of the obligation of due regard under a two-fold perspective: first, it questions its practical 'playing field' vis-à-vis other 'competing' rules; second, it investigates its potential application beyond Article IX OST. Some concluding remarks are offered in section 4.

2 DETECTING THE CONTENT OF DUE REGARD UNDER ARTICLE IX OST

Article IX OST situates due regard at the level of primary norms of international law. By expressly requiring that states parties shall conduct their activities in outer space with due regard for the corresponding interests of all other states parties, the drafters did not opt for optional language, which would have been the case if terms such as should were used, but rather for a legally binding commitment.

However, the content of this obligation is hard to detect to the extent that one may consider it as merely aspirational. As stated, Article IX fails to define key expressions such as 'due regard' or 'corresponding interests'. Moreover, other provisions of the corpus juris spatialis, which also require states to conduct their activities with 'due regard', do not define these terms either. For instance, the Agreement governing the Activities of States on the Moon and Other Celestial Bodies (hereinafter Moon Agreement)[171] contains the expression 'due regard' in Articles 2, 4 and 15,[172] but does not define it. Likewise, no definition of these terms features in non-legally binding instruments, such as the Declaration of Legal Principles Governing the Activities of States in the Exploration and Use of Outer Space,[173] whose Principle 6 mirrors Article IX OST,[174] and the Principles Relating to Remote Sensing of the Earth from Outer Space, which articulates an obligation of due regard in Principle IV.[175]
In addition, no definition can be traced in other international legal instruments governing areas beyond national jurisdiction[176] that uphold an obligation of due regard, such as the United Nations Convention

171 New York, 18 Dec. 1979, entered into force 11 Jul. 1984, 1363 UNTS 3.

172 Article 2 states: 'All activities on the Moon, including its exploration and use, shall be carried out [...] with due regard to the corresponding interests of all other States parties'. Art. 4 provides that: 'The exploration and use of the moon shall be the province of all mankind and shall be carried out for the benefit and in the interests of all countries, irrespective of their degree of economic or scientific development. Due regard shall be paid to the interests of present and future generations as well as to the need to promote higher standards of living and conditions of economic and social progress and development in accordance with the Charter of the United Nations'. Finally, under Art. 15, in case a State Party believes that another one is not fulfilling its obligations, it may request consultations and 'if the consultations do not lead to a mutually acceptable settlement with due regard for the rights and interests of all states Parties', the parties concerned shall take all the means to peacefully solve their dispute.

173 UN Doc. A/RES/1962(XVIII), adopted on 13 Dec. 1963.

174 Principle 6 states: 'In the exploration and use of outer space, State shall the guided by the principle of co-operation and mutual assistance and shall conduct all their activities in outer space with due regard for the corresponding interests of other States'.

175 See UN Doc. A/RES/41/65, adopted on 3 Dec. 1986. Principle IV provides that remote sensing activities shall be conducted 'with due regard to the rights and interests, in accordance with international law, of other States and entities under their jurisdiction'.

176 For the sake of completeness, an obligation of due regard is contained also in international legal provisions that do not concern areas beyond national jurisdiction. They include Art. 3 of the 1944 Convention on International Civil Aviation (Chicago, 7 Dec. 1944, entered into force on 4 Apr. 1947, 15 UNTS 295) and Art. 7 of the Convention on the Law of Non-Navigational Uses of International Watercourses (New York, 21 May 1977, entered into force on 17 Aug. 2014, 2999 UNTS 1).

on the Law of the Sea (UNCLOS)[177] or the Agreement on the Conservation and Sustainable Use of Marine Biodiversity beyond National Jurisdiction (BBNJ).[178]

The ordinary meaning of the expressions 'due regard' and 'corresponding interests' does not dispel this lack of clarity either; instead, it confirms the variable content of the underlying obligation.[179] The word 'regard' indicates 'respect', or 'consideration',[180] whereas the term 'due' means 'appropriate', or 'required'.[181] No different indications come from other linguistic versions, such as the French 'tenant dûment compte' or the Spanish 'tener debitamente en cuenta'. As a result, the ordinary meaning of due regard is that states, when conducting their activities in outer space, shall take into account other states parties' corresponding interests as appropriate and required by the circumstances.

The textual meaning of the expression 'corresponding interests' ('intérêts correspondants' in French; 'intereses correspondientes' in Spanish) does not add much either, as it merely hints at the fact that states share 'analogous' 'claims' and 'concerns'[182] for a global common that they may explore and use on equal terms.

It follows from the above that the level of 'regard' required varies depending on several factors, such as, for instance, the interests at stake, the risks that a specific activity poses to them and the importance of the activity in question. Additionally, the standard to be applied may evolve with time, in light of scientific and technological progress. Its concrete application is therefore context-dependent and linked to a case-by-case assessment.

The variable content of the obligation under exam can be explained by means of its aim and rationale.[183] The duty of due regard in Article IX OST responds to the need to ensure the co-existence of different activities and interests. In outer space, these derive, on the one hand, from the freedom of use and exploration[184] and, on the other, from the circumstance that such freedom is not unlimited. For instance, the freedom is limited by the requirement that states should exercise it 'for the benefit and the interests of all countries, irrespective of their degree of economic or scientific development'[185] and for 'peaceful purposes'.[186]

Despite the elusive character and the flexible nature of the obligation of due regard under Article IX OST, several elements can shed further light on its content. First, it may be assumed that the notion of

177 Montego Bay, 10 Dec. 1982, entered into force on 16 Nov. 1994, 1833 UNTS 3. For an analysis of all provisions of this Convention mentioning 'due regard', thus including those concerning the high sea and the 'Area' (such as Arts 87 and 147) see inter alia, A. Chong, International Law for Freshwater Protection 221–226 (Leiden, Boston 2022).

178 New York, 19 Jun. 2023, not yet into force. The expression 'due regard' appears in several provisions of this Agreement such as in Arts 11, 22(5) and 43(4).

179 The general rule of treaty interpretation in Art. 31 of the Vienna Convention on the Law of Treaties (Vienna, 23 May 1969, entered into force on 27 Jan. 1980, 1155 UNTS 331, VCLT) requires, inter alia, to take into account the ordinary meaning of the terms. On the general rule of interpretation in Art. 31 of the VCLT see ex multis, R. Gardiner, Treaty Interpretation (Oxford 2008); M. E. Villiger, Commentary on the 1969 Vienna Convention on the Law of Treaties 415 ff (Leiden, Boston 2009); Vienna Convention on the Law of Treaties: A Commentary, vol. I 521 (O. Dorr & K. Schmalenbach eds, Heidelberg 2012); A. Aust, Modern Treaty Law and Practice 205 ff (3d ed., Cambridge 2013); R. Kolb, The Law of Treaties: An Introduction 128 ff (Cheltenham, Northampton 2016).

180 See Collins English Dictionary 1382 (10th ed. 2009).

181 Ibid., at 512.

182 Ibid., at 382 & 854.

183 See again Art. 31 VCLT and the teleological method of interpretation provided therein.

184 Art. I OST.

185 Ibid.

186 See Art. IV OST.

corresponding interests includes both individual and community interests (section 2.1). Second, it may be contended that the obligation of due regard in Article IX OST also incorporates an obligation of due diligence (section 2.2). Third, it seems possible to claim the existence of several procedural duties that – irrespective of their autonomous nature – also contribute to better substantiating the duty of due regard (section 2.3).

2.1 Whose interests?

As stated, the term 'interests' is not defined in the OST or other relevant legal instruments even though they use it.[187] At the same time, the ordinary meaning of the term does not solve the vagueness surrounding it. However, some indications concerning what constitutes a 'corresponding interest' under Article IX OST can be deduced from its immediate and wider normative context.[188]

The obligation of due regard sits in the context of a more general provision. Apart from upholding the obligation of due regard, Article IX provides that:

> States Parties to the Treaty shall pursue studies of outer space, including the moon and other celestial bodies, and conduct exploration of them so as to avoid their harmful contamination and also adverse changes in the environment of the Earth resulting from the introduction of extraterrestrial matter and, where necessary, shall adopt appropriate measures for this purpose. If a state Party to the Treaty has reason to believe that an activity or experiment planned by it or its nationals in outer space, including the moon and other celestial bodies, would cause potentially harmful interference with activities of other States Parties in the peaceful exploration and use of outer space, including the moon and other celestial bodies, it shall undertake appropriate international consultations before proceeding with any such activity or experiment. A state Party to the Treaty which has reason to believe that an activity or experiment planned by another state Party in outer space, including the moon and other celestial bodies, would cause potentially harmful interference with activities in the peaceful exploration and use of outer space, including the moon and other celestial bodies, may request consultation concerning the activity or experiment.

A combined reading of the different parts of the provision at stake already identifies two interests that states should take into account: the protection of the outer space environment and the freedom of other states to conduct activities in outer space without suffering from harmful interferences stemming from other states' activities.

This interpretation has the merit of avoiding 'fragmenting' Article IX OST and also reveals the 'all-encompassing nature' of the notion of corresponding interests, which would include both individual and community interests.[189] Whereas only the state whose activities are potentially interfered with has an interest in avoiding such interference, each and all states parties have a collective interest in the preservation of the outer space environment. In this vein, Article IX OST imposes an obligation of due regard which, depending on the interest at stake, is owed either to another state or to all other states parties to the OST (erga omnes partes).

This reading finds further support in the wider normative context. Other provisions of the OST uphold further interests either of an individual or a community character that states parties should consider under Article IX OST. The preservation of peace in outer space, protected under Article IV OST, is a case

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[187] See again, for instance, Art. I OST.

[188] See again Gardiner, supra n. 22, at 177.

[189] On the notion of community interest see S. Villalpando, The Legal Dimension of the International Community: How Community Interests Are Protected in International Law, 21(2) Eur. J. Int'l L. 387–419 (2010), doi: 10.1093/ejil/chq038.

in point. It allows the detection of a further collective interest that should be considered by any state carrying out activities in outer space.

The negotiating history of Article IX reinforces this claim.[190] A cursory look at the documents preceding the adoption of the Declaration of Legal Principles Governing the Activities of States in the Exploration and Use of Outer Space and its principle 6, in whose footsteps Article IX OST followed, reveals that states envisaged some sort of discussion among the states parties concerned any time space activities could have hindered the exploration and use of the outer space for peaceful purposes.[191]

Likewise, it has been noted that, based on other provisions of the OST, states (in particular, non-spacefaring ones) not only have the freedom to use and explore outer space, but also, inherently, an individual right to access outer space.[192] This also deserves to be taken into account under Article IX OST.

Concerning community interests, one could further question whether the obligation of due regard might at times be owed to the international community as a whole (and thus classified as an obligation erga omnes), notwithstanding the express reference in Article IX OST to the corresponding interests of 'State parties'. The answer depends on whether one concludes that the obligation of due regard under Article IX OST takes up, at least as far as certain interests are concerned, an obligation of general international law owed to the international community as a whole. While the issue of the status and reach of the obligation of due regard is examined infra, an 'affirmative view' has already been expressed by the OEWG on Reducing Space Threats, through Norms, Rules and Principles of Responsible Behaviours. According to a draft report of 18 August 2023[193]:

> The working group considered in particular the duty of 'due regard', which could be found in the Outer Space Treaty and other applicable treaties. The working group considered that understanding of the application of 'due regard' in a space context could be informed by its application in the context of the high seas. In this connection, it was noted that law of the sea case law has since indicated that the duty of due regard represents a balancing of rights and interests between and among States, and between States and the international community as a whole. In the context of outer space, this balancing of rights and interests could involve two dimensions: first, between and among spacefaring nations; and, second, between a spacefaring nation and the wider international community, as a whole. It was also noted that the application of due regard cannot be predetermined through a general rule because it depends on the specific circumstances of any situation (emphasis added).[194]

Surprisingly, this statement does not appear in a more recent version of the draft report dated 31 August 2023,[195] which emphasizes that: 'the working group noted the importance attached to the duty of "due regard" which could be found in the Outer Space Treaty and other applicable treaties. The working group considered that this matter should be further discussed in the relevant forums'.

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[190] On the hermeneutical value of preparatory works see Art. 32 VCLT.

[191] See the proposal by the USSR of a draft Declaration on Basic Principles. UN Doc. A/AC. 105/L.2, 10 Sep. 1962, Principle 6. The preparatory works leading to the Declaration are available at, https:// www.unoosa.org/oosa/en/ourwork/spacelaw/treaties/travaux-preparatoires/declaration-of-legal-prin ciples.html (accessed 5 Dec. 2023).

[192] See N. Romici Goldstein, Beyond Free Use: Stewardship, Orbital Debris and the Due Regard Standard in the Outer Space Treaty, 28 Auckland U. L. Rev. 137-164, at 150 (2022).

[193] UN Doc. A/AC.294/2023/CRP.1 of 18 Aug. 2023.

[194] Ibid., paras 9 and 10.

[195] UN Doc. A/AC.294/2023/CRP.1/Rev.1 of 31 Aug. 2023, para. 21.

That said, the notion of corresponding interests in Article IX raises at least two additional questions: first, has this notion expanded over time to include also interests not contemplated in the OST? Second, do 'interests-holders' only include states and the international community?

As to the first question, one could wonder whether interests that are not inferable from the OST or other norms of the corpus juris spatialis, such as the preservation of outer space cultural heritage, are nonetheless included among those to be taken into account under Article IX.

As far as the example of the preservation of outer space cultural heritage is concerned, in the absence of a regime for its protection,[196] the main interpretative 'aid' could come from states' subsequent practice.[197] One relevant example is the Artemis Accords, a set of non-legally binding provisions launched in 2020 and aimed at increasing the safety of operations, reducing uncertainty, and promoting the sustainable and beneficial use of space for all humankind, which, as of 1 December 2023, has received 32 signatories.[198] Under section 9 of the Accords, 'the signatories intend to preserve outer space heritage which they consider to comprise historically significant human or robotic landing sites, artifacts, spacecraft, and other evidence of activity on celestial bodies in accordance with mutually developed standards and practices'.

Yet, whilst subsequent practice by one or more states, which does not express the agreement of all states parties to a treaty, may well account as a supplementary means of interpretation, this kind of practice has limited interpretative value.[199]Therefore, it is doubtful if, for the time being, the Artemis Accords may constitute enough 'practice' to include the protection of space cultural heritage among those interests that should be taken into account under Article IX OST.

Similar considerations could be developed for other interests not specifically contemplated by the OST or, more generally, by the corpus juris spatialis.

Moreover, for those interests whose inclusion in Article IX OST is 'contentious', attention could be paid not only to subsequent practice, but, if existent, also to relevant international rules applicable among the parties.[200] This has been suggested, for instance, for the relevance that human rights or humanitarian considerations assume within the framework of the due regard obligation envisaged in the provisions of the UNCLOS, including those governing an area

[196] As to the possible shapes that this regime could take see inter alia, T. Scovazzi, Cultural Properties in Outer Space, in Cultural Heritage, Sustainable Development and Human Rights. Towards an Integrated Approach 82-92 (L. Pineschi ed., London, New York, 2024) and L. Lixinski, MM Loisier & H. Schreiber, Envisioning the Legal Framework for Outer Space Cultural Heritage, 45(1) J. Space L. 1–45 (2021).

[197] International Law Commission (ILC), Draft Conclusions on Subsequent Agreements and Subsequent Practice in Relation to the Interpretation of Treaties, With Commentaries, Yearbook of the International Law Commission, vol. II, part Two, Conclusion 4 (2018). The role that this practice plays under Art. 32 of the VCLT explains scholarly invitations to States to put in place conducts that could clarify the meaning of due regard, for instance with respect to its application to the creation of space debris. See for instance, J. Goehring, Can We Address Orbital Debris with the International Law We Already Have? An Examination of Treaty Interpretation and the Due Regard Principle, 85(2) J. Air L. & Com. 309–337 (2020).

[198] See s. 11(1): 'The signatories acknowledge and reaffirm their commitment to the Outer Space Treaty, including those provisions relating to due regard and harmful interference'. See also s. 11(3): 'Consistent with Article IX of the Outer Space Treaty, a Signatory authorizing an activity under these Accords commits to respect the principle of due regard'. The signatories who joined the Artemis Accords are listed at, https://www.nasa.gov/specials/artemis-accords/index.html (accessed 5 Dec. 2023). For a general note on this instrument and its text see among others, B. Bartoki-Gonczy & B. Nagy, The Artemis Accords, 62(5) International Legal Materials 888-898 (2023), doi: 10.1017/ilm.2023.17.

