UNCONTROLLED REENTRY: A COMPARISON OF THE CHINESE AND US LEGAL AND POLICY APPROACHES

Jessica Sewell[*]

ABSTRACT

The uncontrolled reentry of the People's Republic of China's (PRC or China) Long March 5B rockets pose preventable risks to persons and property on Earth's surface. When it comes to the reentry of space objects, China's comparatively underdeveloped legal and regulatory regime provides insufficient protection to the public, particularly when compared to the United States (US) regulatory system. The US and international community should call on China to improve its practices with respect to reentry, establish meaningful regulation of launch and reentry activities and continue to promote public safety as global launch cadences increase.

I. INTRODUCTION

The United States (US) and People's Republic of China (PRC or China) are both sophisticated players in outer space launch activities, together accounting for 78% of global space launches in

[*] Jessica E. Sewell (J.D., The University of Texas School of Law; B.A., International Studies, University of Mississippi; B.A., Chinese, University of Mississippi) is a space lawyer who has practiced law in both the United States and Hong Kong. Ms. Sewell is currently pursuing an LL.M. in Air and Space Law from the University of Mississippi School of Law. Her dream is a future where space travel is as common and accessible as air travel is today.

2022.[1] As global launch cadences increase, so too do potentially harmful impacts of space launches and reentries.[2]

One emerging concern is the uncontrolled reentry of large space launch vehicle components from Earth's orbit. In recent years, China's Long March 5B rockets have reentered Earth's atmosphere in uncontrolled, unpredictable manners. Because Long March 5B is particularly large, uncontrolled reentry of the rocket body could cause potentially catastrophic damage were it to impact a populated area. In fact, after the Long March's reentry in May 2020, debris from the rocket body struck two villages in the Ivory Coast, thankfully only damaging buildings.[3] One year later, another Long March 5B core stage reentered the atmosphere, its debris crashing into the Indian Ocean.[4] At the time, the two rocket stages were the "heaviest objects to reenter in an uncontrolled manner" since 1991.[5] Despite a clear trend toward "deorbit maneuvers" and controlled reentry on the international stage, and despite condemnation from the international community, China has continued to launch its Long March 5B rocket and allow the rocket body to reenter Earth's orbit in an uncontrolled fashion, exposing people and property on the Earth's surface to collision risk.

This article analyzes US and Chinese domestic space law and policy, as well as international law, in the context of the case study of China's recent Long March 5B launches. Part I provides a historical overview of uncontrolled reentry more generally, international reactions to uncontrolled reentry and China's Long March 5B's uncontrolled reentry. This section also briefly describes the geopolitical situation between the US and China in 2023. Part II of this article summarizes applicable international, US and Chinese laws, regulations and guidelines as they apply to uncontrolled reentry. This part includes a comparative review of the regulatory regimes

---

[1] Alexandra Witze, *2022 Was a Record Year for Space Launches*, 613 NATURE 426 (Jan. 19, 2023), https://doi.org/10.1038/d41586-023-00048-7.

[2] *See* Michael Byers et al., *Unnecessary Risks Created by Uncontrolled Rocket Reentries*, 6 NATURE ASTRONOMY 1093, 1095 (Sept. 2022), https://www.nature.com/articles/s41550-022-01718-8. The terms "reentry" and "re-entry" are used somewhat interchangeably in scholarship and legislation on this topic. For this this article, I will use the spelling favored in US law and regulations: reentry.

[3] Byers, *supra* note 2, at 1093.

[4] *Id.*

[5] *Id.*

(if any) that have developed in both China and the US with respect to registration of launch activities and reentry requirements. Part III examines applicable US policy toward domestic space launch and China's space program, as well as similar policies within China, and how these policies may encourage or inhibit the development of reentry capabilities that promote public safety. In Part IV, I propose recommendations for the US, China and the international community to address the concerns arising from uncontrolled reentry. And finally, Part V concludes this analysis and sets forth proposed next steps for the mitigation of risks relating to uncontrolled reentry.

II. OVERVIEW AND HISTORICAL BACKGROUND

A. Historical Context

Space launches are an inherently dangerous activity, and most space launches result in the reentry of some portion of the space vehicle into Earth's atmosphere.[6] Throughout the history of crewed and uncrewed spaceflight, components of satellites, space launch vehicles, orbital telescopes and even space stations have de-orbited and fallen to Earth in an unpredictable, uncontrolled fashion, causing consternation—and damage—to people and property on Earth's surface.[7] In the early days of the space age, little heed was paid to the potential impacts of reentering space objects on Earth. During the Apollo era, the National Aeronautics and Space Administration (NASA) regularly left the upper stages of the Saturn V launch vehicle in low Earth orbit to reenter in an uncontrolled fashion, even though the masses of the Saturn V upper stages were approximately half that of the core stage of the Long March 5B.[8] Indeed, in the US and elsewhere, the potential harms associated with uncontrolled reentry were not given much weight until the late 1970s. In 1979, the US space station Skylab was unable to maintain its orbit

---

[6] *See id.*

[7] *See, e.g., Satellite Reentry: Manipulating the Plunge,* AEROSPACE CORP., (May 5, 2018), https://aerospace.org/article/satellite-reentry-manipulating-plunge [hereinafter Aerospace Corp.].

[8] Andrew LePage, *Rockets Falling from Orbit: The Saturn V That Launched NASA's Skylab*, DREW EX MACHINA (July 31, 2022), https://www.drewexmachina.com/2022/07/31/rockets-falling-from-orbit-the-saturn-v-that-launched-nasas-skylab/.

and disintegrated in the atmosphere upon reentry, spreading debris across the Indian Ocean and parts of Australia. As Skylab reentered, the National Aeronautics and Space Administration (NASA) performed a "deorbit maneuver," where a "space object with propulsive capability can be commanded to execute one burn or a series of burns to lower its orbit so that the object will reenter at a specific location"[9]—preferably one far away from people and property on the ground. While there were no injuries from Skylab, the Australian town of Esperance charged NASA a fee of $400 for littering[10]—as was their right under the Liability Convention.[11] NASA never made the payment, which speaks to the relative difficulty of enforcing international law.[12]

B. China's Space Program and the Long March 5B

China's rocket technology has existed in one form or another for more than eight hundred years.[13] Against the background of the Cultural Revolution, China launched its first satellite, the Dong Fang Hong-1, on a Long March (*changzheng*) One vehicle in 1970.[14] As the 1958 Soviet launch of Sputnik "encouraged" the development of the US space program, establishment of NASA and formation of national space law in the US, so too did Sputnik inspire the modern Chinese space age.[15] The Long March rocket series has since proceeded to complete more than 400 launch missions over the past five decades,[16] making China a leading player in the global space

---

[9] Aerospace Corp., *supra* note 7.

[10] Mike Wall, *The Biggest Spacecraft Ever to Fall Uncontrolled from Space*, SPACE.COM (May 5, 2021), https://www.space.com/13049-6-biggest-spacecraft-falls-space.html.

[11] Convention on the International Liability for Damage Caused by Space Objects, Mar. 29, 1972, 24 UST. 2389, 961 U.N.T.S 187 [hereinafter Liability Convention].

[12] *See* Wall, *supra* note 10.

[13] The first Chinese "rockets" were tubes of gunpowder attached to bamboo arrows, which were fired from a bow and would explode upon impact. These "rockets" were used as early as the late tenth century in the Song Dynasty (960-1279). *See* JOAN JOHNSON-FREESE, THE CHINESE SPACE PROGRAM: A MYSTERY WITHIN A MAZE 43 (1998); *see also Rockets of Ancient China,* CHINACULTURE.ORG, http://en.chinaculture.org/created/2005-07/21/content_70826.htm (last visited Nov. 11, 2023).

[14] Wei Long, *China Celebrates 30th Anniversary of First Satellite Launch,* SPACEDAILY.COM (Apr. 25, 2000) https://www.spacedaily.com/news/china-00u.html.

[15] See JOHNSON-FREESE, *supra* note 13, at 45.

[16] Andrew Jones, *China's Long March Rocket Family: History and Photos,* SPACE.COM (Apr. 12, 2022), https://www.space.com/china-long-march-rockets-family.

launch industry. The fifth iteration of the Long March rocket series, Long March 5B, is China's first heavy lift launch vehicle.[17] This single-stage rocket is 187 feet long, 16 feet in diameter, and has a lift capacity of 31,000 pounds to up to geosynchronous orbit (GEO).[18] The Long March 5B was designed specifically for delivering modules of China's space station, the Tiangong (heavenly palace), into orbit.[19] However, in recent years the Long March 5B rocket body has made high-profile, uncontrolled reentries back to Earth's surface. Uncontrolled reentries of China's Long March 5B, specifically, occurred in May 2020,[20] May 2021,[21] July 2022,[22] and November 2022.[23]

These reentries are a problem. The Long March 5B rocket bodies are some of the "heaviest objects to reenter in an uncontrolled manner"[24] in modern history. When particularly large, intact rocket bodies (like those of the Long March 5B) return to Earth, "a substantial fraction of their mass survives the heat of atmospheric reentry as debris," posing significant casualty risks for people and property on the ground.[25] Moreover, disproportionate impacts of such reentry are experienced by non-spacefaring nations:

> [t]he distribution of rocket body launches and reentries leads to the casualty expectation (that is, risk to human life) being disproportionately borne by populations in the Global South, with major launching states exporting risk to the rest of the world... Those national governments whose populations are being put at risk should demand that major spacefaring states

---

[17] *See* Qin Tong et. al., *Development of China's New Generation Launch Vehicles,* 38 Chinese J. Space Sci. 593, 593 (2018), http://english.cssar.cas.cn/ns/NU/201809/W020180906583001107643.pdf.

[18] Jones, *supra* note 16.

[19] *Id*.

[20] *See* Byers, *supra* note 2, at 1093.

[21] *See* Steve Gorman, *US Space Command Tracks Chinese Rocket for Uncontrolled Reentry from Orbit,* REUTERS (May 5, 2021), https://www.reuters.com/lifestyle/science/us-space-command-tracks-chinese-rocket-uncontrolled-reentry-orbit-2021-05-06/

[22] *See* Andrew Jones, *Long March 5B Rocket Stage Makes Fiery Uncontrolled Reentry over Indian Ocean,* SPACENEWS (July 30, 2022), https://spacenews.com/long-march-5b-rocket-stage-makes-uncontrolled-reentry-over-indian-ocean/

[23] *See* Andrew Jones, *Long March 5B Rocket Reenters over Pacific Ocean After Forcing Airspace Closures in Europe*, SPACENEWS (Nov. 4, 2022), https://spacenews.com/long-march-5b-stage-reenters-over-pacific-ocean-after-forcing-airspace-closures-in-europe/

[24] Byers, *supra* note 2, at 1093.

[25] *Id*.

> act, together, to mandate controlled rocket reentries, create meaningful consequences for non-compliance and thus eliminate the risks for everyone.[26]

While an argument could be made that China's Long March 5B launches are merely reflective of past global practice, as the US paid little heed to the potential impacts of reentering Saturn V upper stages during the Apollo era, it bears mentioning that in 2023, "allowing rocket bodies to reenter in an uncontrolled manner is increasingly becoming a choice rather than a technological limitation."[27] According to astrophysicist Jonathan McDowell of the Harvard-Smithsonian Center for Astrophysics, "standard practice" in the aerospace industry requires that rocket stages either be "built with a booster to steer it into a safe landing point in the water after it reenters Earth's atmosphere," or be "built with a rocket stage with some kind of stabilization system and a restartable engine whereby you can slow it down and turn it 180 degrees to land in the ocean."[28] The Long March 5B was not designed or built with either capability, "[a]nd so it's just left in orbit the old-fashioned way to reenter uncontrolled and that is very unusual nowadays," [29] McDowell says. According to McDowell, by continuing to use a rocket that reenters the atmosphere uncontrolled, China is "deliberately just not caring."[30] Indeed, other nations have criticized China's risk appetite in allowing Long March 5B bodies to return to Earth in an uncontrolled fashion and for "imposing the reentry risks of its rockets onto the world."[31]

Furthermore, China recently demonstrated that it does have access to controlled reentry technology. On May 8, 2023, China Aerospace Science and Technology Corporation (CASC) announced that a reusable test spacecraft successfully returned to its

---

[26] *Id*.

[27] *See id*. at 1095.

[28] Passant Rabie, *Uncontrolled Reentry: Why China "Just Not Caring" is a Huge Problem for Space,* INVERSE (May 3, 2021)(quoting Jonathan McDowell), https://www.inverse.com/science/long-march-5b-uncontrolled-reentry.

[29] *Id*.

[30] *Id*.

[31] *See* Byers, *supra* note 2, at 1093.

scheduled landing site after 276 days in orbit.[32] While little is known about the spacecraft and its technology's potential application to heavy-lift rockets like the Long March 5B, this accomplishment indicates that China's uncontrolled reentries—especially any that occur in the future—are not necessarily due to technological limitations.

C. International Response to Uncontrolled Reentries

In the 1970s, Skylab's reentry was an international media event, triggering fear,[33] inspiring satire[34] and spurring the international community to consider the potential impacts of uncontrolled reentry if such events were to occur with more frequency. The European Space Agency (ESA) held a workshop on the reentry of space debris in 1983 in response to Skylab's reentry.[35] Likewise, the US later passed laws and implemented regulations to limit the hazards related to reentering space vehicles, which are discussed below under in Part III.C.2.

Since reentering space debris poses a hazard to people and property on Earth, the international community is pushing for increased adoption of controlled reentry procedures. Controlled reentry "implies that a space object can be made to impact a desired location on the Earth's surface."[36] Controlled reentries "usually target a remote ocean area that is uninhabited," so that the "risk

---

[32] Andrew Jones, *China's Mystery Reusable Spaceplane Lands after 276 Days in Orbit*, SPACENEWS (May 8, 2023), https://spacenews.com/chinas-mystery-reusable-spaceplane-lands-after-276-days-in-orbit/.

[33] *See, e.g.,* Aerospace Corp,, *supra* note 7.

[34] *See, e.g.,* Tom Shales, *Please, Mr. Skylab: The Greatest Hits on Earth,* WASH. POST (July 10, 1979), https://www.washingtonpost.com/archive/lifestyle/1979/07/10/please-mr-skylab-the-greatest-hits-on-earth/7fd747aa-e503-43e4-aa12-d402c688fb40/; Jim Carrier, *Some Find Skylab Good for "Skylaughs",* KOKOMO TRIB. 37 (July 8, 1979), https://www.newspapers.com/image/2604784/?fcfToken=eyJhbGciOi-JIUzI1NiIsInR5cCI6IkpXVCJ9.eyJmcmVlLX-eyJmcmVlLXZpZ2MDQ3ODQsImlhdCI6MTY4MDk5MzE3NywiZXhwIjoxNjgxMDc5NTc3fQ.y0EdBOM7RVvcZRVvcZTGU5liWqs2dporFWuRLF4sbf4.

[35] ESA Space Debris Off., *ESA's Annual Space Environment Report* (2023), https://www.sdo.esoc.esa.int/environment_report/Space_Environment_Report_latest.pdf.

[36] Russell P. Patera, *Hazard Analysis for Uncontrolled Space Vehicle Reentry*, 45 J. SPACECRAFT & ROCKETS 1031, 1031 (2008).

associated with a successful controlled reentry is essentially zero."[37] As awareness of the risks associated with space debris and uncontrolled reentry has grown, the international community has witnessed "increased usage for controlled reentry as disposal strategy," and "controlled reentry" has been described by ESA as a preferred methodology for the deorbit of space vehicles.[38] In fact, in 2021 ESA reported a marked increase in controlled reentry of space objects from orbit,[39] showing that more States are attempting to adhere to international guidelines.

D. Overview of US-China Relations in 2023

> *"A trade war, semiconductors, human rights: in recent years, the US-China relationship has been rocked by successive geopolitical crises that have strained the dynamic between two of the world's most powerful countries."*[40]

Instances of tension between the US and China have increased in recent years, particularly with respect to outer space. On January 11, 2007, China launched a ballistic missile that collided with, and destroyed, a non-operational Chinese weather satellite.[41] This direct ascent antisatellite (ASAT) test created the largest cloud of

---

[37] *Id*.