[199] See again ILC, supra n. 40, para. 33.

[200] Article 31.3(c) of the VCLT.

beyond national jurisdiction, such as the high seas.[201]

Concerning the second question raised above (i.e., if 'interests-holders' only include states and the international community), the reference to 'the interests of present and future generations' in Article 4 of the Moon Agreement could signal a shift from a merely intra-state perspective to one which also embraces an intergenerational equity approach.[202] Such a reading is however 'undermined' by the fact that the Moon Agreement is poorly ratified.[203] Article 4 of the Moon Agreement could accordingly only be given weight by considering it as a subsequent practice between one or more states under Article 32 VCLT.

Nonetheless, the same 'shift' could be upheld also by reading the obligation of due regard in Article IX OST in light of the principle of intergenerational equity, which has meanwhile emerged in international law. In both cases, this interpretation would lead to a conclusion that Article IX OST requires states parties to consider the long-lasting effects of their activities in outer space, also to the benefit of future generations.[204]

Finally, the type of interests and their importance are relevant factors to take into account when assessing which level of regard is due in practice.[205] This was emphasized by the International Law Commission which, in its comment to Article 71 of the Draft project on the Convention on the High Seas, found that 'the case is clearly one of assessment of the relative importance of the interests involved'.[206]

It could be contended, for instance, that community interests require a higher standard of care on the part of the state carrying out a specific space activity. It may furthermore be argued that, in the unlikely event that a conflict arises between an individual and a community interest that cannot be solved, the latter should generally prevail over the former.[207] Yet, in practice it may be difficult to distinguish between community and individual interests, one example being those activities that have an impact on the outer space environment and, as a result, interfere with non-spacefaring states' future access to outer space.[208]

Be that as it may, even though the 'variableness' inherent to the obligation of due regard is unavoidable and even necessary, it is also downsized by the identification of several sub-duties whose fulfilment

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[201] See T. Treves, Human Rights and the Law of the Sea, 28(1) Berkely J. Int'l L. 1-14, at 6 (2010).

[202] This could be seen as the result of the progressive emergence of the principle of inter and intragenerational equity in international environmental law. See e.g., Declaration of the United Nations Conference on the Human Environment, 16 Jun. 1972, UN Doc. A/CONF.48/14/Rev. 1, 3 (also known as Stockholm Declaration).

[203] As of 5 Dec. 2023, 18 States are parties to the Moon Agreement. On 5 Jan. 2023, Saudi Arabia notified the UN Secretary-General of its intention to withdraw from the Agreement with effect from 4 Jan. 2024. The low number of ratifications does not allow considering Art. 4 of the Moon Agreement applicable between the parties to the OST as per Arts 31.3(a) or 31.3(c) of the VCLT.

[204] On this principle see inter alia, E. Brown Weiss, Intergenerational Equity, Max Planck Encyclopedia of Public International Law (Apr. 2021), https://opil.ouplaw.com/display/10.1093/law:epil/ 9780199231690/law-9780199231690-e1421 (accessed 5 Dec. 2023).

[205] This conclusion may be inferred, by analogy, from the findings of the Arbitral Tribunal in The Chagos Marine Protected Area Arbitration case (Mauritius v. United Kingdom), judgment of 18 Mar. 2015, para. 519. The Tribunal found that no universal rule of conduct may be derived from the obligation of due regard in Art. 56 of the UNCLOS, as the extent of the regard required depends upon: (1) the nature of the rights at stake; (2) their importance; (3) the extent of the anticipated impairment; (4) the nature and importance of the activities contemplated by the acting State; (5) the availability of alternative approaches. These findings were taken into account also by the Arbitral Tribunal in its judgment in the case In the Matter of the South China Sea Arbitration (Philippines v. China), judgment of 12 Jul. 2016, para. 742. Art. 56 of the UNCLOS states: 'In exercising its rights and performing its duties under this Convention in the exclusive economic zone, the coastal state shall have due regard to the rights and duties of other States' (emphasis added).

[206] See Yearbook of the International Law Commission, vol. II 299 (1956).

[207] On this issue and the problems surrounding it see again Villalpando, supra n. 32, at 415 ff.

[208] See again Romici Goldstein, supra n. 35, at 150.

ensures compliance with the primary obligation. The following sections will consider whether the interests at stake may also influence the application of any of these sub-duties.

2.2 The obligation of due regard as a due diligence obligation?

It has been observed that the obligation of due regard implies that 'outer space is to be explored and used with due diligence'.[209] Hence, even though Article IX OST does not explicitly mention a duty of due diligence, it nonetheless incorporates it.

Accordingly, states must take all adequate measures and do their utmost to ensure that activities carried out in outer space – particularly by private entities that they authorize and supervise – do not disregard other states' interests.[210] Under this perspective, the obligation of due regard in Article IX OST can be characterized as an obligation of conduct.[211]

This reasoning mirrors that of the International Tribunal for the Law of the Sea in its advisory opinion on Coastal and State Flag Duties to Ensure Sustainable Fisheries Management.[212] There, the Tribunal found that the obligation of due regard in Article 58 UNCLOS[213] includes the 'due diligence obligation to ensure that states nationals engaged in fishing activities in the Exclusive Economic Zone of another state comply with the conservation measures and other conditions established in its law and regulations'.[214]

The Tribunal's findings originated from a legal provision whose wording, object, and context differ greatly from that of Article IX OST, first and foremost, because the obligation of due regard in Article 58 relates to states exercising sovereign rights. This circumstance could in abstract justify a different interpretation.[215] At the same time, however, there are common elements between the two provisions, particularly the fact that they both aim at pursuing a specific goal, which avails and supports a similar 'reading', albeit limited to due diligence.[216]

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[209] See again Marchisio, supra n. 2, at 175. This is not the only due diligence obligation in OST. On this specific aspect see inter alia, R. Deplano, Inclusive Space Law: The Concept of Benefit Sharing in the Outer Space Treaty, 72(3) Int'l & Comp. L. Q. 671–714 (2023), doi: 10.1017/S0020589323000234.

[210] On the nature of states' obligation to ensure see Seabed Dispute Chamber of the International Tribunal of the Law of the Sea, Responsibility and Obligation of States Sponsoring Persons and Entities with Respect to Activities in the Area, advisory opinion of 1 Feb. 2011, para-. 110. On the notion of due diligence see among many, A. Peters, H. Krieger & L. Kreuzer, Due Diligence: The Risky Risk Management Tool in International Law, 9(2) Cambridge Int'l L.J. 121–136 (2020), doi: 10.4337/cilj.2020.02.01.

[211] On the diverging views concerning the nature of obligations of conduct see inter alia, A. Ollino, Due Diligence Obligations in International Law 76 ff (Cambridge 2022).

[212] Advisory opinion of 2 Apr. 2015.

[213] Article 58 of the UNCLOS states that: 'In exercising their rights and performing their duties under this Convention in the exclusive economic zone, States shall have due regard to the rights and duties of the coastal State' (emphasis added).

[214] Paragraphs 124 ff. See also Arbitral Tribunal in the South China case, supra n. 48, paras 743 ff. See again Ollino, supra n. 54, at 129.

[215] See also International Tribunal of the Law of the Sea, The MOX Plant Case (Ireland v. United Kingdom), judgment of 3 Dec. 2001, para. 51 and C. Djeffal, Static and Evolutive Treaty Interpretation. A Functional Reconstruction 168 (Cambridge 2016). The author makes the example of the same term used in a human rights treaty and a treaty of regional economic integration, for which there may be good reasons for a different reading.

[216] Reference to provisions in other treaties as an aid to interpretation is a common practice for international and national tribunals and may help both identify the ordinary meaning of a certain term and set the provision at stake within the framework of the entire international legal system applicable at the time of the interpretation. This last criterion attaches value, inter alia, to other relevant rules of international law applicable in the relations among the parties (see again Art. 31 of the VCLT). On the customary status of the obligations of due regard in the law of the sea, see for instance, G. Zhang, A Discussion of 'Due Regard' in the United Nations Convention on the Law of the Seas, 2014(2) China Oceans L. Rev. 70-93, at 75 (2014).

The due diligence nature of the obligation of due regard could also be inferred from a combined reading of different parts of Article IX OST, connecting it to the no-harm rule in paragraph 2.[217] As has been noted, a state's obligation to take appropriate measures to avoid harmful contamination also requires due diligence.[218]

That stated, the Arbitral Tribunal in the The Matter of the South China Arbitration (Philippines v. China) case, while upholding the aforementioned International Tribunal of the Law of the Sea's view in the advisory opinion in the case Coastal and State Flag Duties to Ensure Sustainable Fisheries Management, justified its stance based on specific factors, such as the strict control of the coastal state on fishing in the Exclusive Economic Zone or the importance of fisheries in that same area.[219] This begs the question if, analogously, there are specific circumstances against which one should conclude – to use the Arbitral Tribunal's words – that 'anything less than due diligence' from the state 'would fall short of the obligation of due regard' under Article IX OST.

Whilst it might be hard to identify particular 'threshold factors' from which to infer the equation between due regard and due diligence (whatever the approach one follows), what seems certain is that the content of the due diligence obligation – like that of the due regard obligation to which it attaches – is also variable and may change depending on several elements, such as the level of resources a state can dispose of[220] or the risk a certain activity implies.[221] As noted by the Seabed Dispute Chamber of the International Tribunal of the Law of the Sea with respect to the Area:

> prospecting is, generally speaking, less risky than exploration activities which, in turn, entail less risk than exploitation. Moreover, activities in the Area concerning different kinds of minerals, for example, polymetallic nodules on the one hand and polymetallic sulphides or cobalt rich ferromanganese crusts on the other, may require different standards of diligence. The standard of due diligence has to be more severe for the riskier activities.[222]

This reasoning could apply mutatis mutandis to certain activities in outer space. As a result, one is prevented from detecting in Article IX OST a 'universal rule of conduct'.[223]

Still, there are general normative standards that provide some substance to due diligence, such as, first and foremost, that of reasonableness, according to which a state should act in the way a well-administered government would do.[224]

Concerning Article IX OST and outer space activities, one could thus wonder whether this parameter of 'good governmentality' finds a clarification in other treaty provisions or technical standards, which de

[217] For this connection see again Radi, supra n. 4.

[218] See again Marchisio, supra n. 2, at 177.

[219] See again Arbitral Tribunal in the South China case, supra n. 48, para. 744.

[220] See International Court of Justice (ICJ), Military and Paramilitary Activities in and Against Nicaragua, judgment of 27 Jun. 1986, para. 157.

[221] See again Seabed Dispute Chamber of the International Tribunal of the Law of the Sea, Responsibility and Obligations of States, supra n. 53, para. 117.

[222] Ibid.

[223] This conclusion was reached also by the Arbitral Tribunal in the Chagos case, supra n. 48, with respect to the obligation of due regard in Art. 56 of the UNCLOS, para. 519.

[224] See again Ollino, supra n. 54, at 168 ff. In light of the purported equation between due regard and due diligence, it does not surprise that scholarship has assumed that this standard also applies to the obligation of due regard, albeit in a different context (ice-covered area in the sea). See for instance, J. J. Solski, The 'Due Regard' of Article 234 of UNCLOS: Lessons from Regulating Innocent Passage in the Territorial Sea, 52(4) Ocean Development & International Law 398-418, at 417 (2021), doi: https://doi.org/10.1080/00908320.2021.1991866, noting, concerning the obligation of due regard in Art. 234 of the UNCLOS, that 'the provision's "due regard" duty imposes a normative standard of reasonableness'.

facto reduce states' discretion in the choice of the measures they should adopt to satisfy their obligation of conduct.

2.3 Procedural duties entailed by the obligation of due regard

Several arguments support the view that there are procedural obligations which inform the primary duty of due regard. These duties provide substance to the concept of due regard (as a standard and a primary obligation)[225] and also to its due diligence component. The next sub-sections will identify some of them. However, it should not be neglected that in academic literature it has been contended that due regard in Article IX OST entails further requirements inferable from general international law, such as the obligation to act in good faith, which – like the others that will be examined infra – would be necessary for a proper case-by-case assessment.[69]

2.3[a] The Duty to Undertake Appropriate Consultations

A first procedural sub-duty incorporated in the obligation of due regard is the duty to undertake appropriate consultations. This view relies on a combined reading of the obligation at stake and the obligation to avoid or minimize harmful interferences with other states' activities, which is also enshrined in Article IX OST.

This reading, and the equation between the two obligations that it underpins, appears in line with what the Arbitral Tribunal in the case The Chagos Marine Protected Area Arbitration (Mauritius v. United Kingdom) asserted for the obligation to refrain from unjustifiable interference in Article 194 UNCLOS and the obligation of due regard in Article 56 of the same instrument. The Tribunal considered the requirement to refrain from unjustifiable interferences with activities carried out by other states to be functionally equivalent to the obligation to give due regard to the rights and duties of other states.[70]

It could be argued that the Tribunal's pronouncement concerned a different provision (i.e., one imposing the obligation of due regard on states that exercise sovereign rights) and that this circumstance deprives it of any meaningful value for Article IX OST. Yet, 'interferences' with the freedom of use by the nationals of other states are also prohibited under the due regard obligation for another area beyond national jurisdiction, namely the high seas.[71] In the same vein, it has been proposed for the former Article 2 of the Convention on the High Seas[72] to interpret the 'reasonable regard' requirement provided therein as meaning that a state which is contemplating a particular use of the high seas should 'consider the interest of other states in their own use of the high seas and [...] adjust or qualify its activity (whether in method or manner or in point of place or time) so as to avoid

standard see C. E. Foster, Global Regulatory Standards in Environmental and Health Disputes. Regulatory Coherence, Due Regard and Due Diligence 3 ff (Oxford 2021). See also with respect to the law of the sea, M. Forteau, The Legal Nature and Content of Due Regard Obligations in Recent International Case Law, 34 (1) Int'l J. Marine & Coastal L. 25–42 (2019), doi: 10.1163/15718085-23341040. In this view, due regard could be conceived also as an international legal concept providing substance to a treaty norm (i.e., Art. IX OST).

69 See Romici Goldstein, supra n. 35, at 155–157.

70 See again Chagos case, supra n. 48, para. 540.

225 According to certain Authors, due regard is emerging at the global level as an autonomous regulatory standard, whose content should be better defined by adjudicators. On the concept of regulatory

[71] See United Nations Convention on the Law of the Sea. A Commentary 681 (A. Proelss ed., Munich 2017).
[72] Geneva, 29 Apr. 1958, entered into force 30 Sep. 1962, 450 UNTS 82.

or minimize unnecessary interferences with others'.[226] The same considerations have been put forward for activities in the deep seabed (or 'Area') which, according to Article 147 UNCLOS, should be undertaken with 'reasonable regard' to

other activities in the marine environment.[227]

Based on a systemic reading of Article IX OST, the equation between the obligation of due regard and the obligation to avoid or minimize harmful interferences with other states' activities allows arguing that the duty of due regard entails, at times (that is, when there is a risk of interference with other States activities), an obligation to undertake appropriate consultations.

Again, this view is not isolated. The already mentioned Arbitral Tribunal in the case The Chagos Marine Protected Area Arbitration, for instance, found that the due regard obligation in Article 56 UNCLOS implies, in the majority of cases, some sort of consultation with the state whose rights may be interfered with.[228]

This provision refers to a different scenario compared to Article IX OST. However, the same Tribunal found that the 'obligation to consult with or give due regard to' is a procedural rule constraining states' action set in several provisions of the UNCLOS, thus including those relating to areas beyond national jurisdiction.[229]Moreover, for the deep seabed, it has been noted that the requirement of reasonable regard imposes, inter alia, the obligation to analyse whether a certain use interferes with another and this may require consultations with other parties concerned.[230] This view, elaborated for global commons, can by analogy also be applied to Article IX OST. As a result, the obligation of due regard in this provision implies the duty to consult with the states whose interests may be interfered with by the activities at stake.

This reading finds further support both in the negotiating history of Article IX OST and in the aforementioned draft report by the OEWG on Reducing Space Threats, through Norms, Rules and Principles of Responsible Behaviours of 18 August 2023.