[38] ESA Space Debris Office, *ESA's Annual Space Environment Report* (2021), https://www.sdo.esoc.esa.int/environment_report/Space_Environment_Report_latest.pdf.

[39] *See id*. at 7. "Between 40 and 90% of rocket bodies reaching end-of-life during the current decade in the LEO protected region in a non-compliant orbit attempt to comply with space debris mitigation measures. Between 30% and 80% do so successfully, with the compliance trend linearly increasing. Between 40% and 50% of the rocket bodies delivering payloads in or near the GEO protected region during the last decade were in compliance with space debris mitigation measures. Between 85% and 100% of all payloads reaching end-of-life during the last decade in the GEO protected region attempt to comply with space debris mitigation measures. Between 60% and 90% do so successfully, with the compliance trend asymptotically increasing."

[40] Emily Feng & Lexie Schapitl, *How a Chinese "Spy Balloon" Prompted the US to Scour the Skies*, NPR (Feb. 14, 2023), https://www.npr.org/2023/02/14/1156731462/china-spy-balloon-timeline-key-dates.

[41] *See* Brian Weeden, *2007 Chinese Anti-Satellite Test Fact Sheet,* SECURE WORLD FOUND. (Nov. 23, 2010), https://swfound.org/media/9550/chinese_asat_fact_sheet_updated_2012.pdf. While orbital space debris is an important topic in current space law discourse, this paper will focus exclusively on debris that collides with the Earth's surface.

space debris ever tracked[42] and sparked international outcry.[43] The 2007 test also signaled to the US considerable progress—and potential threats—arising from China's space program and its capabilities.

In February 2022, Zhao Lijian, spokesperson for China's Ministry of Foreign Affairs, claimed that China was required to maneuver its Tiangong space station twice in 2021 to avoid close approaches by SpaceX Starlink satellites.[44] Zhao noted that "[a]fter the incidents, China's competent authorities tried multiple times to reach the US side via e-mail, but received no reply."[45] The US, on the other hand, disputed China's claim in a note verbale delivered to the UN Secretary-General.[46] The note verbale similarly highlighted concerns with respect to US-China communications channels:

> . . . the United States urges all nations, in particular those with human spaceflight missions, to provide updated contact information on designated entities authorized to engage in timely exchanges of appropriate information on on-orbit human spacecraft operations, in particular those entities that are

---

[42] *See id.*

[43] *See* Carin Zissis, *China's Anti-Satellite Test,* COUNCIL ON FOREIGN RELATIONS (CFR) (Feb. 22, 2007), https://www.cfr.org/backgrounder/chinas-anti-satellite-test, detailing outcry from Japan ("In the days after the Chinese test, Japanese Prime Minister Shinzo Abe charged Beijing with violating the United Nations' 1967 Outer Space Treaty, which bans the use of weapons of mass destruction in space and which China ratified in 1983"); the United States ("If China and the United States both took out each other's satellites in a conflict, the Americans would lose far more"); India (within two weeks of Beijing's test, India's air force announced intentions to protect the country's space operations (Space.com) by setting up an aerospace command); and even Russia ("Moscow condemned the Chinese test, but Sergei Ivanov, Russia's former defense minister, tempered the reaction by referring to earlier Soviet and US tests, saying, "It is not China that opened up Pandora's box.").

[44] *Foreign Ministry Spokesperson Zhao Lijian's Regular Press Conference on February 10, 2022*, Ministry of Foreign Affairs of the People's Republic of China (Feb. 10, 2022), https://www.fmprc.gov.cn/mfa_eng/xwfw_665399/s2510_665401/2511_665403/202202/t20220210_10640952.html.

[45] *Id.*

[46] *Note Verbale Dated 28 January 2022 from the Permanent Mission of the United States of America to the United Nations (Vienna) Addressed to the Secretary-General*, U.N. Doc. A/AC.105/1265 (Jan. 28, 2022). https://www.unoosa.org/oosa/en/oosadoc/data/documents/2022/aac.105/aac.1051265_0.html.

> responsible for adopting precautionary and response measures for crewed missions.[47]

Together with legal restrictions like the Wolf Amendment (discussed in Part IV.A), lack of clear channels of communication have made it difficult for the US and China to exchange information on issues of public safety and have at times triggered avoidable geopolitical escalation.

For example, a similar breakdown in communications occurred in February 2023, when the US shot down a Chinese balloon that entered US airspace in violation of international air law.[48] When US officials attempted to contact their Chinese counterparts for an explanation of the balloon's presence in US airspace, China indicated that their side had,

> after verification, repeatedly informed the US side of the civilian nature of the airship and conveyed that its entry into the US due to *force majeure* was totally unexpected. The Chinese side has clearly asked the US side to properly handle the matter in a calm, professional and restrained manner.[49]

On the other hand, the US Pentagon spokesperson Brigadier General Pat Ryder called out the balloon as a "high-altitude surveillance balloon" that was "clearly" intended for surveillance purposes.[50] The US proceeded to shoot down the balloon and sanction six civilian Chinese aerospace companies that it accused of ties to China's military space program.[51] Unsurprisingly, the US-China relationship has not since improved.

---

[47] *Id*.

[48] Feng & Schapitl, *supra* note 40.

[49] *The Foreign Ministry Issues Statement on the US Claim of Downing a Chinese Unmanned*, Ministry of Foreign Affairs of the People's Republic of China (Feb. 5, 2023), https://www.fmprc.gov.cn/mfa_eng/zxxx_662805/202302/t20230205_11019871.html.

[50] US Dep't of Def., *Transcript: Senior Defense Official Holds a Background Briefing on High-Altitude Surveillance Balloon* (Feb. 2, 2023), https://www.defense.gov/News/Transcripts/Transcript/Article/3287204/senior-defense-official-holds-a-background-briefing-on-high-altitude-surveillan/.

[51] Additions to the Entity List, 88 Fed. Reg. 9389 (Feb. 14, 2023) (to be codified at 15 C.F.R. pt. 744), https://www.govinfo.gov/content/pkg/FR-2023-02-14/pdf/2023-03193.pdf.

III. APPLICABLE LEGAL FRAMEWORK

A. International Space Law

"Generally, international space law falls into two categories: (1) binding or normative instruments such as treaties, standards, and national regulations, and (2) non-binding agreements which are used to convey voluntary, non-normative and/or aspirational ideals that may be too difficult to achieve international consensus on."[52] The United States and China have signed treaties that form the basis of international space law; therefore, both countries are subject to international law in pursuing space activities (including reentry of rocket bodies).

First, both China and the US have signed the Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies, commonly known as the Outer Space Treaty.[53] Under Article III of the Outer Space Treaty, signatories agree to "carry on activities in the exploration and use of outer space, including the Moon and other celestial bodies, in accordance with international law, including the Charter of the United Nations, in the interest of maintaining international peace and security and promoting international co-operation and understanding."[54] Article VI of the Outer Space Treaty provides for State Parties to the Treaty to bear "international responsibility for national activities in outer space."[55] Article VII in turn provides that:

> "[e]ach State Party to the Treaty that launches or procures the launching of an object into outer space, including the Moon and other celestial bodies, and each State Party from whose territory or facility an object is launched, is *internationally liable for damage to another State Party to the Treaty or to its natural or juridical persons by such object or its component parts on the*

---

[52] Sophie Goguichvili et. al., *The Global Legal Landscape of Space: Who Writes the Rules on the Final Frontier?,* WILSON CENTER (Oct. 1, 2021), https://www.wilsoncenter.org/article/global-legal-landscape-space-who-writes-rules-final-frontier.

[53] 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 UST. 2410, 610 U.N.T.S. 205 [hereinafter Outer Space Treaty].

[54] *Id.* at art. III.

[55] *Id*. at art. VI.

> *Earth*, in air or in outer space, including the Moon and other celestial bodies."[56]

Based on the text of Article VII of the Outer Space Treaty, there is no question that China would be "internationally liable" for any damage caused by a deorbiting rocket body to people or property on Earth.