As to the former, it has been noted already how the preparatory works concerning Article IX point at the drafters' underlying idea of envisaging some sort of preventive discussion among the States concerned any time activities carried out in outer space could have undermined their use for peaceful purposes.

As to the latter, the Group pointed at the 'availability of consultations as a means to ensure compliance with the duty of due regard' in Article IX OST.[231]

At the same time, however, state practice denotes a scarce reliance on consultations even when activities are carried out that could interfere with other states' activities. Kinetic ascent-descent anti-

[226] D. Anderson, The Principle of Reasonableness in the Law of the Sea, in Coexistence, Cooperation and Solidarity. Liber Amicorum Rüdiger Wolfrum 660 (H. P. Hestermeyer et al eds, Leiden, Boston 2012). On the corresponding meaning of the expressions 'due regard' and 'reasonable regard' see ICJ, Fisheries Jurisdictions (United Kingdom v. Iceland), judgment of 25 Jul. 1974, para. 68.

[227] See again Proelss, supra n. 71, at 1041.

[228] See again the Chagos case, supra n. 48, para. 519.

[229] Ibid., para. 322.

[230] See again Proelss, supra n. 71, at 1041.

[231] See again UN Doc. A/AC.294/2023/CRP.1, supra n. 36, para. 10. However, this statement did not appear in a subsequent version of the same report. See again UN Doc. A/AC.294/2023/CRP.1/ Rev.1, supra n. 38.

satellite weapons tests are a case in point.[232] States performing them have generally not undertaken previous consultations with other states despite the risk they pose for their individual and community interests, but this seems to be a violation of the duty rather than evidence of its 'limited' content.

The obligation to carry out appropriate consultations de facto entrusts the states involved with a sort of 'contractual freedom'[233] in making a balance between the interests at stake in light of the circumstances, which is functional to avoid or minimize the risk of harmful interferences. States could for instance acquire in advance information concerning ongoing space activities to assess the risk of interference and could discuss the availability of alternative (less harmful) solutions.

2.3[b] The Duty to Cooperate

A similar reasoning applies to the principle of cooperation and mutual assistance that Article IX OST upholds; based on an overall approach to Article IX OST, it can be argued that the obligation of due regard also encompasses a duty to cooperate.

If read in light of other provisions of the OST and the corpus juris spatialis, this duty would imply, as a minimum, that states should provide information concerning the conduct, nature and location of their activities.[234] Hence, the obligation of due regard could be operationalized by providing other states with sufficient information to enable them to understand how their interests may be undermined. Or, in a broader sense, it could mean that states should do their utmost to ensure equal participation by all – including non-spacefaring states – in the exploration and use of a common good.[235]

The above reading finds further support in the wider normative context. The duty to cooperate represents a common feature of the legal regimes governing common spaces[83] (notwithstanding the potential differences as to its consequences in each of them)[84] where it has often been framed as a component of the obligation of due regard. This is evident in the recently adopted Agreement on the Conservation and Sustainable Use of Marine Biological Diversity of Areas beyond National Jurisdiction. Even though not yet into force, its Article 11 requires states, when collecting marine genetic resources in areas beyond national jurisdiction, to pay due regard, inter alia, to the interests of other states in those areas and, to this end, provides that parties should cooperate, as appropriate. The Agreement is more advanced than the OST as it envisions a specific mechanism – an open-access platform – to facilitate such cooperation.[85]

Yet, at least as far as the community interest in the preservation of the outer space environment is concerned, the mandate to adopt more specific mechanisms of cooperation as part of the obligation of due regard could be inferred from general international law.[86] Article 24 of the Stockholm Declaration on the Human Environment[87] reads, for instance, that:

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[232] States contesting these tests, however, have been cautious in relying on Art. IX OST. See for instance, the existing debate about whether the protest of Japan against the ASAT test performed by China in 2007 was based or not on an alleged breach of Art. IX OST. See A. Azcarate Ortega, Placement of Weapons in Outer Space: The Dichotomy between Word and Deed, Lawfare (2021), https://www.lawfaremedia.org/article/placement-weapons-outer-space-dichotomy-between-word-and-deed (accessed 5 Dec. 2023).

[233] This expression is used in A. O. Elferink, Coastal State and MPAS in ABNJ: Ensuring Consistency with the LOSC, in Conserving Biodiversity in Areas beyond National Jurisdiction 72 (D. Freestone ed., Leiden, Boston 2019).

[234] See Art. XI of the OST.

[235] As to the approach to cooperation inherent to the OST see inter alia, R. Wolfrum, Cooperation, International Law, Max PlanckEncyclopedia of International Law(Apr. 2010), https://opil.ouplaw.

Co-operation through multilateral and bilateral arrangements or other appropriate means is essential to effectively control, prevent, reduce and eliminate adverse environmental effects resulting from activities conducted in all spheres, in such a way that due account is taken of the sovereignty and interests of all States (emphasis added).

com/display/10.1093/law:epil/9780199231690/law-9780199231690-e1427?prd=EPIL (accessed 5 Dec. 2023). See also Declaration on International Cooperation in the Exploration and Use of Outer Space for the Benefit and in the Interest of All States, Taking into Particular Account the Needs of Developing Countries, UN Doc. A/RES/51/122 of 4 Feb. 1997.

83 See also Antarctic Treaty (Washington, 1 Dec. 1959, entered into force on 23 Jun. 1961, 402 UNTS 71), Art. I.

84 See again Wolfrum, supra n. 82.

85 For the connection existing between the due regard obligation and the duty to cooperate in the UNCLOS and general international law see instead Forteau, supra n. 68, at 32 ff.

86 The hermeneutical relevance of this – and similar – general international law provisions rests on the need to take into account all relevant rules applicable among the parties as per Art. 31 of the VCLT. Moreover, as recognized by the International Court of Justice, the need to make allowance, among other things, to the developments in international law is particularly at stake when the parties have used generic terms in a treaty and the treaty is of continuing duration, such as is the case for the expression 'due regard' in OST. The ICJ has analogously considered the term 'rights' a generic one. See ICJ, Aegean Sea Continental Shelf case (Greece v. Turkey), judgment of 19 Dec. 1978, par. 78. In these cases, the parties are presumed to have intended the relevant terms to have an evolving nature. See ICJ, Certain Activities Carried Out by Nicaragua in Border Area (Costa Rica v. Nicaragua), judgment of 16 Dec. 2015, para. 66.

87 Stockholm Declaration, supra n. 45. The duty to cooperate is enshrined in other international instruments concerning the protection of the environment, such as, for instance, Art. 19 of the Rio Declaration on Environment and Development (adopted on 14 Jun. 1992, UN Doc. A/CONF151/ 26 (Vol. I)).

2.3[c]The Obligation to Undertake a Prior Impact Assessment

In addition to the sub-duties already examined, it might be debated whether an obligation to conduct a prior assessment of the potential impacts of an envisaged activity could also be subsumed in the obligation of due regard under Article IX OST.

Scholars have proposed such an interpretation, for instance, with respect to the obligation of reasonable regard in the deep seabed, as per Article 147, paragraph 1, UNCLOS. It has been pointed out how this obligation should be operationalized by providing that states, first of all, assess in advance what other activities are planned or conducted in the vicinity of the ones they want to conduct and whether they may interfere with each other.[236] The same reasoning could apply to outer space activities and the obligation of due regard in Article IX OST.

What is more, the obligation of due regard in Article IX OST could be read in light of the general obligation concerning environmental impact assessment,[237] at least when the preservation of the outer space environment is the community interest to be taken into account. It is indeed a 'requirement under general international law to undertake an environmental impact assessment where there is a risk that the proposed [...] activity may have a significant adverse impact'[238] not only in a transboundary context but also 'on the environment in an area beyond national jurisdiction'.[239]

236 See again Proelss, supra n. 71, at 1014.

237 On its customary nature see again Seabed Dispute Chamber of the International Tribunal of the Law of the Sea, Responsibility and Obligations of States, supra n. 53, para. 145.

238 ICJ, Pulp Mills on the River Uruguay (Argentina v. Uruguay), judgment of 20 Apr. 2010, para. 204.

239 See again Seabed Dispute Chamber of the International Tribunal of the Law of the Sea, Responsibility and Obligations of States, supra n. 53, para. 148. This obligation is also enshrined, inter alia, in Principle 17 of the Rio Declaration on Environment and Development, supra n. 87.

General international law does not however spell out the content and scope of the environmental impact assessment requirement,[240] with the consequence that only the adoption of more precise indications as to its application to activities in outer space could ensure more specificity.

2.3[d]Towards a Further 'Proceduralization' of the Obligation of Due Regard?

Apart from the above-mentioned broad 'sub-duties' the obligation of due regard in Article IX OST may have undergone a further 'proceduralization' in general or for more specific scenarios (according to a sort of 'customized approach'), i.e., its vagueness may have been progressively eroded by additional 'parameters' that help clarify how states should fulfil their primary duty.

Under this perspective, soft law instruments and technical guidelines, which, as Dupuy noted in 1990, can help define the standard of good behaviour that is

expected from a state, may provide useful indications.[241]

One example, among many, are the Space Debris Mitigation Guidelines of the Committee on the Peaceful Uses of Outer Space,[242] which are the result of the work of the Committee itself and its Scientific and Technical Sub-Committee. These Guidelines present themselves as 'a prudent and necessary step towards preserving the outer space environment' (hence, a community interest),[243] but also aim at reducing the risks that space debris poses for the operation of spacecraft. Accordingly, they envisage several measures whose implementation helps preserve the outer space environment and minimize the risk of interference with other states' activities. Examples of these measures are that 'all on-board sources of stored energy should be depleted or made safe when they are no longer required for mission operations or post-mission disposal' or that 'spacecraft and launch vehicle orbital stages that have terminated their operational phases in orbits that pass through the LEO (Low Earth Orbit) region should be removed from orbit in a controlled fashion'.[244] The Guidelines, however, do not – at least explicitly – link the envisaged measures to Article IX OST.

Along the same line, one could expect that useful indications on the operationalization of the obligation of due regard will come from the work of the Working Group on Legal Aspects of Space Resources Activities, which was established in 2022 with a five-year mandate to formulate a set of guiding principles and practical recommendations for states engaging with this kind of activities.[245]

Notably, no guidance has emerged from the work of the OEWG on Reducing Space Threats, through Norms, Rules and Principles of Responsible Behaviours, even though several states[246] and the European Union had noted the need for 'further discussions to shape a common understanding of the concept (…) of 'due regard' (…) and [its] implementation by states' (emphasis added).[247]The Japanese delegation, for instance, observed that:

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[240] Seabed Dispute Chamber of the International Tribunal of the Law of the Sea, Responsibility and Obligations of States, supra n. 53, para. 149.

[241] P-M. Dupuy, Soft Law and the International Law of the Environment, 12(2) Michigan J. Int'l L. 420-435, at 434 (1990).

[242] Endorsed by the UN General Assembly through resolution No. 62/2017 of 22 Dec. 2007, UN Doc. A/RES/62/2017 of 1 Feb. 2008.

[243] Ibid., at 1.

[244] Guidelines 5 and 6.

[245] See UN Doc. A/76/20 of 21 Oct. 2021.

[246] See e.g., Iran's comments on Possible Elements on Items 6(a) and 6(b) of the Agenda of the OEWG (23 Feb. 2023).

[247] See EU Joint contribution to the works of OEWG, 14 Jun. 2023, UN Doc. A/AC. 294/2023/WP. 18.

> the international community does not have a common understanding as to what exactly consists a 'due regard', 'harmful interference' or 'consultation'. This lack of common understanding could be mentioned as an example where existing legal frameworks fall short of addressing emerging threats in outer space, and thus could be discussed at the first session of this [Open-Ended Working Group].[248]

Whereas any discussion on the 'operationalization' of due regard in the context of the broad mandate of the OEWG would likely have led to generic indications, it is unfortunate that in its draft final report the Group only acknowledged the relevance of due regard, and that no consensus was reached on a final report to the UN General Assembly.[249]

That said, the opportunity to rely on soft law instruments to operationalize obligations of flexible context has not found unanimous support. It has been argued, for instance, that this development would represent states' 'abdication' from their regulatory powers.[250]

Under this perspective, a significantly different case is that of the Artemis Accords, which, as stated, represents a political commitment endorsed by 32 signatories. Section 11 of the Accords explicitly refers to the obligation of due regard in Article IX OST. By this provision, signatories commit, inter alia, 'to provide each other with necessary information regarding the location and nature of space-based activities under these Accords if a signatory has reason to believe that the other signatories' activities may result in harmful interference with or pose a safety hazard to its space-based activities'. Moreover, under the same section, they express the intention to 'provide notification of their activities and commit to coordinating with any relevant actors to avoid harmful interference' in so-called 'safety zones', which are defined as areas 'in which nominal operations of a relevant activity or an anomalous event could reasonably cause harmful interference'. The signatories also enlist several principles related to safety zones, which they commit to use for scientific discovery or extraction and utilization of space resources, and which other states commit to respect.

The creation of safety zones and the identification of specific requirements for signatories represent an interesting way to operationalize the due regard obligation enshrined in Article IX OST, which mirrors, at least in part, the regime envisioned in Article 147, paragraph 2, of the UNCLOS for the Area.

Still, despite the explicit reference to the obligation of due regard, the Artemis Accords remain a non-legally binding instrument which has been endorsed, for the time being, by a limited number of signatories. Even though this includes most spacefaring states, this circumstance has little value for the operationalization of a duty that is owed also to non-spacefaring states and the international community.

What is more, the provision of safety zones and the requirements coming with it does not exclude that there may be other means to discharge the obligation of due regard[251] or that their application should be extended beyond their original scope.

Two elements, however, appear as particularly relevant and appreciable in this respect: first, the signatories 'intend to use their experience under the Accords to contribute to multilateral efforts to

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[248] See the statement of the Delegation of Japan at the First Session of the OEWG (9 May 2022).

[249] The 4th session of the Working Group, which took place from 28 Aug. to 1 Sep. 2023, was characterized by the opposition of the Russian Federation and other allied countries.

[250] See M. Koskenniemi, International Law and Hegemony: A Reconfiguration, 17(2) Cambridge Rev. Int'l Aff. 210–211 (2004), doi: 10.1080/0955757042000245852.

[251] Other proposals have included, for instance, that of providing for something similar to a 'Social License to Operate' for extraction activities. See again Bittencourt, Hofmann, Masson-Zwaan & Stefoudi, supra n. 5, at 58.

further develop international practices, criteria, and rules applicable to the definition and determination of safety zones and harmful interference'[252]; second, they intend to use their experience under the Accords to develop international practices and rules with respect to interests that so far have been neglected, such as the protection of space cultural heritage.[253]

3 THE 'REACH' OF THE OBLIGATION OF DUE REGARD

The analysis undertaken in the previous section concerning the content of the obligation of due regard under Article IX OST raises two additional questions: whether this obligation could find concrete application despite the concurrence of other relevant rules and whether – and to what extent – it exists independently from the treaty provision at stake.

As to the former question, most of the sub-duties that the obligation of due regard arguably incorporates also have an autonomous nature, generally inferable from OST provisions. Furthermore, for specific 'interests', these sub-duties equate general international rules which are also applicable to outer space activities. An example is the duty to cooperate about environmental matters, which has constantly been recognized as a 'fundamental principle' of international environmental law.[254]

The reach of the due regard obligation does not end, however, with any of the sub-duties it allegedly incorporates. On the one hand, abidance by the duty to cooperate or the duty to undertake appropriate consultations, if taken in isolation, would likely not be enough for the state party to discharge its obligation of due regard. On the other hand, rules of general international law have a limited 'role' considering the multitude of interests that might be imperiled and the fact that no general rule exists which applies to outer space activities (one could think once again, for instance, about the protection of outer space cultural heritage).

It follows from the above that the practical role of the obligation of due regard in Article IX OST is not marginal.

The question whether the obligation of due regard exists beyond Article IX OST is however a different matter. Some authors have argued that the obligation of due regard is an 'organizing principle' of wide reach.[255] Others have questioned its customary status.[256] Whereas these arguments have been advanced mostly in relation to the status of this obligation under the UNCLOS, nothing prevents similar questions with respect to the obligation of due regard under different legal regimes, such as that governing outer space, or under the international legal framework as a whole. One could wonder indeed whether the obligation of due regard in Article IX OST reflects either a general principle of law or a customary rule, as such binding for all states, including those that are not party to the OST.