Second, the Convention on Registration of Objects Launched into Outer Space[57] (Registration Convention), which both the US and China are party, requires launching States to register space objects "launched into earth orbit or beyond" with the Secretary-General of the United Nations.[58] Launching States are required to furnish various information with the registration, including the name of the launching State, the date and location of launch, and basic orbital parameters.[59] However, there is no requirement in the Registration Convention that launching States (1) notify the United Nations of the trajectory or timing of de-orbit or (2) identify where the space object will land upon reentry.[60]

Finally, according to Article II of the 1972 Space Liability Convention,[61] a "launching State" is "absolutely liable to pay compensation for damage caused by its space object on the surface of the earth . . . ."[62] Therefore, if a space object launched by China, such as the Long March 5B rocket body, reenters Earth's atmosphere and causes damage to persons or property on Earth, not only would China be "internationally liable" for such damage under Article VII of the Outer Space Treaty,[63] but China would also be "absolutely liable" under the Liability Convention to "pay compensation for damage caused" by such reentry.[64] The Liability Convention was exercised for the first time in the history of space exploration in

---

[56] *Id*. at art. VII (emphasis added).

[57] Convention on Registration of Objects Launched into Outer Space, Jan. 14, 1975, 28 UST. 695, 1023 U.N.T.S. 15 [hereinafter Registration Convention].

[58] *Id.* at art. II.

[59] *Id*. at art. IV.

[60] *See generally*, Registration Convention, *supra* note 57.

[61] Liability Convention, *supra* note 11.

[62] *Id*. at art. II.

[63] Outer Space Treaty, *supra* note 53, art. VII.

[64] Liability Convention, *supra* note 11, art. II.

1978.[65] After Cosmos 954, a Soviet nuclear-powered satellite, crashed in Canada's Northwest Territories and scattered radioactive debris across a large area, the USSR made a payment of approximately $3,000,000 to the Canadian government.[66] It is not known whether China paid any compensation to the Ivory Coast for damage caused by the May 2020 Long March 5B uncontrolled reentry. It is also not clear that the Liability Convention provides a meaningful deterrent for risky activities in outer space, or if "'liability risk' is treated as just another cost of doing business,"[67] as in other commercial and diplomatic activities.

Notably, none of the international space law treaties specifically addresses the issue of uncontrolled reentry of space objects like China's Long March 5B rocket body. The shortage of rules on this matter may be due to "[t]he added technological complexity and cost involved in achieving controlled reentries,"[68] as well as the fact that the signatories to the Outer Space Treaty and Liability Convention signed it at the dawn of the space age, when controlled reentry technology did not yet exist. However, in the current environment, States should consider the "cumulative risks"[69] associated with increasing launch cadences, since technologies that could eliminate the need for most uncontrolled reentries have been successfully proven in the 2020s. A careful balance must be struck between promoting public safety from a legal perspective, while keeping the international stage open for new entrants in space launch activities.

B. Non-Binding International Guidelines

Guidance from international organizations and agreements among space agencies, while not binding international law, can be instructive in determining international standards for certain activities. Such guidance can also be interpreted as a means of establishing customary international law and acceptable norms of behavior. According to the Aerospace Corporation's Robin Dickey, "norms

---

[65] Bryan Schwartz & Mark L. Berlin, *After the Fall: An Analysis of Canadian Legal Claims for Damage Caused by Cosmos 954*, 27 MCGILL L. J. 677 (1982).

[66] *Id.*

[67] Byers et. al., *supra* note 2, at 1094.

[68] *Id.* at 1093.

[69] *See id.*

of some kind are necessary to protect the safety, stability, security, and sustainability of the space domain."[70] Specifically, organizations including the Inter-Agency Space Debris Coordination Committee (IADC) and United Nations Office for Outer Space Affairs' Committee on the Peaceful Uses of Outer Space (UNCOPOUS) have published guidelines for space activities that prescribe preferred approaches for de-orbit and reentry of space objects, including rocket bodies like the Long March 5B first stage.

i. IADC Guidelines

On March 1, 2020, the IADC, which is described as "an international forum of space agencies, authorized governmental or intergovernmental entities for the coordination of activities related to the issues of human-made and natural debris in space,"[71] published guidelines for the reduction and treatment of space debris, including post-mission disposal of space objects.[72] Specifically,

> [i]f a spacecraft or orbital stage is to be disposed of by reentry into the atmosphere, debris that survives to reach the surface of the Earth should not pose an *undue risk* to people or property. This may be accomplished by limiting the amount of surviving debris or confining the debris to uninhabited regions, such as broad ocean areas.[73]

The China National Space Administration (CNSA) and NASA are both member agencies of the IADC, and the Guidelines "have been agreed to by consensus among the IADC member agencies."[74] The Guidelines do not define "undue risk" and do not specifically label large rocket bodies as debris that may constitute such a risk.

---

[70] Robin Dickey, *Building Normentum: A Framework for Space Norm Development*, AEROSPACE CORP. (Jul. 2021), https://csps.aerospace.org/sites/default/files/2021-07/Dickey_BuildingNormentum_20210706.pdf.

[71] IADC*, IADC Space Debris Mitigation Guidelines* (Mar. 1, 2020), at Foreword https://orbitaldebris.jsc.nasa.gov/library/iadc-space-debris-guidelines-revision-2.pdf.

[72] *Id.*

[73] *Id.* § 5.3.2.

[74] *Id.* at Introduction.

ii. UNCOPOUS Guidelines

In January 2021, the United Nations Office for Outer Space Affairs' Committee on the Peaceful Uses of Outer Space (UNCOPOUS) published Guidelines for the Long-term Sustainability of Outer Space Activities of the Committee on the Peaceful Uses of Outer Space[75] (UNCOPUOS Guidelines) These guidelines include a specific Guideline B.9, "Take measures to address risk associated with the uncontrolled reentry of space objects."[76] These measures are excerpted in their entirety in Appendix A.

The UNCOPOUS Guidelines could be a good guidepost for countries, including China, to implement regulations regarding reentry of space objects. Although additional costs and technical challenges are associated with controlled reentry capability, these guidelines indicate that the international community is increasingly recognizing the importance of employing controlled reentry techniques to protect public safety and minimize casualty risk.

C. US Space Laws and Regulations Applicable to Rocket Body Reentry

i. US Space Laws

US domestic space law fulfills two primary purposes: originally, to respond to national security concerns relating to the USSR's launch of Sputnik 1,[77] and more generally, to fulfill its obligations under international space law. In fulfillment of its supervisory responsibility obligations under the Outer Space Treaty, the US, through Congress, has passed federal laws to authorize administrative agencies to regulate outer space activities.[78] First, the National Aeronautics and Space Act, passed in 1958, established NASA as a civilian agency to "exercise[e] control over aeronautical

---

[75] Comm. on the Peaceful Uses of Outer Space, Rep. of the Comm. on Its Sixty-Second Session, Annex II, U.N. Doc A/74/20 (2019) https://www.unoosa.org/res/oosadoc/data/docments/2021/stspace/stspace79_0_html/st_space79E.pdf [hereinafter LTS Guidelines].

[76] LTS Guidelines at Guideline B.9.

[77] *See* STEVE MIRMINA AND CARYN SCHENEWERK, INTERNATIONAL SPACE LAW AND SPACE LAWS OF THE UNITED STATES 7 (2022).

[78] *See* Outer Space Treaty, *supra* note 53, art. IV; *see also* MIRMINA & SCHENEWERK, *supra* note 77, at 12.

and space activities sponsored by the United States."[79] Later codified as positive law of the United States in Title 51 of the United States Code,[80] the NASA Act provides the statutory basis under which US administrative agencies, such as the Federal Aviation Administration (FAA) and the Department of Transportation (DOT), issue regulations in line with Outer Space Treaty obligations. The FAA was granted authority to establish a space vehicle licensing regime under 51 USC. § 50901(b) for the purpose, among others, of "promoting the continuous improvement of the safety of launch vehicles designed to carry humans, including through the issuance of regulations. . ."[81] The NASA ACT also delegates authority to the Secretary of Transportation to "oversee and coordinate the conduct of commercial launch and reentry operations, issue permits and commercial licenses and transfer commercial licenses authorizing those operations, and protect the public health and safety, safety of property, and national security and foreign policy interests of the United States."[82]

Other laws promoting the development of commercial space in the US include the 1984 Commercial Space Launch Act[83] and the 2015 Commercial Space Launch Competitiveness Act, sometimes referred to as the Spurring Private Aerospace Competitiveness and Entrepreneurship (SPACE) Act of 2015.[84]

---

[79] National Aeronautics and Space Act of 1958, 51 USC. § 20102 (1958).