Concerning the former scenario, there is an emerging consensus that the expression 'general principles of law' includes both principles originating in municipal legal systems and principles that are derived

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[252] See s. 11.

[253] See s. 9.

[254] See again Wolfrum, supra n. 82.

[255] B. X. Oxman, The Principle of Due Regard, in The Contribution of the International Tribunal for the Law of the Sea to the Rule of Law: 1996–2016 108–117, at 113 (Leiden, Boston 2018).

[256] See again Zhang, supra n. 59, at 89.

directly from the international legal order.[257] In this perspective, whereas the concept of due regard is not alien to domestic legal systems,[258] when scholars and states use the expression 'principle' for it,[259] they seem to do so having in mind a principle originating from the international legal system. This is made evident also by the fact that scholars do not usually mention national space legislation.

The very circumstance that due regard features not only in Article IX OST and the Moon Agreement, but also in declarations of principles, such as the Declaration of Legal Principles Governing the Activities of States in the Exploration and Use of Outer Space and in the Principles Relating to Remote Sensing of the Earth from Outer Space, could further support the thesis of its 'international origin'.

In the law of the sea domain the idea of the existence of an organizing principle of due regard with a gap-filling function has found 'legitimacy' in the case law,[260] but this 'recognition' is still lacking for the corpus juris spatialis. Yet, the case law on the law of the sea could be seen as a signal of the existence of a general legal principle of due regard that transcends single branches of international law (likely limited to areas with common traits, such as those beyond national jurisdiction).[261]Likewise, it could be argued that a general principle of due regard exists in the law of outer space. But both issues require further study to come to a definitive answer.

Due to the lack of case law on this matter, any attempt to invest the duty of due regard with customary status meets similar challenges. On the one hand, there are several factors, such as its recurrence within the corpus juris spatialis and in provisions governing areas beyond national jurisdiction, the conduct of states in connection with resolutions adopted by international organizations – such as in the case of the already mentioned set of principles concerning outer space – [262]and states' statements concerning the due regard obligation, which could be classified, at least in principle, as forms of state practice or opinio juris to detect the existence of a customary rule.[263]

On the other hand, at a closer look, these provisions and statements depict a heterogenous picture. As seen from the previous analysis, there are terminological differences among the treaty provisions upholding the obligation of due regard, which often also imply a distinct content. What is more, states' statements so far have neither acknowledged expressis verbis the customary status of the obligation under exam nor featured that amount of consistency concerning its characters and rationale that would allow inferring without hesitation the existence of an international custom.[264] The lack of relevant national space legislation makes the issue even more complex.

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[257] See among others, G. Gaja, General Principles of Law, Max Planck Encyclopedia of Public International Law (Apr. 2020), https://opil.ouplaw.com/display/10.1093/law:epil/9780199231690/law-9780199231690e1410 (accessed 5 Dec. 2023).

[258] See for instance, J. B. Wiener, Disregard and Due Regard, 29(3) N.Y.U. Envtl. L. J. 437–461 (2021).

[259] For states using this expression see for instance, the statement by the Canadian representative quoted in the Introduction.

[260] The International Tribunal for the Law of the Sea, for instance, has reached such a conclusion in its judgment in the Bay of Bengal case. See Dispute Concerning the Delimitation of the Maritime Boundary in the Bay of Bengal (Bangladesh v. Myanmar), judgment of 14 Mar. 2012, para. 475.

[261] This is the view expressed by the Philippines. See The Duty of Due Regard as a Foundational Principle of Responsible Behavior in Space, UN Doc. A/AC. 294/2022/WP. 12 of 11 May 2022.

[262] On the value of these Declarations of Principles to consolidate international customary law see inter alia, S. Marchisio, The Law of Outer Space Activities 38 (Rome 2022).

[263] See ILC, Draft Conclusions on the Identification of Customary International Law, 2018, in Yearbook of the International Law Commission, vol. II, part Two, in particular Conclusions 6 and 10 (2018).

[264] See e.g., the various statements on due regard released by states' representatives within the OEWG on Reducing Space Threats through Norms, Rules and Principles of Responsible Behaviours.

Against this background it appears contentious if, and to what extent, the obligation of due regard under Article IX OST currently constitutes a rule of general international law, binding for all states. One could argue that a customary obligation has been emerging for outer space and other global commons, requiring states to act with due regard for certain interests of the international community as a whole, such as the preservation of the environment or international peace. But it is difficult to reach a similar conclusion for different applications of the due regard obligation.

4 CONCLUSIONS

Despite the uncertainties concerning its status under general international law and the existence of concurring obligations, it is beyond doubt that the duty of due regard enshrined in Article IX OST plays an increasingly important role. Given the proliferation of competing interests in outer space and on celestial bodies, its concrete implementation is urgent.

The analysis undertaken in this contribution has allowed to substantiate the content of this obligation by clarifying the kind of interests that should be taken into account and by identifying several of its sub-duties and how they might orientate the balancing process it implies. Despite the lack of interpretative practice on Article IX OST, important indications can be inferred from the immediate and wider normative context in which it sits.

Yet, the full and effective implementation of a treaty provision of flexible content is generallyensuredthrough thedevelopment ofmoreconcreteframeworks that operationalizeitsapplicationvis-à-viscurrentchallenges.Theelaborationoftheseframeworksmay occur at the multilateral level, either through the adoption of treaties or, more generally, withininternationalorganizations.[265]Thislastoptionhasbeenprospected,forinstance,in relation to the International Seabed Authority's role in envisioning a framework that could clarify how to balance competing interests in the Area, thus operationalizing the duty of due regard contained in the relevant provisions of the UNCLOS.[266]

In the space sector, the most 'explicit' advanced efforts towards the operationalization of the due regard duty in Article IX OST (i.e., the Artemis Accords) have originated, so far, from outside an 'institutional context' through an initiative, which, whilst endorsed by several signatories and much appreciable in terms of envisioned solutions, is still far from reaching global consensus. Remarkably, however, this initiative presents itself as a 'starting point', by stating signatories' willingness to contribute to further multilateral efforts towards a more detailed framework.

The likeliness that such efforts will take place connects to broader issues, such as the long-standing difficulties in reaching consensus for wide-ranging binding agreements in the sector. The fact that no agreement was reached in the OEWG on Reducing Space Threats, through Norms, Rules and Principles of Responsible Behaviours concerning a final report to be submitted to the UN General Assembly might be read as additional evidence of these difficulties. Whereas the OEWG might not be the most appropriate forum to engage in a definitional exercise of the obligation of due regard – as argued by

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[265] Y. Long, The Role of the International Seabed Authority in the Implementation of 'Due Regard' Obligation under the LOSC: Addressing Conflicting Activities, 8(1) J. Territorial & Mar. Stud. 27–46 (2021).

[266] Ibid.

certain states, primarily the United States – [267] it has become clear that the existence of diverging views could hinder any future multilateral operationalization process.

It is hoped that this impasse will be overcome in the future and that states will agree, at least for the most pressing issues, on a detailed framework to operationalize the duty of due regard, thus contributing to its concrete implementation.

[267] See supra n. 12.

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Unidentified Orbital Debris: The Case for a Market-Share Liability Regime

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Unidentified Orbital Debris: The Case for a Market-Share Liability Regime

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Introduction

We stand today on the threshold of a new space age. Public interest in space activity is strong and signs of vitality in space are everywhere.[1] The Space Shuttle continues to fly regularly, NASA's program to explore Mars has been aggressive, and the construction of the International Space Station has commenced.[2] Private industry also has a firm first foothold in space. Telecommunication companies, for example, plan to envelop the Earth with satellite constellations in order to make global wireless broadband Internet access a practical reality.[3] With the development of a reusable launch vehicle, the cost of achieving orbit will fall and the full vigor of the free market will be unleashed.[4] At that point, various space

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1. *See Mars Trip is Declared a Success*, L.A. TIMES, Aug. 9, 1997, Metro, at 1. The NASA webcast of the Mars rover mission in 1997 was "the largest Internet event in the history of the world." *Id.*

2. *See Mission to Mars Gives New Life to Space Program*, N.Y. TIMES, July 20, 1997, Late Ed. (Final), at A2. Admittedly, the string of NASA missions to Mars have included some embarrassing failures. *See* Usha Lee McFarling, *NASA Failures Blamed on Policies*, L.A. TIMES, Mar. 14, 2000, at A3. Despite these setbacks, NASA plans to persevere in the exploration of Mars. *See* Keay Davidson, *Bouncing Back, NASA Plans Mars Mission*, S.F. EXAMINER, July 28, 2000, at A15.

3. *See* ESA SPACE DEBRIS MITIGATION HANDBOOK, at 4.2-1, European Space Agency (Release 1.0, 1999) [hereinafter ESA HANDBOOK].

4. A reusable launch vehicle, or RLV, does not rely on disposable rocket

industries, such as meteor mining, zero gravity manufacturing, and tourism, will emerge.[5]

Our fledgling space industry, however, faces a grave danger. The volume of orbital debris has become so great that collisions are already commonplace. As the debris population continues to grow, the costs resulting from collisions will eventually smother the industry.

The most effective way to protect the space industry from the crushing costs of orbital debris is to internalize the costs so that those who are responsible for creating the hazard pay for any damage to innocent parties. This internalization can be achieved by assigning liability to those responsible for creating the debris. The United Nations Convention on International Liability for Damage Caused by Space Objects (Liability Convention) already internalizes some debris-related costs by means of a fault-based liability regime for damage caused by space objects.[6] The Convention only partially succeeds in internalizing debris-related costs, however, because its provisions only reach damage caused by larger pieces of debris.[7] The scope of the Liability Convention is limited in this way because the fault standard requires that the owner of the harmful space object be identified. Identification, in turn, requires that the debris fragment be

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boosters to break free of Earth's gravitational pull, as does the Space Shuttle. The mass-production of RLVs may be close at hand due to the establishment of the X-Prize, a privately funded contest which offers an award in excess of ten million dollars to the inventor of the first RLV. *See* X PRIZE Foundation, *X-Prize Homepage* (visited Mar. 5, 2000) <http://www.xprize.org>. Eighteen teams from around the world have entered the competition and a winner is on the horizon. *See id.* The aerospace establishment as well as entrepreneurs unaffiliated with the X-Prize have also taken up the RLV challenge. *See* Erick Schonfeld, *Going Long*, FORTUNE, Mar. 20, 2000, at 172-92. Lockheed, for example, has developed a prototype RLV called the X-33. *See id.* at 174.

Some private companies, including Martin Marrieta, General Dynamics, McDonnell Douglas, and Space Services of Texas, already provide limited space delivery services. *See* Christopher Myers and Jonathan Ball, *Trends in Commercial Space 1996: Space Transportation* (visited Mar. 3, 2000) <http://www.ta.doc.gov/space/tics/spctrans.htm>.

5. *See* Schonfeld, *supra* note 4, at 174, 179. In fact, space tourism has already begun. *See Former JPL Scientist to Visit Mir Space Station as Tourist*, L.A. TIMES, June 17, 2000, at B7. The first space tourist, Dennis Tito, will pay approximately twenty million dollars to spend ten days on the rehabilitated Mir space station, now owned by the Dutch company MirCorp. *See id.*

6. Convention on International Liability for Damage Caused by Space Objects, art. III, Mar. 29, 1972, 24 U.S.T. 2389, T.I.A.S. No. 7762, 961 U.N.T.S. 187 [hereinafter Liability Convention].

7. *See* discussion *infra* Part III.

continuously tracked from Earth throughout its orbital lifetime. Currently, however, governments only track debris fragments with a diameter over ten centimeters.[8] Smaller fragments are not tracked and therefore nobody can be held liable for any damage caused by these fragments. This problem of identification is a very serious matter because small objects make up by far the largest and most dangerous class of debris. These objects already number in the trillions and are ever increasing.

Market-share liability solves the unidentified orbital debris problem. Market-share liability has been successfully applied in situations where several parties contribute to a dangerous condition but where no clear causal link ties a particular party to the harm caused by the condition. This solution has been proposed by a handful of commentators over the years but no mechanism for imposing market-share liability in outer space has yet been devised.

This Note explores the threat of unidentified orbital debris and proposes a mechanism for imposing a form of market-share liability. Part I describes the nature of the unidentified debris threat. Part II describes how various agencies track debris and explains the limitations of debris identification. Part III discusses international law relevant to space debris.[9] Part IV exposes the weaknesses of some previously proposed solutions to the unidentified debris problem. Part V argues that market-share liability is the best way to internalize the costs of unidentified debris damage. Finally, Part VI proposes an amendment to the Liability Convention that applies market-share liability to damage caused by unidentified orbital debris.

This Note comes on the heels of UNISPACE III, the third annual conference of the United Nations Committee on the Peaceful Uses of Outer Space (UNCOPUOS), which took place in July 1999.[10] At the meeting, the Scientific and Technical Subcommittee made public the fruits of a five-year study of the orbital debris problem.[11] In

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8. *See* discussion *infra* Part II.

9. *See generally* Howard A. Baker, *Space Debris: Law and Policy in the United States*, 60 U. COLO. L. REV. 55 (1989) (discussing United States space law and policy); *see also* Jennifer M. Seymour, *Containing a Cosmic Crisis: A Proposal for Curbing the Perils of Space Debris*, 10 GEO. INT'L ENVTL. L. REV. 891, 903-06 (1998).

10. *See* U.N. Office of Outerspace Affairs, *UNISPACE III Homepage* (visited Mar. 4, 2000) <http://www.un.org/events/unispace3/>.

11. *See* TECHNICAL REPORT ON SPACE DEBRIS, Scientific and Technical Subcommittee of the United Nations Committee on the Peaceful Uses of Outer

April 1999, the European Space Agency also released a detailed study of space debris and debris mitigation.[12] These new studies will provide the technical foundation for the next generation of orbital debris scholarship. I was fortunate to have access to these sources while writing this Note.

I. The Nature of the Debris Threat

The United Nations will only address the unidentified debris problem when the international community is convinced that space debris poses a significant threat to our future in space. This Part describes the current state of the debris problem and explains how this problem, if ignored, will eventually reach crisis levels.

A. *The Debris Population*

The phrase "space debris" refers to all non-functional man-made space objects.[13] There are four categories of debris: (1) inactive payloads, (2) operational debris, (3) fragmentation debris, and (4) microparticulate debris.[14] Inactive payloads are defunct satellites that drift through space.[15] Operational debris includes anything released into space during the course of a mission, such as spent rocket stages, exploding bolts, and lens caps ejected prior to camera operation.[16] Fragmentation debris, which makes up the greatest segment of the debris population, consists of fragments born of collisions and explosions.[17] Microparticulate debris consists largely of paint chips from deteriorating surfaces and particles created by the burning of solid rocket fuels.[18]

Debris can also be divided into three size groups: (1) "large"

Space, U.N. Doc. A/AC.105/720 [hereinafter TECHNICAL REPORT].

12. ESA HANDBOOK, *supra* note 3.

13. *See* TECHNICAL REPORT, *supra* note 11, at 2. The Technical Subcommittee for UNCOPUOS defines debris as including "all man-made objects, including their fragments and parts, whether their owners can be identified or not, in Earth orbit or re-entering the dense layers of the atmosphere that are non-functional with no reasonable expectation of their being able to assume or resume their intended functions or any other functions for which they are or can be authorized." *Id.*

14. *See* Seymour, *supra* note 9, at 893; *see also* Delbert D. Smith, *The Technical, Legal, and Business Risks of Orbital Debris*, 6 N.Y.U. ENV'TL. L.J. 50, 52 (1997).

15. *See id.*

16. *See id.*

17. *See id.; see also* ESA HANDBOOK, *supra* note 3, at 2.2-1 to 2.2-4 (cataloguing 144 known space object fragmentations caused by explosions and collisions).

18. *See id.*

objects with a diameter over ten centimeters, (2) "medium" objects with a diameter between ten centimeters and one millimeter, and (3) "small" objects less than one millimeter in diameter.[19] As a result of the almost 3900 space missions launched since 1957,[20] there are now approximately 15,100 "large" pieces of debris adrift in Low Earth Orbit (LEO).[21] Smaller debris is far more numerous: tens of millions of "medium"-sized pieces of debris float in space while trillions of "small" pieces wash across the orbits like waves of sand.[22]

Medium and small fragmentation debris is particularly dangerous because this debris typically travels much faster than large debris and can be shot in any direction by the explosive force of a collision.[23] An individual piece of debris may reach speeds up to fifteen kilometers per second (54,000 kilometers per hour).[24] At this speed, a fragment the size of a bullet could torpedo a space station or destroy a satellite.[25] A much smaller fragment would easily pierce an astronaut's suit.[26] Even small particles traveling at a relatively low speed can over time degrade the surfaces of spacecraft components.[27] Disturbingly, ninety-nine percent of all orbital debris is composed of this deadlier class of debris with a diameter under ten centimeters.[28]

B. The Risk of Collision

Any spacecraft that spends a significant amount of time in orbit will inevitably collide with some type of debris.[29] A partial list of

19. *See* Peter J. Limperis, *Orbital Debris and the Spacefaring Nations*, 15 ARIZ. J. INT'L & COMP. LAW 319, 322 (1998).

20. *See* ESA HANDBOOK, *supra* note 3, at 2.0-1.

21. *See id.* at 2.4-1. The Low Earth Orbit (LEO) is the most heavily utilized orbit. Objects in LEO orbit between 200 kilometers and 2000 kilometers above the surface of the earth. In Geosynchronous Earth Orbit (GEO), spacecraft typically orbit approximately 36,000 kilometers above the earth. Objects in GEO have orbital periods of twenty-four hours, matching the Earth's rotational period, which allows them to remain constantly positioned within view of a chosen point on earth, such as a communications station. *See* Limperis, *supra* note 19, at 320-21.

22. *See* ESA HANDBOOK, *supra* note 3, at 2.4-1.

23. *See id.* at 2.4-3.

24. *See id.* at 9.0-1.

25. *See* Richard Berkley, *Space Law Versus Space Utilization: The Inhibition of Private Industry in Outer Space*, 15 WIS. INT'L L.J. 421, 431 (1997); *see also* Seymour, *supra* note 9, at 896.

26. *See id.*

27. *See* Limperis, *supra* note 19, at 328.

28. *See* Seymour, *supra* note 9, at 910 n.146.

29. *See* Limperis, *supra* note 19, at 326. The probability of collision is a function

orbital collisions and near collisions involving debris shows that the danger is real:[30]

1. In July 1996, a fragment of the European Ariane rocket struck the French Cerise spy satellite.[31]
2. Damage to Japan's Midori satellite was likely to have been caused by debris.[32]
3. The Space Shuttle has had 27 windows damaged by debris during 18 flights.[33]
4. In 1998, orbital debris destroyed the expended third stage of a Minuteman 2 intercontinental ballistic missile (ICBM).[34]
5. The Hubble telescope's solar panels have been pierced numerous times by debris.[35]
6. The Space Shuttle took evasive maneuvers to avoid debris on seven missions.[36]
7. In 1997, both the ERS-1 satellite and the CNES spacecraft SPOT-2 were forced to maneuver in order to avoid collision with debris.[37]
8. Debris detectors placed in orbit to test debris density have shown many thousands of craters.[38]
9. Various other retrieved space objects have shown debris-related degradation.[39]

This list includes only those episodes which are known to have involved debris. The unexplained malfunctions of a great number of satellites may well have been caused by debris damage.[40] Perhaps the

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of the surface area of the spacecraft, its altitude, and the time it spends in space.

30. Additional collisions are listed at TECHNICAL REPORT, *supra* note 11, at 9.

31. *See* ESA HANDBOOK, *supra* note 3, at 2.2-1.

32. *See* Limperis, *supra* note 19, at 319.

33. *See* Seymour, *supra* note 9, at 896; *see also* Smith, *supra* note 14, at 53-54.

34. *See* Seymour, *supra* note 9, at 896.

35. *See* TECHNICAL REPORT, *supra* note 11, at 10; *see also* Smith, *supra* note 14, at 50.

36. *See* ESA HANDBOOK, *supra* note 3, at 8.0-1. The Space Shuttle has had to engage in evasive maneuvers approximately once every ten missions.

37. *See id.*

38. These debris detectors include the NASA Long-Duration Exposure Facility, or LDEF (which showed over 30,000 penetrations) and the Mir Environmental Effects Payload, or MEEP. *See* NASA, SETAS Homepage (visited Mar. 4, 2000) <http://setas-www.larc.nasa.gov>.

39. *See* TECHNICAL REPORT, *supra* note 11, at 9.

40. *See* Seymour, *supra* note 9, at 896; *see also* James P. Lampertius, *The Need for an Effective Liability Regime for Damage Caused by Debris in Outer Space*, 13 MICH.

most telling indication of the high probability of collision is the prediction made by NASA that the International Space Station stands a one-in-five chance of being critically damaged by debris during its first ten years in orbit.[41]

Not only is the threat posed by orbital debris real, but it is also increasing. Debris volume has grown by three to five percent every year and will continue to increase due to vigorous space activity.[42] One project that promises to add considerably to orbital congestion is the proposed deployment of multiple satellite constellations to optimize wireless global communication.[43] The proposed Teledesic constellation will surround the Earth with 288 satellites.[44] Fourteen other constellation projects have been proposed by companies such as Hughes and General Electric.[45] These projects could add approximately 700 new satellites to "regions of peak debris density."[46] The effect on the orbital debris threat will be two-fold. First, the placement of more satellites in the path of orbital debris will increase the probability of collision. Second, the deployment of these constellations will itself increase the debris population by creating operational debris and, if any mishaps occur, fragmentation debris. Computer-modeling programs predict that even if only a fraction of the proposed constellation projects are successfully implemented, the number of catastrophic collisions in orbit will triple by the year 2050.[47]

The United States government also intends to accelerate the testing of its orbital missile interception system, known as the National Missile Defense.[48] When conducting these tests, the government first launches an ICBM.[49] A second rocket is then

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J. INT'L L. 447, 458 (1992).

41. *See* Limperis, *supra* note 19, at 326. NASA intends to employ over two hundred shields to protect the space station from debris. *See* TECHNICAL REPORT, *supra* note 11, at 35.

42. *See* Smith, *supra* note 14, at 53.

43. *See* ESA HANDBOOK, *supra* note 3, at 4.2-1.

44. *See id.*

45. *See id.* at 4.2-3.

46. *Id.* at 4.2-1.

47. *See id.* at 4.2-2.

48. *See* Seymour, *supra* note 9, at 893-94, 903 n.92; Lampertius, *supra* note 40, at 462.

49. *See* Seymour, *supra* note 9, at 893-94, 903 n. 92; *see also* Robert Burns, *Crucial Anti-Missile Defense Test Today*, S.F. CHRON., Jan. 18, 2000, at A4; Jim Abrams, *House Backs Missile Defense System, Sends Bill to Clinton*, BOSTON GLOBE, May 21, 1999, at A15.

launched that carries the experimental exoatmospheric kill vehicle (EKV) into orbit. As the rocket nears the target missile, the EKV is released and collides with the ICBM in orbit.[50] The resulting explosion releases vast amounts of fragmentation debris.

This increased space activity may bring about the most frightening future scenario of all: the Kessler effect, also known as the "cascade effect."[51] The Kessler effect describes a point in time when the volume of space debris will become so great that one collision will trigger a cataclysmic chain of self-perpetuating collisions.[52] These collisions will eventually produce an impenetrable cloud of fragmentation debris that will encase Earth. This is a worst case scenario that would make space travel, as one commentator has put it, "a thing of the past" and would obstruct our dream of colonizing outer space.[53] If no concerted international action is taken to reduce debris, it will only be a matter of time before the critical volume is reached. In the absence of aggressive debris reduction, critical mass will be achieved first in the highly congested LEO.[54] Although computer modeling cannot generate precise predictions, critical mass in LEO may occur within the next one hundred years.[55] Once collisions begin, it will be impossible to stop the chain reaction.[56] In the event that cascading does occur, the use of space will be derailed for hundreds of years until the debris particles are eventually pulled into the Earth's atmosphere and vaporized.[57]

II. Registration and Tracking: "Identified" vs. "Unidentified" Debris

Debris is "identified" if the international community knows who is responsible for launching it into space. Identification requires that the launch of the object be duly registered and that the object be continuously tracked in orbit. Several powerful Earth-based tracking

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50. *See* Burns, *supra* note 49.

51. ESA HANDBOOK, *supra* note 3, at 4.6; *see also* Berkley, *supra* note 25, at 431; Seymour, *supra* note 9, at 914.

52. *See* ESA HANDBOOK, *supra* note 3, at 4.6.

53. Seymour, *supra* note 9, at 914.

54. *See* ESA HANDBOOK, *supra* note 3, at 4.6-1. For a definition of LEO, see discussion *supra* note 21.

55. *See* ESA HANDBOOK, *supra* note 3, at 4.6-2.

56. *See id.* at 4.6-1.

57. *See id.* Orbital lifetimes in LEO can span several hundred years.

stations are currently tracking almost 10,000 objects in orbit.[58] These stations use either optical technology, i.e. telescopes, or radar to track debris.[59] Radar technology is superior to telescopes not only because radar is far more sensitive (and therefore allows detection of smaller debris) but also because radar, unlike telescopes, can operate during the day as well as during inclement weather.[60]

The United States Space Command (USSPACECOM) and its Russian counterpart have used tracking technology to catalogue space objects since Sputnik was launched in 1957.[61] These entities, however, do not track debris smaller than ten centimeters in diameter.[62] Therefore, the vast majority of space debris, which is composed of fragments less than ten centimeters in diameter, has been left "unidentified."

This failure to track smaller objects cannot be attributed to a lack of technology. The United States government's Haystack, Haystack Auxiliary (HAX) and Goldstone radar facilities have the ability to detect debris as small as 5 millimeters in diameter in orbit 1000 kilometers above Earth.[63] The government entities have simply drawn the line at ten centimeters and do not track smaller objects. However, even if the United States government decided to use the HAX to track smaller objects, this would not necessarily mean that the government would be able to identify the "owners" of small debris. The origin of small debris is virtually impossible to determine because the fragments are typically created by explosions and collisions between larger debris in orbit. The orbits have become a soup of debris fragments that collide and create new smaller fragments which then shoot off in various directions. Keeping track of who owns each particle of debris would be a task of overwhelming complexity. As explained in the following section, this inability to identify the origin of smaller debris poses a serious challenge to the current international liability regime.

58. *See* TECHNICAL REPORT, *supra* note 11, at 5-8.

59. *See id.* at 4, 7.

60. *See id.* at 4, 6.

61. *See id.* at 5.

62. *See id.*

63. *See id.* at 6-7. An experimental radar system under development in Germany may be able to detect objects in orbit that are no larger than a speck of dust. *See id.*

III. Liability Under Current International Law

Four international agreements govern outer space activities: (1) the Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies[64] (Outer Space Treaty), (2) the Agreement on the Rescue of Astronauts, the Return of Astronauts and the Return of Objects Launched into Space[65] (Rescue and Return Agreement), (3) the Liability Convention, and (4) the Convention on Registration of Objects Launched into Outer Space[66] (Registration Convention). As we shall see, the spirit of these agreements suggests that the launching state has perpetual responsibility for any damage caused by its space objects. Nevertheless, the current treaty regime fails to provide a fair compensation mechanism for damage caused by debris. This lacuna is most glaring with respect to damage caused by unidentified debris.

The Outer Space Treaty was the international community's first effort to assign liability for space activities. Article VII states that "each state party to the treaty that launches or procures the launching of an object into outer space . . . is internationally liable for damage [caused] by the object or its component parts."[67] However, the absence of any clear standard of liability renders this provision so vague as to be practically worthless. The treaty also fails to create a procedural mechanism for seeking compensation.[68] Another weakness, which recurs in later treaties, is the vague definition of "space object." This term may only encompass active spacecraft and satellites while excluding defunct objects such as debris.[69] On the other hand, commentators have argued convincingly that the term "object" has a broader meaning that may include man-made debris

64. Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies, Jan. 27, 1967, 18 U.S.T 2410, T.I.A.S. No. 6347, 610 U.N.T.S. 205 [hereinafter Outer Space Treaty].

65. Agreement on the Rescue of Astronauts, the Return of Astronauts and the Return of Objects Launched into Space, April 22, 1968, 19 U.S.T. 7570, T.I.A.S. No. 6599, 672 U.N.T.S. 119 [hereinafter Rescue and Return Agreement].

66. Convention on Registration of Objects Launched into Outer Space, Jan. 14, 1975, 28 U.S.T. 695, T.I.A.S. No. 8480, 1023 U.N.T.S. 15 [hereinafter Registration Convention].

67. Outer Space Treaty, *supra* note 64, art. VII.

68. *See* Limperis, *supra* note 19, at 330.

69. *See id.* at 333.

because the provision mentions "component parts."[70] Despite the vague nature of the liability provision, it does give the impression that a launching state should be perpetually liable for any and all damage caused by its space objects.[71]

Article IX of the Outer Space Treaty also requires states to avoid "harmful contamination" of outer space.[72] This provision reveals an international awareness that space use could cause hazardous environmental conditions, such as debris pollution, and suggests that the launching state is responsible for reducing these hazards. Similarly, the Rescue and Return Agreement requires a state "to take effective steps . . . to eliminate possible danger of harm [by its space objects when they are returned to Earth]."[73] Although this obligation does not extend to objects still in space, the provision suggests that states have a continuing responsibility for defunct objects.[74]

The Liability Convention was enacted in 1972 to elaborate on the extent and nature of a state's liability for damage caused by its space objects. The liability scheme imposed by the Convention has two prongs: Article II renders a state strictly liable for all damage caused by its space objects that occurs either on Earth or in airspace, while Article III creates fault-based liability for all damage that occurs in orbit.[75] The Convention also provides that the injured state can submit a claim for damages directly to the launching state.[76] If the states fail to reach a resolution, Article XIV calls for the appointment of a Claims Commission to arbitrate the matter.[77]

The Liability Convention has a number of weaknesses which have been addressed in recent legal literature. First, it is still not clear that "space object" includes debris and therefore the question remains whether the Convention extends to damage caused by orbital debris.[78] The definition of "space object" provided in Article I,

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70. Smith, *supra* note 14, at 55.

71. *See id.* at 57.

72. Outer Space Treaty, *supra* note 64, art. IX.

73. Rescue and Return Agreement, *supra* note 65, art. V.

74. *See* Seymour, *supra* note 9, at 899-900.

75. Liability Convention, *supra* note 6, arts. II, III. Article III states that "[i]n the event of damage being caused elsewhere than on the surface of the earth to a space object of one launching State or to persons or property on board such a space object of another launching State, the latter shall be liable only if the damage is due to its fault or the fault of persons for whom it is responsible." *Id.* art. III.

76. *Id.* art. IX.

77. *Id.* art. XIV.

78. *See* Limperis, *supra* note 19, at 331.

however, includes "component parts of a space object."[79] This language may support an interpretation bringing debris damage within the scope of the Convention.[80] Second, the Convention lacks a clear standard of care for determining when a state would be liable for damage.[81] The vague wording of the Convention leaves unanswered certain questions regarding the duty of the launching state and how a breach of that duty would occur.[82] For example, would the launching state be liable if damage to a third party results from the launching state's failure to follow construction guidelines?[83] And is the fault standard objective or subjective?[84] The third and most troublesome flaw, a flaw which this Note attempts to cure, is the Convention's failure to assign fault in those cases where the destructive object cannot be identified.[85] This issue is the sword onto which the Liability Convention will ultimately fall. Unidentified debris poses the greatest risk of damage in outer space and yet the Convention provides no compensation to its victims.[86]

The Registration Convention makes the fault-based liability scheme more effective by aiding in the identification of space objects. Article II requires states to keep a registry of all objects launched into space.[87] In theory, powerful tracking systems will then keep track of registered objects after launch. Thus, any objects involved in an orbital collision will be instantly identifiable and the party "at fault" will be liable. The Convention also urges states with tracking capabilities to assist others in tracking their space objects.[88] Unfortunately, compliance with the convention has been poor.[89] A larger problem is that these provisions help assign liability only insofar as an object can be tracked and, as explained above, most orbital debris cannot be tracked.[90] Therefore the Liability Convention, even when assisted by the provisions of the Registration

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79. Liability Convention, *supra* note 6, art. I.
80. *See* Berkley, *supra* note 25, at 440.
81. *See* Lampertius, *supra* note 40, at 456-57.
82. *See id.* at 456.
83. *See* Smith, *supra* note 14, at 58.
84. *See* Lampertius, *supra* note 40, at 456.
85. *See id.* at 455.
86. *See id.* at 459.
87. Registration Convention, *supra* note 66, art. II.
88. *Id.* art. IV.
89. *See* Lampertius, *supra* note 40, at 460.
90. *See* discussion *supra* Part II.