[80] National and Commercial Space Programs, Pub. L. 111-314, § 2, 124 Stat. 3328 (2010).

[81] 51 USC. § 50901(b) ("The purposes of this chapter are— (1) to promote economic growth and entrepreneurial activity through use of the space environment for peaceful purposes; (2) to encourage the United States private sector to provide launch vehicles, reentry vehicles, and associated services by— (A) simplifying and expediting the issuance and transfer of commercial licenses; (B) facilitating and encouraging the use of Government-developed space technology; and (C) *promoting the continuous improvement of the safety of launch vehicles designed to carry humans, including through the issuance of regulations, to the extent permitted by this chapter*") (emphasis added).

[82] 51 USC. § 50901(b)(3).

[83] Commercial Space Launch Act, Pub. L. No. 98-575, § 7, 98 Stat. 3055, 3058 (1984) (codified as amended at 49 USC. 70101 (Suppl. II 2008)).

[84] Commercial Space Launch Competitiveness Act, Pub. L. No. 114-90 (2015).

ii. US Regulatory Framework

Safe launch and reentry are a primary goal of US space regulations.[85] Part 450 of the FAA regulations details the licensing process for US commercial space launches, including the "requirements for obtaining and maintaining a license to launch, reenter, or both launch and reenter a launch or reentry vehicle."[86] An FAA license "authorizes reentry," which is defined to include both "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" and "activities necessary to return the reentry vehicle, or vehicle component, to a *safe condition on the ground* after impact or landing."[87]

Clear emphasis on safety is prevalent throughout Part 450.[88] Specifically, the applicant for a license must demonstrate that "[i]ts launch or reentry would not *jeopardize public health and safety*, *safety of property*, US national security or foreign policy interests, or international obligations of the United States."[89] Similar language is echoed throughout Part 450 in various stages of review, including general payload review and determination;[90] classification of payloads;[91] interagency consultation;[92] payload application

---

[85] 14 C.F.R. § 450.1.

[86] *Id*. *See also* recent regulations of the Federal Communications Commission (FCC) (47 C.F.R. 25.114), which require space stations that are deorbiting and "planning disposal through uncontrolled atmospheric reentry" to complete such disposal no later than five years following the end of the relevant mission. Since space stations are outside the scope of this paper, this analysis will focus on the FAA framework applicable to space launches and reentries.

[87] 14 C.F.R. § 450.3(c) (emphasis added).

[88] 14 C.F.R. § 450.43(a).

[89] *Id*. (emphasis added).

[90] 14 C.F.R. § 450.43(a) ("If applicable, the FAA issues a favorable payload determination for a launch or reentry to a license applicant or payload owner or operator if… [i]ts launch or reentry would not jeopardize public health and safety, safety of property, US national security or foreign policy interests, or international obligations of the United States.").

[91] 14 C.F.R. § 450.43(c) ("However, prior to a launch or reentry, each payload is subject to verification by the FAA that its launch or reentry would not jeopardize public health and safety, safety of property, US national security or foreign policy interests, or international obligations of the United States.").

[92] 14 C.F.R. § 450.43(e)(3) ("The FAA consults with… [o]ther Federal agencies, including the National Aeronautics and Space Administration, authorized to address issues of public health and safety, safety of property, US national security or foreign policy

requirements;[93] specific contents of payloads;[94] and other unique safety policies, requirements, and practices.[95] The FAA can deny a launch or reentry license based on "safety approval,"[96] and the burden is on the applicant to demonstrate that reentry activities will not "jeopardize[e] public health and safety and safety of property."[97] Part 450 also sets forth the system safety program requirements for the "lifecycle of a launch or reentry system,"[98] including requirements for hazard control[99] and physical containment of flight-related hazards to a prescribed containment area.[100] License recipients are required to maintain the accuracy of any representations set forth in their application for the entire term of the license[101] and must apply to the FAA for a license modification if any representation in their application "that is *material to public health and safety or the safety of property* is no longer accurate and complete" or there have been changes to the licensee's launch or reentry procedure.[102]

The FAA also requires that applicants disclose information about reentering payloads.[103] Specific disclosure requirements for

---

interests, or international obligations of the United States, associated with the launch or reentry of a proposed payload or payload class.").

[93] 14 C.F.R. § 450.43(i)(1)(xi) (The applicant must provide the FAA with "[a]ny other information necessary to make a determination based on public health and safety, safety of property, US national security or foreign policy interests, or international obligations of the United States.").

[94] 14 C.F.R. § 450.45(e)(6) ("The FAA will evaluate the launch or reentry of any radionuclide on a case-by-case basis, and issue an approval if the FAA finds that the launch or reentry is consistent with public health and safety, safety of property, and national security and foreign policy interests of the United States".).

[95] 14 C.F.R. 450.177(b) ("The FAA may identify and impose a unique policy, requirement, or practice as needed to protect the public health and safety".).

[96] 14 C.F.R. § 450.45(d).

[97] 14 C.F.R. § 450.45(a) ("The FAA issues a safety approval to an applicant if it determines that an applicant can conduct launch or reentry without jeopardizing public health and safety and safety of property. A license applicant must satisfy the application requirements in this section and subpart C of this part.").

[98] 14 C.F.R. § 450.103.

[99] *See* 14 C.F.R. § 450.107.

[100] *See generally,* 14 C.F.R. § 450.110; 14 C.F.R. § 450.133.

[101] 14 C.F.R. § 450.211(a)

[102] 14 C.F.R. § 450.211(b)(2)(emphasis added) ("A change is material to public health and safety or the safety of property if it alters or affects—(i) The class of payload; (ii) The type of launch or reentry vehicle; (iii) The type or quantity of hazardous material; (iv) The flight trajectory; (v) The launch site or reentry site or other landing site; or (vi) Any system, policy, procedure, requirement, criteria, or standard that is safety critical.").

[103] 14 C.F.R. § 450.43(i)(2).

reentering payloads are outlined in 14 CFR 450.43(i)(2) and include the following:

> (i) Payload name or class of payload, and function;
>
> (ii) Physical characteristics, dimensions, and weight of the payload;
>
> (iii) Payload owner and payload operator, if different from the person requesting the payload review and determination;
>
> (iv) Type, amount, and container of hazardous materials and radioactive materials in the payload;
>
> (v) Explosive potential of payload materials, alone and in combination with other materials found on the payload or reentry vehicle during reentry; and
>
> (vi) Designated reentry site.[104]

Finally, 14 CFR 450.101(b) sets forth specific acceptable risk guidelines for the reentry or deorbiting of a space vehicle, specifying the acceptable, quantifiable risk that can be associated with any such activity.[105] These reentry risk criteria for collective risk, individual risk, and aircraft risk are excerpted in their entirety in Appendix B. The FAA regulations demonstrate the agency's commitment to protecting public safety by quantifying risk to individuals, property, and even aircraft. By prescribing quantified risk guidance for rocket body reentry in the licensing requirements for space launch operators, the FAA regulations encourage the safe—preferably controlled—reentry of launch vehicle components. Doing so not only fulfills US responsibilities under international space law, but also sets a standard upon which other players in the space industry can measure the acceptable level of risk associated with their space launch activities.

---

[104] *Id.*

[105] 14 C.F.R § 450.101(b).

D. Applicable Chinese Space Laws, Policy and Regulations[106]

> *"…[T]hose assuming that analyzing or interacting with China is the same as dealing with any other country are deluding themselves."*[107]

China is unusual among space powers in that it lacks a national space law.[108] In analyzing Chinese laws and regulations applicable to outer space activities, and specifically uncontrolled reentry, it is necessary to first consider the cultural context of the role of law and codification in modern Chinese society. Especially for a Western audience, "it is surely necessary to acquaint ourselves with the particular cultural background we wish to study before we can really understand the foreign text,"[109] and "when studying non-Western legal systems and cultures, [non-Chinese] must not approach or appraise these systems from their own Western viewpoints or judge them by European or American standards."[110] Western scholarship on Chinese space law, and on the role of law in China more generally, is lacking compared with other jurisdictions.