Convention, does not provide a compensatory mechanism for damage caused by unidentified debris.

IV. Two Previously Proposed Solutions: Insurance and the Liability Pool

As the damage caused by unidentified orbital debris increases, the cost of space use will increase correspondingly. If international law does not allocate this cost to the responsible parties, the injured parties will be forced to absorb the cost. At some point, this cost will be so great that space ventures will become prohibitively expensive and any hope of private industry in space will evaporate. The challenge is to design a mechanism for internalizing the cost of unidentified debris so that the burden on innocent space venturers is lifted and private industry can flourish. In addition to market-share liability, which will be discussed in the next section, legal commentators have proposed two mechanisms for providing compensation to parties damaged by unidentified orbital debris: (1) insurance, and (2) a "liability pool." Neither of these mechanisms, however, provides an acceptable solution to the debris problem.

The less attractive of the proposed solutions is insurance.[91] Insurance could be purchased to cover any damage caused by unidentified debris. This is a palatable solution for the time being since the risk may be spread, for instance, among a number of satellite owners. As long as the pool of insured satellite owners is large enough, the insurance premiums will be affordable. However, as the debris population grows, the premiums will rise with the probability of collision. Eventually, the insurance premium itself will become a significant barrier to entering the space industry. More importantly, the insurance solution is unsatisfactory because it does not internalize the cost of harm caused by debris but only spreads the cost among the parties at risk.[92]

Commentators have also proposed the creation of an international compensation fund, or "liability pool."[93] Each launching entity would contribute to the fund in proportion to the amount of debris that its mission would be likely to create. The fund would then

91. *See* Smith, *supra* note 14, at 64-66.

92. *See id.* (synopsis of various satellite insurance provisions).

93. Lawrence D. Roberts, *Addressing the Problem of Orbital Space Debris: Combining International Regulatory and Liability Regimes*, 15 B.C. INT'L & COMP. L. REV. 51, 70 (1992).

be used to pay compensation for any damage caused by unidentified orbital debris. While this solution does internalize the costs of debris, it does so imperfectly due to the impossibility of determining prior to launch how much debris an individual mission will create. There are many unforeseen events that may result in debris creation. For example, a navigator on Earth may make an error when guiding a satellite to its orbit. If a collision results and thousands of new debris fragments are created, according to the per-launch schema, the company will not have to pay more into the fund at that point. Therefore, the cost of that new hazard created by the collision is not internalized. It is also unfair to charge a launching entity for damage which has not yet, and may never, occur. For example, a given company may launch, operate, and then retrieve a satellite without the creation of any significant amounts of debris. That company would have already paid into the liability pool even though it ultimately made no contribution to the debris hazard.

Furthermore, if instituted now, a liability pool funded by a per-launch fee would be sorely underfunded for many years to come. It would take several years for the pool to collect the funds needed to meet the demands for compensation. If a string of collisions were to occur early on, the fund would be quickly depleted. One commentator has suggested that contributions for prior space pollution should be demanded from the United States government and other polluters in order to build a sufficient pool of funds quickly.[94] Such a request would most likely be rejected out of hand.

V. Market-Share Liability as a Solution

Market-share liability provides the only fair and effective solution to the unidentified debris problem.[95] This theory of liability, which was created in the context of a pharmaceutical case in 1980 by the California Supreme Court,[96] holds each party liable in proportion to its contribution to the dangerous condition.[97] The application of this theory of liability to the unidentified debris problem was first

94. *See id.*

95. *See generally* GLENN H. REYNOLDS & ROBERT P. MERGES, OUTER SPACE: PROBLEMS OF LAW AND POLICY 177 (1989); Lampertius, *supra* note 40, at 466; Roberts, *supra* note 93, at 70-73; Berkley, *supra* note 25, at 440; Limperis, *supra* note 19, at 339-41.

96. *See Sindell v. Abbott Lab.*, 26 Cal. 3d 588, 607 P.2d 924, 163 Cal. Rptr. 132 (1980).

97. *See* discussion *infra* Part V.A.

proposed in 1989 by Professors Glenn Reynolds and Robert Merges.[98] Recently, this idea has enjoyed a resurgence in space debris scholarship. Two articles published in 1992 touted the idea as a possible solution to the unidentified debris problem.[99] In 1997, Richard Berkley again put forth market-share liability as a potential solution.[100] Most recently, Peter Limperis made a forceful argument for the application of market-share liability to orbital debris.[101] Despite the popularity of market-share liability, none of the commentators mentioned above has explored the feasibility of applying the theory to orbital debris.

A. *A Brief History of Market-Share Liability*

Market-share liability first emerged in a tort case in which the plaintiffs suffered harmful side effects from diethylstilbesterol (DES), a synthetic form of estrogen.[102] During the thirty-year period between 1941 and 1971, the drug was administered to pregnant women for the purpose of preventing miscarriage.[103] Over two hundred pharmaceutical companies manufactured the drug during this period.[104] It was later discovered that women whose mothers had ingested DES suffered a high incidence of vaginal and cervical cancer as a side effect of the drug.[105] However, due to the passage of time and, more importantly, due to the fungible nature of the product, the victims were unable to identify the specific manufacturer that produced the pills prescribed to their mothers.[106] Because the pills were perfectly substitutable, pharmacists routinely filled prescriptions for DES with pills produced by any of the two hundred manufacturers.[107] This inability to create a clear causal link between the harm and a particular manufacturer raised a new challenge for the California Supreme Court.

The court in *Sindell* first considered, but ultimately rejected,

98. *See* REYNOLDS & MERGES, *supra* note 95, at 177.
99. Lampertius, *supra* note 40, at 466; Roberts, *supra* note 93, at 70-73.
100. *See* Berkley, *supra* note 25, at 440.
101. *See* Limperis, *supra* note 19, at 339-41.
102. *See Sindell*, 26 Cal. 3d at 593.
103. *See id.*
104. *See id.* at 602.
105. *See id.* at 594.
106. *See id.* at 595, 610.
107. *See id.* at 595.

three traditional tort theories of multiple causation.[108] The first of these theories was "alternative liability," which had been espoused previously by the court in *Summers v. Tice*.[109] In *Summers*, the plaintiff had been hit by buckshot after two hunters fired shotguns simultaneously in his direction.[110] Because both defendants were negligent and both were in a better position than the plaintiff to determine who fired the harmful bullet, the court shifted the burden to the defendants to absolve themselves of blame individually.[111] Under this theory, if the defendants are unable to isolate the liable party, all defendants are held jointly and severally liable.[112]

The court in *Sindell* refused to apply alternative liability to the DES situation for two reasons. First, the drug manufacturers had no special information that would have given them an advantage over the plaintiffs in determining which company had made the pills ingested by each plaintiff's mother.[113] Second, the probability that an individual drug manufacturer had actually produced the drug ingested by each plaintiff's mother was very low, unlike the situation in *Summers* where a fifty percent probability existed that each of the defendants had fired the harmful bullet.[114] Therefore, the court concluded that it would be unfair to hold a company jointly liable for harm it most likely did not cause.[115]

The second approach rejected by the court in *Sindell* was the theory of "concert of action liability."[116] Under this theory, multiple tortfeasors can be held jointly liable for the actions of the group if they collaborated, either expressly or implicitly, in committing a tortious act, or else knowingly provided substantial assistance in the commission of the tort.[117] The court found no such collaboration or common plan among the various drug manufacturers and rejected this theory of liability.[118]

Finally, the court in *Sindell* refused to find the defendants liable

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108. *Id.* at 598-610.
109. Summers v. Tice, 33 Cal. 2d 80, 199 P.2d 1 (1948).
110. *Id.* at 82.
111. *See id.* at 86.
112. *See id.* at 88.
113. *Sindell*, 26 Cal. 3d at 601.
114. *Id.* at 602-03.
115. *See id.* at 603.
116. *Id.* at 603-06.
117. *See id.* at 604.
118. *See id.* at 605.

under the theory of "enterprise liability."[119] Enterprise liability, also known as "industry-wide liability," requires that each of the manufacturers follow the safety guidelines issued by a central trade association.[120] In such cases, the individual manufacturers in effect shift their responsibility for ensuring the safety of their product onto the trade organization.[121] When such an organization is negligent in the formulation of safety standards and these inadequate standards result in the production of goods that cause harm, each of the manufacturers is held jointly liable.[122] However, because no such centralized trade organization existed in the DES industry, the court in *Sindell* dismissed this theory of liability.[123]

Having rejected these traditional theories of liability, yet being unwilling to let the victims go uncompensated, the court decided to create a novel tort theory. The court explained that the realities of the modern marketplace, replete with fungible products, demanded a new theory of liability that would permit victim compensation without requiring the identification of a specific tortfeasor.[124] Under this new theory, later dubbed "market-share liability," the court held that each of the drug manufacturers would be liable in proportion to their share of the DES market.[125] Each company's resulting liability, the court reasoned, "would approximate its responsibility for the injury caused by its own products."[126] The court permitted an individual defendant company to exculpate itself by proving that its product could not possibly have caused harm.[127] In fact, one defendant in *Sindell* succeeded in exculpating itself by showing that it did not begin producing the drug until after the victims were born.[128]

Since the decision by the California Supreme Court in *Sindell*, the high courts of several states have adopted market-share liability.[129] The high courts of Washington, New York and Florida applied

119. *Id.* at 607-10.
120. *Id.* at 607-08.
121. *See id.*
122. *See id.*
123. *Id.* at 609.
124. *See id.* at 610.
125. *See id.* at 612.
126. *Id.*
127. *See id.*
128. *Id.* In the DES cases, the victim was harmed as a fetus as a result of medication taken by the mother.
129. *See* Christina Bohannan, Note, *Product Liability: A Public Policy Approach to Contaminated Factor VIII Blood Products*, 48 FLA. L. REV. 263, 284 n.146 (1996).

market-share liability in DES cases similar to *Sindell*.[130] Taking market-share liability beyond the context of DES for the first time, Hawaii's Supreme Court adopted market-share liability to compensate plaintiffs who contracted the human immunodeficiency virus (HIV) from a tainted blood product manufactured by a number of companies.[131]

When the Wisconsin Supreme Court was faced with a DES case, it ostensibly rejected market-share liability but then applied another theory of liability, "risk contribution liability," which differed only in name from market-share liability.[132] The court held that a manufacturer of DES should be held liable for damages on the grounds that it had contributed to the risk posed by the drug.[133]

Other jurisdictions have refused to accept market-share liability.[134] The high courts of Missouri, Iowa, Illinois and Ohio have rejected market-share liability on the basis of one or more of the following criticisms: (1) the theory abolishes the common law requirement of a clear causal link, (2) the task of determining market-share is difficult and can lead to the unfair apportionment of liability, and (3) market-share liability is a form of social engineering best left to the legislature.[135] For the same reasons, the First and Third Circuits have refused to hold paint manufacturers liable under a market-share theory for brain damage in children caused by exposure to lead paint.[136]

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130. *See id.*; *see also* Martin v. Abbott Lab., 689 P.2d 368 (1984); Hymowitz v. Eli Lilly & Co., 539 N.E.2d 1069 (N.Y. 1989); Conley v. Boyle Drug Co., 570 So. 2d 275 (Fla. 1990). A federal court in Massachusetts has also applied market-share liability in a DES case. *See* McCormack v. Abbott Lab., 617 F. Supp. 1521 (D. Mass. 1985); *see generally* Andrew B. Nace, Note, *Market Share Liability: A Current Assessment of a Decade-Old Doctrine*, 44 VAND. L. REV. 395, 407 (1991).

131. *See* Smith v. Cutter Biological, Inc., 823 P.2d 717 (Haw. 1991); *see also* Bohannan, *supra* note 129, at 264-65, 284 n.146.

132. Collins v. Eli Lilly Co., 342 N.W.2d 37 (Wis. 1984); *see also* Suzanne Ernst Drummond, *DES and Market Share Liability in Ohio—A Lesson in How What You Don't Know Can Hurt:* Sutowski v. Eli Lilly, *696 N.E.2d 187 (Ohio 1998)*, 67 U. CIN. L. REV. 1331, 1341-42 (1999).

133. *See* Drummond, *supra* note 132, at 1341.

134. *See id.* at 1342-43.

135. *See* Zafft v. Eli Lilly & Co., 676 S.W.2d 241, 244 (Mo. 1984); Mulcahy v. Eli Lilly & Co., 386 N.W.2d 67, 70 (Iowa 1986); Smith v. Eli Lilly & Co., 560 N.E.2d 324, 328-29 (Ill. 1990); Sutowski v. Eli Lilly & Co., 696 N.E.2d 187, 190 (Ohio 1998); *see also* Drummond, *supra* note 132, at 1342-43; Kenneth R. Lepage, *Lead-Based Paint Litigation And The Problem Of Causation: Toward A Unified Theory Of Market Share Liability*, 37 B.C. L. REV. 155, 175-76 (1995).

136. *See* Santiago v. Sherwin-Williams Co., 782 F. Supp. 186, 188 (D. Mass. 1992),

Although market-share liability has been most successful in the context of DES cases, plaintiffs have made attempts to apply the theory to other areas of product liability. As mentioned above, the Hawaii Supreme Court adopted market-share liability to permit the recovery of damages for a tainted blood product. California has also applied the theory to allow compensation for victims of a defective polio vaccine.[137] Efforts to extend market-share liability to health problems caused by asbestos and lead paint have failed so far.[138] Potential areas of tort litigation that may in the future lend themselves to market-share liability are cases targeting tobacco companies and gun manufacturers.[139] One reason for the infrequent use of market-share liability outside of the DES cases is that truly fungible products are rare.[140]

B. The Application of Market-Share Liability to Orbital Debris

Orbital debris poses an unusual liability problem that resembles the challenge faced by the California Supreme Court in *Sindell.* Like DES tablets, small fragments of space debris are indistinguishable, i.e. debris is fungible. When unidentified debris causes damage, the specific party responsible for producing the harmful debris fragment cannot be identified. As in the DES cases, the current debris threat demands a creative solution. The fault-based scheme of the Liability Convention may work in those instances when the debris is identified, but when the debris is untrackable, the owner cannot be identified, fault cannot be attributed, and thus liability cannot be assigned. A form of market-share liability, however, can circumvent this problem of identification.[141] Under such a scheme, each launching entity, whether public or private, will be partially liable for any damage caused by unidentified debris in proportion to the percentage of the unidentified debris population for which it is responsible.[142]

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aff'd, 3 F.3d 546 (1st Cir. 1993); City of Philadelphia v. Lead Indus. Ass'n, 994 F.2d 112, 115 (3d Cir. 1993); *see also* Lepage, *supra* note 135.

137. *See* Morris v. Parke, Davis & Co., 667 F. Supp. 1332 (C.D. Cal. 1987); *see also* Nace, *supra* note 130, at 416-18.

138. *See* Nace, *supra* note 130, at 414-16; Lepage, *supra* note 135, at 175.

139. *See* Robert L. Rabin, *Enabling Torts*, 49 DEPAUL L. REV. 435, 452 (1999).

140. *See* Nace, *supra* note 130, at 416 n.164.

141. Perhaps "risk-contribution liability" would be a more appropriate name since there is no market in space debris. Nonetheless, I will use the phrase "market-share liability" for the sake of simplicity.

142. *See* Limperis, *supra* note 19, at 340.

Who then would pay for damage caused by unidentified debris? Under the market-share scheme, the liability for such damage will fall almost exclusively on the United States and Russia for a long time to come. These states are the great pioneers in space use but they are also the primary contributors to the debris problem. The United States and Russia have sent over ninety percent of all catalogued space objects into orbit.[143] The remaining portion is attributable to thirty-six other states and private entities.[144]

The greatest obstacle to extending market-share liability to orbital debris is the difficulty in determining the contribution of each spacefaring state and private entity to the existing debris hazard. The total unidentified debris population can be estimated by sampling methods and mathematical models, but it is impossible to determine with any precision what portion of that population is attributable to the activities of a particular state. In the DES cases, the courts were able to calculate the market-share of each of the defendant drug manufacturers by simply measuring the volume of medication each defendant sold at the time the victims purchased the drug.[145] Sales records provided fairly precise evidence of market-share. But even with the sales records in hand, the court in *Sindell* still showed some concern that exact calculation of market-share was not possible and might therefore lead to an unfair apportionment of liability.[146] Despite these misgivings, the court felt that the risk of unfairness was acceptable because the risk was, in essence, no different from the risk of misapportionment of liability that results when a jury is asked to determine liability in cases involving comparative fault.[147]

When extending market-share liability to orbital debris, the central question is whether the risk of unfair apportionment of liability is too great. In other words, can a state's contribution to the unidentified debris hazard be calculated with acceptable accuracy? The answer is yes. Although it is impossible to identify the owner of each particle of debris, there are measurable indices that would allow us to approximate with some accuracy each state's contribution to the total unidentified debris population. The possible indices that might

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143. *See* ESA HANDBOOK, *supra* note 3, at 2.1-3. For the sake of simplicity, this Note assumes that Russia will take responsibility for space debris created by the former U.S.S.R.

144. *See id.*

145. *See, e.g., Sindell*, 26 Cal. 3d at 612.

146. *Id.* at 613.

147. *See id.*

be used for this purpose are (1) the number of operational objects each state currently has in orbit, (2) the total number of objects each state has placed in orbit, and (3) the number of identified debris fragments currently in orbit for which each state is responsible. Of these three possible indices, we should use the one that would provide the most accurate estimate of each entity's contribution to the unidentified debris population.

The first index, based on existing operational objects in orbit, bears virtually no relation to the unidentified debris population. If, for example, the United States were to deorbit all of its current spacecraft and satellites, it would own zero percent of the operational objects in orbit. If the operational vehicle index were then used to determine "market-share," the United States' market-share would be zero and the United States would thus be immunized from liability for unidentified debris damage. This would clearly be unfair because the United States is a primary contributor to space debris.

The second option would give a more reliable indication of unidentified debris risk contribution. Because every mission creates debris and objects in LEO can remain in orbit for hundreds of years, the number of missions launched by each state since 1957 should, it seems, provide a fairly accurate indication of each state's contribution to orbital debris. This index, however, has two distinct flaws. First, not every space mission creates the same amount of debris. Second, it is difficult to determine how much of the debris created in the year 1961, for instance, remains in orbit and how much has reentered Earth's atmosphere. Therefore, the number of missions launched has only a tenuous connection to the current debris population.

The third possible index, based on the number of identified debris fragments currently in orbit, is the best indicator of unidentified debris market-share. Unidentified debris is composed largely of fragmentation debris created by the collision and explosion of larger debris bodies.[148] Larger debris, in effect, becomes smaller debris. Therefore, if a state is responsible for creating a large portion of the known body of large debris, it is also likely that the same state is responsible for creating an equal portion of the unidentified debris fragments.

Assuming that the third option is selected as the index of a state's contribution to the unidentified debris population, the remaining

148. *See* discussion *supra* Part I.A.

steps for determining liability would be simple. The first step would be to determine each state's contribution to the identified debris population (hereinafter "contribution index") using current catalogues of identified debris. We would then assume that each state has contributed in the same proportion to the unidentified debris population. The USSPACECOM catalogue can provide the figures for these calculations.[149] As of December 31, 1997, the catalogue showed that the total number of identified debris fragments was 6186.[150] Of these, the United States owned 3272 objects, which make up 52.9% of the total population, thus giving the United States a contribution index of 52.9%.[151] Russia was identified as being responsible for 2526 fragments, or 40.8% of the total population.[152] Responsibility for the remaining 6.3% of the fragments was divided among ten other states and entities.[153]

When unidentified debris causes damage in orbit, the contribution index of each state and private entity would be used to allocate liability. This process is straightforward: if a satellite suffers $10,000,000 of damage, the United States would be liable for 52.9% of the costs, or $5,290,000. Other states and private entities would be similarly liable in proportion to their share of the identified debris population.

As in the DES cases, exculpation will be possible if a spacefaring state or private entity can prove that it could not possibly have produced the debris that caused the damage. Such exculpation would be difficult but is conceivable under certain circumstances. Imagine, for instance, that a space station was pierced by a large fragment of unidentified debris that left a hole half a meter wide. It would be clear that the fragment must have had a diameter of approximately fifty centimeters. A state that had sent only a few satellites into orbit and had closely tracked all pieces of its debris over ten centimeters would be able to exculpate itself by showing that the large debris for

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149. *See* ESA HANDBOOK, *supra* note 3, at 2.1-3.

150. *See id.*

151. *See id.*

152. *See id.*

153. These ten states and entities are the ESA with 197 fragments (3.2%), the People's Republic of China with 103 fragments (1.7%), Japan with 58 fragments (0.9%), France with 16 fragments (0.3%), India with 4 fragments (<0.1%), Italy with 3 fragments (<0.1%), Australia with 2 fragments (<0.1%), Germany with 1 fragment (<0.1%), the United Kingdom with 1 fragment (<0.1%), and Iridium with 1 fragment (<0.1%). *See id.*

which it was responsible was nowhere near the point of collision. This opportunity for exculpation will provide an additional incentive for states to track debris closely. States might also exculpate themselves by means of chemical analysis. This method would require that the damaged object be retrieved from space in order to test for any traces that the debris fragment may have left behind. These tests would reveal the exact chemical composition of the fragment. States could then exculpate themselves by showing that they had never launched anything made of that material into space.

C. The Benefits of Market-Share Liability

Market-share liability will benefit the space industry by (1) providing compensation to the injured party where none existed before, (2) creating an incentive for states to mitigate debris production, (3) creating an equal incentive to remove existing debris, (4) promoting the registration and tracking of space objects, (5) encouraging states to cooperate in the prevention of collisions, and (6) ultimately lowering the economic barrier to entering the space industry.

The immediate benefit of market-share liability will be the creation of a compensation system where none now exists. Currently, the victims of unidentified debris damage must absorb the cost of any collision while the parties who created the debris incur no liability. A market-share liability amendment will fill this gap in the Liability Convention.

Of greater importance in the long run is the fact that market-share liability would create an incentive for states to reduce the production of large debris. The production of trackable debris will increase a state's contribution index and, hence, its liability exposure. Launching entities would therefore take measures to minimize large debris production in order to minimize liability. Venting excess fuel, for example, would reduce the risk of explosions in orbit.[154] A state can also reduce its contribution index by deorbiting defunct satellites. This can be achieved by either retrieving the satellites or by propelling the "dead" satellites into the Earth's atmosphere so that they are vaporized.[155]

Market-share liability will not only promote debris mitigation

154. *See* Seymour, *supra* note 9, at 911.
155. *See id.*

measures but also encourage the improvement of debris removal technologies. Entities will be able to reduce their contribution index, as explained above, by removing debris that is already in orbit. Currently, debris can be removed by sending the Space Shuttle to retrieve defunct satellites. Other options include using an Earth-based laser to push objects out of their orbits so that they reenter the Earth's atmosphere and are destroyed. The Orion laser is currently being developed for this purpose by the United States government.[156] One commentator has even suggested using a "giant Nerf ball" to catch debris, in effect "sweeping" the orbits clean.[157] Those states and private entities that do not have easy access to debris retrieval technology or do not have a laser of their own would be able to buy these services from the United States.

The United States and Russia, as well as other states, would also have a two-fold incentive to improve their systems for registering, tracking, and cataloguing space objects. First, states would strive to improve their tracking capabilities so that they would be able to show that another state owned a specific debris fragment that caused damage. Once the responsible state is identified, only that state would be liable. Second, the United States and Russia would be eager to identify as many pieces of debris as possible that belong to each other. The United States, for example, would want to increase the number of catalogued fragments identified as Russian. By doing so, the Russian contribution index would grow and the contribution index of all other states would simultaneously fall. Improvements in tracking capabilities would be beneficial because they would allow a fairer apportionment of liability and would assist in debris evasion.

Spacefaring states would also make efforts to improve debris evasion technology out of the fear of incurring liability. After all, the most effective method of avoiding liability is to ensure that collisions do not occur. More effective evasion capabilities could be achieved by establishing a communications system whereby states with tracking facilities, such as the United States, could warn other states when their satellites or spacecraft were in the path of approaching debris. Upon receiving this information, the spacecraft owner would be able to engage in evasive maneuvers. This warning system could make use

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156. *See* Smith, *supra* note 14, at 66-67.

157. Seymour, *supra* note 9, at 908. The aerogel substance used in the MEEP program to capture debris may be suitable for this purpose although implementation of such a program would, at the moment, be prohibitively expensive. *See id.*

of sensitive ground-based debris detection technology as well as debris-detecting satellites.[158]

Ultimately, market-share liability would lower the economic barrier to entering the space industry. The costs associated with unidentified debris damage would be reallocated to those who created the hazard. This internalization of costs would eliminate a burden which would otherwise crush private space ventures. The costs of engaging in the space industry would drop dramatically and the risks of debris-related damage would also become more predictable, thus allowing companies to plan confidently for the future.[159] The private space industry would therefore be able to expand unfettered and the accompanying benefits of private enterprise would follow.

D. The Weaknesses of Market-Share Liability

Along with its many benefits, market-share liability would also present a number of challenges that may threaten its success. These challenges include (1) the creation of a perverse incentive to halt all debris tracking, (2) the possibility that the international community may consider market-share liability unfair, (3) the weak incentive to reduce small debris, (4) possible weaknesses in the incentive to mitigate the production of large debris, (5) the expense of debris mitigation measures, and (6) political opposition from the United States and Russia. Although this list is long, cogent counter-arguments or simple solutions exist in each case.

Using a state's contribution to the existing identified debris population as the index for determining liability may create a perverse incentive for states to scale down their debris tracking activities. Since liability would be tied to the number of debris fragments whose ownership is known, states may try to reduce their liability simply by halting their efforts to identify debris. However, because several nations would soon be engaged in debris detection, the desire of each of these states to increase the risk-contribution of other states (and thereby reduce their own contribution) would cause each of them to track each other's debris aggressively. The sum of this multinational effort would easily offset the perverse incentive to

158. *See* TECHNICAL REPORT, *supra* note 11, at 11. These debris detection satellites could use detection technology such as that currently employed by the MSX spacecraft which has already been placed into orbit by the United States.

159. *See* Berkley, *supra* note 25, at 428.

reduce tracking one's own objects.

The international community may also complain that market-share liability is unfair because it relies on rough estimates of each state's contribution to the unidentified debris population. However, as discussed above, estimates of risk contribution based on certain indices will have to suffice and these estimates will probably be close enough to the real figures to avoid gross unfairness.[160] Some countries may also raise the objection that the market-share analysis does not take into account the possibility that naturally occurring meteoroids could have caused the damage. In response, proponents of market-share theory can argue that it would be highly unlikely for an orbital collision to involve a meteoroid because meteoroids pass through the orbits very quickly before burning up in the Earth's atmosphere.[161]

Opponents of market-share liability may also contend that the market-share scheme creates only a weak incentive to reduce unidentified debris, i.e. debris that is too small to track. Because a state's contribution index is based on the volume of identified debris created by that state, the creation of unidentified debris will not increase a state's liability exposure. Therefore, no incentive to mitigate small debris, such as paint chips or lens caps, will exist. In response to this complaint, one could argue that an incentive to reduce small debris will arise out of a state's desire to minimize the probability of future collisions for which it would be partly liable. Moreover, once tracking technology improves, it will become possible to assign ownership to smaller pieces of debris such as lens caps. At that point, an ejected lens cap will be catalogued as identified debris and will increase the launching state's contribution index. This will create an incentive to mitigate small debris. In the meantime, in order to ensure maximum reduction of small debris, the United Nations should require that states follow guidelines for mitigating operational and microparticulate debris.[162]

Another potential problem with market-share liability stems from the fact that states and private entities that have contributed only a negligible amount to the debris population will continue to

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160. *See* discussion *supra* Part V.B.

161. *See* Limperis, *supra* note 19, at 322; *see also* Seymour, *supra* note 9, at 893.

162. The guidelines should require spacecraft to be designed in ways that minimize debris. The absence of paint on external surfaces, for example, would eliminate paint chipping. Using non-explosive bolts and carefully avoiding the ejection of objects into space would reduce operational debris. *See* Seymour, *supra* note 9, at 910; *see also* Smith, *supra* note 14, at 61.

have a very small contribution index for many years to come. The European Space Agency, for example, is responsible for only a small share of existing debris and this share will not increase by much until the agency launches hundreds of objects. Therefore, the European Space Agency would not have an incentive to make efforts to mitigate debris knowing that it would be liable for only a very small percentage of any damages awarded. Just as the risk contribution of smaller space programs will not increase, the contribution indices of the United States and Russia will remain high for years to come regardless of how much they try to mitigate debris. This might discourage these states from working to reduce debris since their current liability exposure will persist for years despite any efforts at mitigation. NASA may see little benefit in attempting to reduce debris and throw up its hands in frustration. Mandatory international guidelines for debris mitigation, however, would remedy this potential problem.

Another danger is that certain states may decide that the current risk of collision is too small to warrant concern. As a result, these states may not be compelled by the fear of liability to mitigate debris production.[163] This would again have the effect of transferring the costs of orbital debris onto future generations who will inevitably be harmed if current space users do not take remedial action. The international enforcement of debris mitigation guidelines will help to solve this problem by compelling debris reduction when the specter of potential liability is not enough.

Although market-share liability would lower the barrier to market entry by reducing the costs related to debris damage, it may also create a new economic barrier by requiring companies to spend large amounts of money on debris mitigation.[164] Companies would be compelled to implement debris mitigation techniques by either the fear of incurring liability or by the fact that mitigation would be required by supplemental laws. Designing satellites with debris-minimizing features, such as special boosters to deorbit the satellite at the end of its lifespan, would place an extra financial burden on companies. It must be kept in mind, however, that the cost of mitigation measures is minor when compared to the future costs of frequent collisions that the space industry will have to face if no such measures are taken.

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163. *See* Roberts, *supra* note 93, at 71.
164. *See* Smith, *supra* note 14, at 69-70.

The greatest threat to the implementation of market-share liability is sheer political opposition.[165] If a number of satellites are destroyed by unidentified debris, the cost to the United States and Russia could easily run into the billions of dollars. Why then would these states ever agree to implement such a system? The answer to this lies once again in the benefits of private enterprise. If the United States and Russia agree to pay for their fair share of debris damage, it will allow private industry to thrive in space. The benefits resulting from the free market (lower prices, more reliable technology, etc.) would become available for the governments of the world to enjoy as much as for the private individual. The United States and Russian governments must look forward to the day when they will be able to lease space on a private orbiter at a reasonable rate. In this way, private enterprise will ultimately save these governments money.

In the meantime, the United States and Russia may be required to pay large amounts in compensation for damage caused by orbital debris. A reorganization of the NASA budget would make this possible without placing any further economic burdens on the United States government. The government should begin to phase out portions of its orbital programs and allow private industry to take its place. The money that is now earmarked for the Space Shuttle and other programs should be used to pay for any debris damage suffered by private enterprises. We are at a crossroads in history when private industry must replace government in space. NASA and the Russian Space Agency have achieved a marvelous feat by opening space to humankind. Now it is time for these agencies to step aside and help private companies to take their place in space.

VI. A Proposed Amendment to the Liability Convention

In order to implement market-share liability for damage caused by unidentified debris, Article III of the Liability Convention must be amended. The following proposal for amending the convention imposes a market-share theory of liability and creates a mechanism for its implementation. The proposed definition of space debris is borrowed, with some modifications, from the Technical Subcommittee for UNCOPUOS.[166] Proposed additions to Article III are in *italics* while ~~strikethrough~~ indicates deleted matter.

165. *See* Limperis, *supra* note 19, at 342; REYNOLDS & MERGES, *supra* note 95, at 177; Lampertius, *supra* note 40, at 466; Seymour, *supra* note 9, at 903.

166. *See supra* note 13.

Article III

1. In the event of damage being caused elsewhere than on the surface of the Earth to a space object of one launching State or to persons or property on board such a space object by a*n identified* space object *belonging to* ~~of~~ another launching State, the latter shall be liable only if the damage is due to its fault or the fault of persons for whom it is responsible.