First, in the Chinese system, "the legal and organizational factors of space activities are subordinated to the overall national strategy development based on the principles of the rule of law with the Chinese specifics."[111] "Chinese specifics" in the rule of law in China can be difficult for outsiders to understand, but can be described as follows:

> The first thing to note is that the theoretical thinking and practice of the Chinese rule of law is based on the theoretical postulates of Marxism, not dogmatic, but taking into account the modern time and the Chinese traditions. When the process of government is carried out in accordance with the law and on

---

[106] Where translations of original Chinese text, including applicable regulations and similar, are used in this Section and elsewhere in this Article, unless noted otherwise herein, these translations are unofficial translations by the author of this Article and have not been professionally certified.

[107] JOHNSON-FREESE, *supra* note 13, at 38.

[108] *See* Olga Yeshchuk & Anna Vasina, *Chinese Space Law: Problems and Areas of Reforming*, 3 ADVANCED SPACE L., 140, 140 (2019) http://asljournal.org/journals/2019-3/ASL_vol_3_YeshchukVasina.pdf.

[109] PETER DE CRUZ, COMPARATIVE LAW IN A CHANGING WORLD 223 (3d ed. 2008) (1995).

[110] *Id.* at 229.

[111] Yeshchuk & Vasina, *supra* note 108, at 141.

> the basis of Marxist theory of law and practice of a socialist legal state with Chinese characteristics. After all, according to Chinese scholars, the rule of law in any country not only reflects the universality and community, but also the peculiarity and individual development of each state. Such features include the specific legal culture of Chinese citizens and the understanding that the development of the rule of law cannot go beyond the stages of economic and social development.[112]

The roles that lawyers, judges, statutes and contracts play in society in the Chinese legal system are distinct from their roles in the US and Western legal systems.[113] For example, "law and the recourse to the courts is traditionally seen as a last resort" in the Chinese system, and law is perceived as playing a "minor role" in society.[114] Conversely, "the lack of a mature legal system is often cited by the Chinese to explain their inability to accommodate normal business practices."[115] For these reasons, it makes some sense that China would proceed to develop leading space capabilities in the absence of the type of legal and regulatory framework that Western scholars would expect to see—though it also reasonably raises questions as to whether China's existing legal framework is sufficient to govern their increasingly frequent space launch activities.

i. Five-Year Plans

Because China lacks formal space laws, its space activities are instead governed by informal departmental regulations and national long-term policies referred to as five-year-plans, or White Papers.[116] China's most recent five-year plan is discussed in more detail in Part IV.

ii. Chinese Departmental Regulations

As discussed above, China is a party to the Outer Space Treaty, Registration Convention, and Liability Convention.

---

[112] *Id*. at 141-42.
[113] DE CRUZ, *supra* note 109.
[114] *See id*. at 209.
[115] JOHNSON-FREESE, *supra* note 13, at 27.
[116] *See* Yeshchuk & Vasina, *supra* note 108.

However, these international space treaties are not self-executing and require States to adopt domestic rules and regulations to implement them.[117] In China, "the lack of formal national civil space law. . . does not mean that there is no legal regulation in the field."[118]

China's space program is instead governed by low-level administrative regulations: (1) Measures for the Administration of Registration of Objects Launched into Outer Space 2001[119] (Registration Measures) (2) Interim Procedure for the Administration of Licenses for Civil Space Launch Programs[120] (Licensing Measures) and (3) various non-binding, interim space debris mitigation measures.[121] Of these, (2) and (3) are the most immediately applicable to uncontrolled reentry and reentry regulations.

a. Registration Measures

The Registration Measures have been enacted in the form of departmental regulations, which constitute "one of the lowest level of laws in China."[122] The purpose of the 2001 Registration Measures is to implement China's obligations under the Registration Convention, which requires States Parties to register space objects in

---

[117] *See* Fabio Tronchetti, *Space Law and China*, *in* OXFORD RESEARCH ENCYCLOPEDIA OF PLANETARY SCIENCE (2019), https://oxfordre.com/planetaryscience/display/10.1093/acrefore/9780190647926.001.0001/acrefore-9780190647926-e-66?d=%2F10.1093%2Facrefore%2F9780190647926.001.0001%2Facrefore-9780190647926-e-66&p=emailAKJ3P%2FekvgM7.

[118] Yeshchuk & Vasina, *supra* note 108.

[119] Measures for the Administration of Registration of Objects Launched into Outer Space 2001.

[120] China Comm'n of Sci., Tech., and Indus. for Nat'l Def., Ord. No. 12: Interim Procedure for the Administration of Licenses for Civil Space Launch Programs, (Nov. 21, 2002) http://www.moj.gov.cn/pub/sfbgw/flfggz/flfggzbmgz/200303/t20030321_143416.html [hereinafter Licensing Measures].

[121] *See* 空间碎片减缓要求 (*Kongjian Yapian Jianhuan Yaoqiu*), 中华人民共和国航天行业标准, 国防科学技术工业委员会法师, (Apr. 11, 2005), *QJ* 3221-2005.pdf (ydylstandards.org.cn) [hereinafter Space Debris Mitigation Requirements]; *see also* Zizheng Gong, *China Practices on Satellites Post Mission Disposals Toward Space Long Term Sustainability*, presented at 53rd Sess. of the Comm on the Peaceful Uses of Outer Space Sci. and Tech. Subcomm. (Feb. 15-26, 2016), https://www.unoosa.org/documents/pdf/copuos/stsc/2016/tech-21E.pdf.

[122] Tronchetti, *supra* note 117, at 3.

national and international registries.[123] The Registration Measures do not, however, require any registration or reporting of reentering space objects.[124]

b. Licensing Measures

The purpose of the 2002 Licensing Measures is to standardize the management of civil (non-military) space launch projects, promote the "healthy development" of China's civil space launch industry, and fulfill China's obligations under the Outer Space Treaty.[125] The Licensing Measures require "any natural person, legal person, or organization engaged in civil launch projects" to apply for "examination and approval" from China's National Defense Science, Technology and Industry Commission (SASTIND), and applicants are prohibited from carrying out such a project until an authorization is obtained.[126]

---

[123] *Id*.; *see also*, China Comm'n of Sci., Tech., and Indus. for Nat'l Def. and the Ministry of Foreign Affairs, Ord. No. 6: Procedure of Space Objects Registration and Management (Feb. 8, 2001).

[124] *See id*.

[125] *See* Licensing Measures, *supra* note 120.

[126] *Id*. at art. III.

License applicants must meet the following conditions:

(1) Abide by State laws and regulations, and keep State secrets; (2) The applied project does not endanger national security, does not harm national interests, and does not violate the country's foreign policy and signed and effective international conventions; (3) The project being applied for will not cause irreparable harm to public health, safety and property *due to gross negligence or intentional behavior*; (4) Possess relevant permit documents issued by relevant State departments to engage in the applied project; (5) Possess the technical force, economic strength and complete technical information to engage in the applied project; and (6) Other conditions stipulated by laws, regulations and rules.[127]	（一）遵守国家法律、法规，保守国家秘密； （二）申请的项目不危害国家安全，不损害国家利益，不违反国家的外交政策和已签署并发生效力的国际公约； （三）申请的项目不会因重大过失或故意行为对公众的健康、安全和财产构成无法补偿的危害； （四）具有国家有关部门发放的从事所申请项目的相关许可文件； （五）具备从事所申请项目的技术力量、经济实力及完善的技术资料； （六）法律、法规、规章规定的其它条件。

Here, the license requirements differ significantly from Part 450 under the US licensing regime. Unlike the commitment to public health and safety that is referenced throughout Part 450, the Licensing Measures only require that the project for which the applicant applies will not cause "irreparable" harm to public health, safety and property "due to gross negligence or intentional

[127] *Id.* at art. V (emphasis added). As noted above in Note 106, this is an unofficial translation by the author of this Article and has not been professionally certified.

behavior."[128] This language limits the scope of the protection significantly.