2. In the event of damage being caused elsewhere than on the surface of the Earth to a space object of one launching State or to persons or property on board such a space object by unidentified orbital debris, each spacefaring State will be liable for the damage in proportion to that State's recognized contribution to the total identified orbital debris population unless that State is able to exculpate itself.

3. For the purposes of this Article:

(a) "Identified" means that the State responsible for placing the object in orbit is known;

(b) "Unidentified" means that the State responsible for placing the object in orbit is not known;

(c) "Debris" means all man-made objects, including their fragments and parts, whether their owners can be identified or not, that are non-functional with no reasonable expectation of their being able to assume or resume their intended functions or any other functions for which they are or can be authorized;

(d) A State's "recognized contribution to the total identified orbital debris population" will be calculated in accordance with the current combined space debris data provided by those States that track debris;

(e) A State can "exculpate" itself by proving that the debris that caused the damage could not possibly have originated from any of its space objects or missions.

As discussed above, the United Nations should also adopt mandatory debris reduction regulations alongside the amendment in order to ensure maximum debris reduction.[167] Such regulations should require that states (1) design spacecraft in accordance with debris mitigation guidelines, (2) use their best efforts to track and

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167. *See* discussion *supra* Part V.D.

identify debris, (3) warn other states when a collision risk arises, (4) vent excess fuels to reduce the probability of explosion, and (5) deorbit defunct objects.[168]

Conclusion

Space debris threatens our future in outer space. Thousands of fragments scream through the orbits at terrific speeds causing damage to operational satellites and spacecraft with ever-increasing frequency. This threat of expensive damage will stifle the growth of private industry in space unless companies are protected from the costs related to debris. The solution to this problem requires that these costs be internalized so that they are not borne by innocent parties.

Internalization can be achieved by assigning liability to the party that created the harmful debris. The fault-based compensation mechanism adopted in the Liability Convention adequately assigns liability when identified debris causes damage, but the Convention fails to assign liability in cases where the debris is unidentified. Under the Convention, fault cannot be assigned unless the owner of the harmful debris is identified. This limitation leaves a gaping hole in the Convention because the vast majority of space debris eludes identification.

To remedy this shortfall, this Note proposes an amendment to the Liability Convention that applies a form of market-share liability when unidentified debris causes damage in orbit. Under the amendment, each state would be liable for any damage caused by unidentified debris in proportion to its contribution to the debris hazard. Market-share liability would energize the private space industry by lowering the economic barrier to market entry. Although the costs of market-share liability would, at first, fall heavily on the governments of the United States and Russia, a robust private space industry would ultimately benefit the governments. Ultimately, market-share liability will allow private industry to usher in a new space age.

168. The guidelines could be modeled on NASA's Guidelines and Assessment Procedures for Limiting Orbital Debris. For a description of NASA's guidelines see Seymour, *supra* note 9, at 905; see also *supra* note 162.

CNN Article of Potential Russian Nuclear ASAT Tests

3 MIN READ

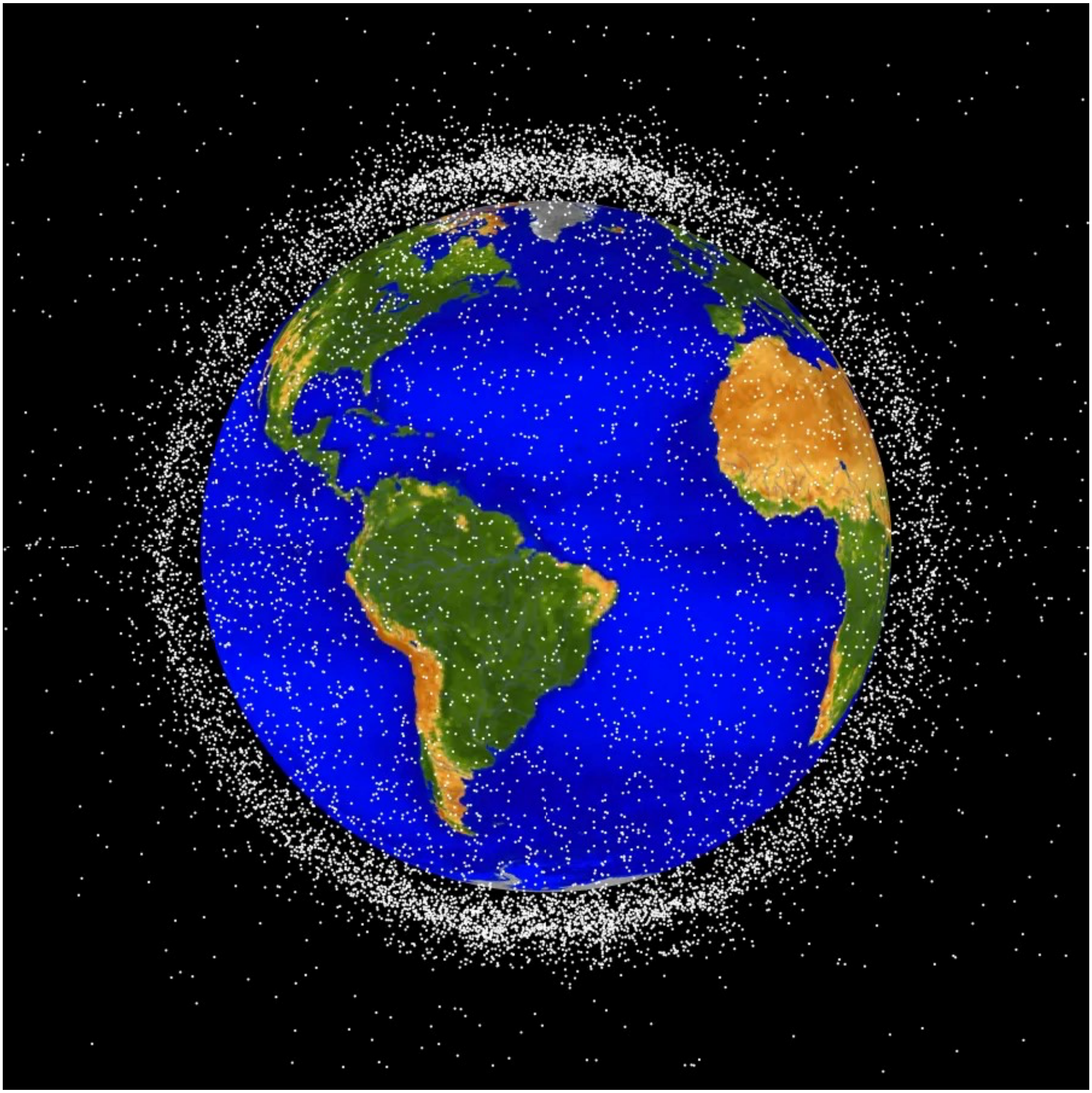
New NASA Strategy Envisions Sustainable Future for Space Operations

Tiernan P. Doyle

APR 09, 2024

RELEASE **24-051**

NASA Headquarters



Low Earth orbit, the focus of volume one of NASA's Space Sustainability Strategy, is the most concentrated area for orbital debris. This computer-generated image showcases objects that are currently being tracked. Credits: NASA ODPO

To address a rapidly changing space operating environment and ensure its preservation for generations to come, NASA released the first part of its integrated Space Sustainability Strategy, on Tuesday advancing the agency's role as a global leader on this crucial issue.

"The release of this strategy marks true progress for NASA on space sustainability," said NASA Deputy Administrator Pam Melroy. "Space is busy – and only getting busier. If we want to make sure that critical parts of space are preserved so that our children and grandchildren can continue to use them for the benefit of humanity, the time to act is now. NASA is making sure that we're aligning our resources to support sustainable activity for us and for all."

For decades, NASA has served as a proactive leader for responsible and sustainable space operations. Entities across the agency develop best practices, analytic tools, and technologies widely adopted by operators around the world. The new strategy seeks to integrate those efforts through a whole-of-agency approach – allowing NASA to focus its resources on the most pressing issues. To facilitate that integration, NASA will appoint a new director of space sustainability to coordinate activities across the agency.

Key aspects of our approach include providing global leadership in space sustainability, supporting equitable access to space, and ensuring NASA's missions and operations enhance space sustainability.

Space environments currently are seeing the rapid emergence of commercial capabilities, many of them championed by NASA. These capabilities include increased low Earth orbit satellite activity and plans for the use of satellite constellations, autonomous spacecraft, and commercial space destinations. However, this increased activity also has generated challenges, such as an operating environment more crowded with spacecraft and increased debris. Understanding the risks and benefits associated with this growth is crucial for space sustainability.

Developed under the leadership of a crossagency advisory board, the space sustainability strategy focuses on advancements NASA can make toward measuring and assessing space sustainability in Earth orbit, identifying cost-effective ways to meet sustainability targets, incentivizing the adoption of sustainable practices through technology and policy development, and increasing efforts to share and receive information with the rest of the global space community.

NASA's approach to space sustainability recognizes four operational domains: Earth, Earth orbit, the orbital area near and around the Moon known as cislunar space, and deep space, including other celestial bodies. The first volume of the strategy focuses on sustainability in Earth orbit. NASA plans to produce additional volumes focusing on the other domains.

Learn more about the Space Sustainability Strategy at:

https://www.nasa.gov/spacesustainability

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The National Aeronautics and Space Administration

NASA explores the unknown in air and space, innovates for the benefit of humanity, and inspires the world through discovery.

Exclusive: Russia attempting to develop nuclear space weapon to destroy satellites with massive energy wave, sources familiar with intel say

By Katie Bo Lillis, Jim Sciutto, Kristin Fisher and Natasha Bertrand, CNN

5 minute read · Updated 7:57 AM EST, Sat February 17, 2024

(CNN) — Russia is trying to develop a nuclear space weapon that would destroy satellites by creating a massive energy wave when detonated, potentially crippling a vast swath of the commercial and government satellites that the world below depends on to talk on cell phones, pay bills, and surf the internet, according to three sources familiar with US intelligence about the weapon.

These sources gave CNN a more detailed understanding of what Russia is working on – and the threat it could pose – than the US government has previously disclosed.

Republican Rep. Mike Turner of Ohio, the chair of the House Intelligence Committee, set off a frenzy in Washington on Wednesday when he issued a statement saying his panel "had information concerning a serious national security threat." By Friday, President Joe Biden had publicly confirmed that Turner was referring to a new Russian nuclear anti-satellite capability — but officials have steadfastly refused to discuss it further, citing the highly classified nature of the intelligence.

The weapon is still under development and is not yet in orbit, Biden administration officials have emphasized publicly. But if used, officials say, it would cross a dangerous rubicon in the history of nuclear weapons and could cause extreme disruptions to everyday life in ways that are difficult to predict.

This kind of new weapon — known generally by military space experts as a nuclear EMP — would create a pulse of electromagnetic energy and a flood of highly charged particles that would tear through space to disrupt other satellites winging around Earth. Biden on Friday emphasized publicly that there is “no nuclear threat to the people of America or anywhere else in the world with what Russia is doing at the moment.”

“Anything that they’re doing and/or they will do relates to satellites and space and damaging those satellites, potentially,” he said.

The Defense Department and the intelligence community have tracked Russian efforts to develop a broad range of anti-satellite weapons, including an EMP, for years.

And there has been a stream of intelligence reporting in recent months related specifically to Russia’s efforts to develop nuclear-powered anti-satellite capabilities, according to one defense official.

But Russia has recently made progress in its efforts to develop a nuclear EMP — a related but far more alarming technology.

“Our general knowledge of Russian pursuit of this kind of capability goes back many, many months, if not a few years,” National Security Council spokesman John Kirby said Thursday. “But only in recent weeks now has the intelligence community been able to assess with a higher sense of confidence exactly how Russia continues to pursue it.”

The intelligence community, Biden said, had “found out there was a capacity to launch a system into space that could theoretically do something that was damaging” but that it “hadn’t happened yet.”

“It’s not a new concept and, as a concept, dates back to the late Cold War,” said one US official. But, they said, “the big fear with any eventual EMP device in orbit [is] it might render large portions of particular orbits unusable” by creating a minefield of disabled satellites that “would then prove dangerous to any new satellites we might try to put up to replace or repair the existing satellites.”

The Office of the Director of National Intelligence, the Defense Department and the National Security Council all declined to comment.

It was not immediately clear whether the device as designed could impact GPS and nuclear command and control satellites, which operate in a higher orbit than the vast constellation of commercial and government satellites whizzing through low-Earth orbit. Those larger satellites are designed to be impregnable to a nuclear blast, but a former top space official at the Pentagon told CNN that “they could be vulnerable” depending on how close they were to the EMP, how old they are and how big the blast.

‘Last-ditch weapon’

Experts say this kind of weapon could have the potential to wipe out mega constellations of small satellites, like SpaceX’s Starlink, which has been successfully used by Ukraine in its ongoing war with Russia.

This would almost certainly be “a last-ditch weapon” for Russia, the US official and other sources said — because it would do the same damage to whatever Russian satellites were also in the area.

It also remains unclear how well-developed the technology is. Russia has had a number of public debacles with their nuclear technology in recent years. In 2019, seven Russians were killed in a nuclear accident that occurred while Moscow was trying to recover a nuclear-powered cruise missile that had crashed into the White Sea during a failed test.

Still, a recent intelligence assessment on Russian progress so alarmed some lawmakers on Capitol Hill that Turner issued an invitation to all members of the House to be read in on the matter.

Shortly thereafter, he issued the vague public statement that forced the issue into the public eye.

Several sources familiar with the matter said that the exposure of the intelligence was extremely damaging because the source was incredibly sensitive. According to those sources, the intelligence community is now scrambling to figure out how to preserve its access.

Biden administration officials contend that if Russia were to field a nuclear EMP, it would be the first-ever violation of the Outer Space Treaty of 1967, which bans stationing weapons of mass destruction in outer space.

"It would be a violation of the Outer Space Treaty to which more than 130 countries have signed up to, including Russia," Kirby said Thursday, without providing details.

Russia has withdrawn from several arms control treaties in recent years, leaving the postCold War arms control architecture all but gutted.

2023/24 MEMBERS OF THE GLOBAL SPACE LAW CENTER RESEARCH COUNCIL

Justin Daniels-Dawes earned his B.A in Sociology with a concentration in Deviance from George Mason University. As a 2L now at CSU law, Justin clerks under the Chief magistrate for the city of Cleveland. On top of this he is also a teacher's assistant to the Clemency, Pardon, and Reentry clinic at the law school. Justin joined the Global Space Law Center Research Council in order to help further research efforts into the militarization of space and its effect on space law.

Caylan Fazio is a first-year J.D. student at CSU College of Law. She received her Bachelor of Science in Mathematics from John Carroll University with a minor in Computer Science. After college she gained eclectic work experiences in data analytics, management, and wilderness guiding. Through volunteer legislative advocacy, she found her true love for research and technical writing. Caylan started law school at CSU to pursue her passion for legal writing and a career in space law.

Michael Garetto-Balmer is a 2L at CSU College of Law. He was born and raised in Chicago and is a graduate from Lake Forest College where he pursued a double-major in Political Science and History. Michael joined the Research Council in 2024.

Keaton Hall began law school at Cleveland State in 2023. With an academic background in economics, Keaton brings a unique perspective to the intersection of law and economic principles. Keaton envisions leveraging legal expertise to support the burgeoning field of space exploration and industry. Keaton has served for four years in the marine corps, and eight years as a civilian paramedic.

Abby Jones is a 2L at CSU College of Law. She attended the University of Akron for undergrad and studied Political Science, Philosophy, and Economics in 2013. Since starting law school, Abby joined the Global Space Law Center Research Council to assist Professor Sundahl in research related to the complexities of ever-evolving Space Law and international relations. She was drawn to Space Law because of the vast scope of the field and its many applications in existing practice areas. Abby is also the Vice President of the Women's Law Student Association and is a Dean's Leadership Fellow.

Abigail McCoy is a 2L at CSU College of Law. She received her Bachelor of Arts in International Studies and English from Case Western Reserve University with minors in French and Political Science in 2019. After college, Abigail spent two years working at Southeastern Ohio Legal Services as a Community Engagement Specialist. Her interest in space law is at the intersection of international law and space law and the militarization of space. In addition to the Research Council, Abigail is involved in the Dean's Leadership Fellows program and Phi Alpha Delta.