The Licensing Measures also require a satellite launcher to provide:

Safety design reports related to the project and materials for ensuring public safety, the reliability of key safety systems, and the impact of normal and fault states during the launch process of the launch vehicle on property and personal safety near the launch site and within the range of the launch track. impact, how to avoid pollution and space debris, and other safety-related supplementary materials; for foreign-related projects, policy assessment and confidential safety assessment materials must also be submitted.[129]	（四）与该项目相关的安全设计报告及保障公众安全的材料，关键安全系统的可靠性、运载火箭发射过程中正常及故障状态对发射场附近及发射轨迹范围内的财产及人身安全构成的影响、如何避免污染和空间碎片问题以及其它有关安全的补充材料；涉外项目，还须提交政策性评估和保密安全性评估材料。

Notably, the disclosure requirements relating to safety, space debris, and hazard mitigation are limited solely to launch, not reentry. There is some scholarly criticism as to

> whether the scope of the license, apart from covering the launch itself, also extends to activities actually occurring in outer space once the launch is complete. In other words, as the [Licensing] Measures only focus on the 'launching' phase, it is not clear whether the behavior of the licensee in space is regulated by the [Licensing] Measures and if the government is provided with effective means to control it.[130]

---

[128] *See id*.

[129] *Id*. at art. VI. As noted in Note 106, this is an unofficial translation by the author of this Article and has not been professionally certified.

[130] Tronchetti, *supra* note 117, at 6.

Therefore, it does not appear that the Licensing Measures apply to reentry of space objects.[131] And further, the Licensing Measures do not contain limitations on acceptable ranges of risk or public safety protections for reentry.

c. Space Debris Measures

China has circulated various "interim" measures relating to the regulation or mitigation of space debris, but, as "interim" measures, these efforts lack binding effect. Chinese scholars like Dr. Li Shouping, the Director of the Space Law Institute at Beijing Institute of Technology, have noted the need for China to establish national laws or regulations relating to space debris mitigation to implement the UNCOPUOS Guidelines.[132] Li describes the existing space debris mitigation measures in China as "several documents without legally binding force and with limited political influence."[133] These documents include the interim space debris mitigation measures promulgated between 2005 and 2010.[134] According to Li, the interim measures are "just a government blue book" that do not actually vest any rights, or impose any obligations, on any institutions or individuals in China.[135] Indeed, under the existing Chinese regime, the current space debris mitigation measures lack national authority or enforcement ability from high-level bodies such as the Chinese State Council or NPC,[136] and do not sufficiently regulate space debris mitigation measures such as reentry regulation.

Nevertheless, it can be worthwhile to review the terms of these interim measures, however nonbinding they may be. For example, in the 2005 interim measures, the Chinese term "离轨 (ligui), or deorbit, is defined as "a maneuver of a space system to artificially leave the original orbit for reentry into the atmosphere before its end of life."[137] The 2005 interim measures vest authority to regulate

---

131 *Id*.

132 *See* Li Shouping, *The Present Situation and Prospects of Chinese National Mechanism on Space Debris Mitigation*, 26航空宇宙法學會誌 第 239, 249 (Dec. 22, 2011).

133 *See id*.

134 *Id*.

135 *Id*.

136 *See id*.

137 *See* Space Debris Mitigation Requirements, *supra* note 121, at 3.5.

space debris mitigation measures with CNSA.[138] The measures require that space operators take measures to establish and implement space debris management plans and effectively control the generation of space debris in the event of a failure of a space object, and also require launch providers, as part of the mitigation plan, to submit a description of the plan for post-mission disposal of space objects.[139] The measures do not, however, specify any preferred "post-mission disposal" or reentry procedures, or provide acceptable risk or casualty limitations for post-mission or deorbiting activities.[140] Instead, the measures encourage disclosure of the intended approach and available alternative options.[141]

A subsequent interim space debris measure, the 2010 Space Debris Interim Instrument, encourages space operators to comply with a series of technical standards.[142] These standards include: (1) control of debris release during normal operations; (2) minimization of debris generated by accidental explosions; (3) choice of safe flight profile and operational configuration; and (4) post-mission disposal of space objects, either by re-orbiting or de-orbiting.[143] Article 8 makes clear that every operator willing to obtain a license to launch a civil space object must include in its application undefined space debris mitigation measures,[144] but again, the measures are very high-level, non-binding, and do not specify reentry requirements beyond disclosure that de-orbiting, or reentry, will occur.

Based on the existing "interim" measures, there is some indication that China may be considering reducing the harmful impacts of space debris – and perhaps, by extension, of uncontrolled reentry. For example, China has indicated the establishment of a space debris coordination and expert group and the Chinese Academy of Space Technology (CAST) Debris Monitoring Research Center to continue its *orbital* debris mitigation efforts.[145] It is not clear

---

[138] *Id*. at 5.2.1.
[139] *Id*. at 5.3.1.
[140] *See id*.
[141] *See id*.
[142] Tronchetti, *supra* note 117.
[143] *Id*.
[144] *Id*.
[145] Kevin Pollpeter, *China's Role in Making Outer Space More Congested, Contested, and* Competitive, CHINA AEROSPACE STUD. INST. (Oct. 2021), https://www.cna.org/archive/CNA_Files/pdf/chinas-role-in-making-outer-space-more.pdf.

whether either of these initiatives relate to reentry of space objects or launch vehicle components. Moreover, China's actions to date with respect to space debris mitigation, including the various interim measures, all predate the initial launch of Long March 5B.[146] It is not currently known whether CNSA, in launching the Long March 5B, intentionally adheres to the nonbinding interim measures. And furthermore, China's continued practice of repeatedly reentering the Long March 5B in an uncontrolled fashion further calls into question the effectiveness of the existing regime.

IV. POLICY FRAMEWORK

A. Applicable US Space Policy

Two main priorities in US space policy that are important for this analysis are (1) a commitment to safety in space launch and reentry and (2) remaining a world leader in outer space activities—and using that status to influence international norms in outer space activities.

First, safety is a constant refrain in US space policy that transcends political parties and administrations.[147] While the Biden Administration's 2021 US Space Priorities Framework does not specifically discuss controlled reentry, a commitment to developing space capabilities in a safe manner is apparent:

> [t]he United States, working with commercial industry, allies, and partners, will promote the implementation of existing measures and lead in the development of new measures that contribute to the safety, stability, security, and long-term sustainability of space activities. The United States will

---

[146] *See* Byers, *supra* note 2.

[147] *See, e.g.*, *Space Policy Directive-22, Streamlining Regulations on Commercial Use of Space*, TRUMP WHITE HOUSE, NAT'L ARCHIVES, (May 24, 2018), https://trumpwhitehouse.archives.gov/presidential-actions/space-policy-directive-2-streamlining-regulations-commercial-use-space/ ("[i]t is therefore important that regulations adopted and enforced by the executive branch promote economic growth; minimize uncertainty for taxpayers, investors, and private industry; protect national security, *public-safety*, and foreign policy interests; and encourage American leadership in space commerce") (emphasis added); *See also United States Space Priorities Framework*, WHITE HOUSE, (Dec. 1, 2021), https://www.whitehouse.gov/briefing-room/statements-releases/2021/12/01/united-states-space-priorities-framework/ [hereinafter Space Priorities Framework].

> demonstrate how space activities can be conducted in a responsible, peaceful, and sustainable manner.[148]

In addition to US policy statements, the FAA's regulatory framework detailed in Part III.C reflects a strong commitment to safety in space launch and reentry as a priority for the US. The consistent messaging—and commitment to safety—in US space policy together reinforce the idea that safe launch and reentry practices are a priority for the US

A second, and perhaps even more important priority for the US in outer space affairs is using its prominent position as a space leader to influence international norms with respect to space activities. The Biden Administration's 2021 Interim National Security Strategic Guidance provides: "[w]e will lead in promoting shared norms and forge new agreements on emerging technologies, *space*, cyber space, health and biological threats, climate and the environment, and human rights."[149] In addition, the US military's policy documents have a focus on "promot[ing] responsible norms of behavior" in outer space pursuits.[150] Through its space policies, the US continues to use the lens of policymaking and prominence in outer space affairs to influence international norms and create customary international law. Part of the US norm-setting mission includes the Artemis Accords, an inter-agency framework signed by NASA and other national space agencies.[151] While not relating to launch and reentry specifically, even the Accords include their own commitment to "increase the safety of operations" in outer space activities.[152] The US,

> . . . whose concerted government-wide efforts to refocus its attention on space led to the creation of a new National Space Policy, as well as a series of Space Policy Directives, which outline and provide rules of the road for American space activities

---

[148] Space Priorities Framework, *supra* note 147.

[149] Interim Nat'l Sec. Strategic Guidance, WHITE HOUSE, (Mar. 2021), https://www.whitehouse.gov/wp-content/uploads/2021/03/NSC-1v2.pdf.

[150] United States Space Force, *Space Power: Doctrine for US Space Forces*, (June 2020), https://www.spaceforce.mil/Portals/1/Space%20Capstone%20Publication_10%20Aug%202020.pdf.

[151] *See* The Artemis Accords: Principles for Cooperation in the Civil Exploration and Use of the Moon, Mars, Comets, and Asteroids, NASA, https://www.nasa.gov/wp-content/uploads/2022/11/Artemis-Accords-signed-13Oct2020.pdf.

[152] *Id*.

> in the wake of pressing international challenges. These documents cover our human space exploration program (SPD-1); commercial space regulations (SPD-2); national space traffic management (SPD-3); the creation of the Space Force (SPD-4); cybersecurity in space (SPD-5); and space nuclear power and propulsion (SPD-6). With the addition of the US-led Artemis Accords, these documents taken together are a means to establishing modern customary international law and norms of behavior beyond the Cold War-era provisions of the foundational U.N. space treaties.[153]

Another wrinkle applicable to this analysis is the so-called Wolf Amendment. NASA receives its funding via the National Defense Authorization Act (NDAA), a set of annual laws that determines US defense spending, including NASA funding.[154] Notably, under a provision of the NDAA commonly referred to as the Wolf Amendment, NASA, the Office of Science and Technology (OSTP), and the National Space Council (NSC) are expressly prohibited from using any NDAA funds "to develop, design, plan, promulgate, implement, or execute a bilateral policy, program, order, or contract of any kind to participate, collaborate, or coordinate bilaterally in any with China or any Chinese-owned company unless such activities are specifically authorized by a law enacted after the date of enactment."[155] This prohibition also applies to "any funds used to effectuate the hosting of official Chinese visitors at facilities belonging to or utilized by NASA.[156] The Consolidated and Further Continuing Appropriations Act, 2013, provided that the prohibitions in the Wolf Amendment can be avoided if NASA or the Office of Science and Technology Policy certifies to Congress that the activities:

> (1) pose no risk of resulting in the transfer of technology, data, or other information with national security or economic security implications to China or a Chinese-owned company; and

---

[153] Goguichvili et. al., *supra* note 52.

[154] Fed'n of Am. Sci., *Defense Primer: Navigating the NDAA*, CONG. RSCH. SERV. (Nov. 23, 2022), https://sgp.fas.org/crs/natsec/IF10516.pdf.

[155] Department of Defense and Full-Year Continuing Appropriations Act 2011, Pub. L. No. 112-10, § 1340.

[156] *Id*.

> (2) will not involve knowing interactions with officials who have been determined by the United States to have direct involvement with violations of human rights.[157]

Because these notification requirements and exceptions exist, the Wolf Amendment has been described as a "speed bump" to collaboration between the US and Chinese space agencies— "not a ban necessarily… but it does require pre-notifying Congress and vetting partners."[158] It remains to be seen if there is a path for CNSA to execute the Artemis Accords (with an appropriate notification by NASA to Congress) or for the US and Chinese space agencies to find alternative means of cooperation in space.

Note that CNSA has displayed interest in international cooperation in space, as it has executed its own international agreement with Russia's Roscosmos to develop "a program for the development of space cooperation" between both national space agencies from 2023-2027.[159]

B. Chinese Space Policy

In China, exploration and use of outer space is carried out in accordance with five-year plans called White Papers.[160] The White Papers are "a kind of Chinese constitution for the next five years, based on the general principle of the rule of law with Chinese features, on the one hand, with the starting points for national civil space law on the other."[161] Relevant text of the most recent Chinese space policy five-year plan, White Paper 2021: "China's Space Program: a 2021 Perspective"[162] is excerpted in the table below:

---

[157] Consolidated and Further Continuing Appropriations Act, 2013, Pub. L. No. 113-6 (Mar. 26, 2013) § 535(c), https://www.congress.gov/113/plaws/publ6/PLAW-113publ6.pdf.

[158] *10 Years of the Wolf Amendment: Assessing Effects and Outcomes*, Zoom Webinar, SECURE WORLD FOUNDATION, (Dec. 9, 2021), https://swfound.org/media/207289/10-years-of-the-wolf-amendment_-assessing-effects-and-outcomes_transcript-1.pdf (including a conversational keynote with former NASA Administrator Charles Frank Bolden Jr.).

[159] *See Russia, China Sign Program of Space Cooperation Development for 2023-2027*, INTERFAX INT'L INFO GRP, (Dec. 29, 2022), https://interfax.com/newsroom/top-stories/86585/.

[160] Yeshchuk & Vasina, *supra* note 108.

[161] *See id*. at 142.

[162] 2021中国的航天, 中华人民共和国, (Dec. 1, 2022), 2021中国的航天_白皮书_中国政府网 (www.gov.cn); English translation provided at *China's Space Program: A 2021*

2. Development of Space Technology and Systems ● *China's space industry serves its major strategic needs, and targets cutting-edge technology that leads the world…* ● *As a result, China's capacity to enter and return from space, and its ability to engage in space exploration, utilization and governance have grown markedly along a sustainable path.*	● **二、发展空间技术与系统** **中国航天面向世界科技前沿和国家重大**战略需求，以航天重大工程为牵引，加快关键核心技术攻关和应用，大力发展空间技术与系统，**全面提升进出、探索、利用和治理空间能力，推**动航天可持续发展
In the next five years, China will continue to improve the capacity and performance of its space transport system.	**未来五年，中国将持**续提升航天运输系统综合性能，加速实现运载火箭升级换代
In response to the growing need for regular launches, China will develop new rocket engines, combined cycle propulsion, and upper stage technologies to improve its capacity to enter and return from space and make space entry and exit more efficient.[163]	**持**续开展重复使用航天运输系统关键技术攻关和演示验证。面向航班化发射需求，发展新型火箭发动机、组合动力、上面级等技术，拓展多样化便利进出空间能力。

While adding controlled reentry capability is not mentioned specifically, the White Paper does reference a desire for China to "improve its capacity to… return from space."[164] This implies that China may be working on technological solutions to make its "return from space" more efficient; however, controlled reentry technologies are not mentioned, nor is there any apparent emphasis on improving the safety of, and lowering the associated risks associated with, launch and reentry.

Perspective, THE STATE COUNCIL INFORMATION OFFICE OF THE PEOPLE'S REPUBLIC OF CHINA, CHINA NATIONAL SPACE ADMINISTRATION, (Jan. 28, 2022), https://www.cnsa.gov.cn/english/n6465645/n6465648/c6813088/content.html.

[163] "Official" English translation provided at *China's Space Program: A 2021 Perspective*, THE STATE COUNCIL INFORMATION OFFICE OF THE PEOPLE'S REPUBLIC OF CHINA, CHINA NATIONAL SPACE ADMINISTRATION (Jan. 28, 2022), https://www.cnsa.gov.cn/english/n6465645/n6465648/c6813088/content.html.

[164] *Id*.

V. RECOMMENDATIONS

A. Leverage "Normentum" To Exert Pressure

Public and private actors can promote acceptable norms through their behaviors in launch and reentry. Specifically, four "strategic decision points" are involved in developing norms:

> (1) establishing domestic buy-in through interagency coordination; (2) selecting initial international negotiating partners; (3) choosing diplomatic mechanisms for generating international commitment; and (4) setting a target for which and how many states need to support the proposal for it to be considered a norm . . .[165]

By signing on to—and then codifying—recommendations set forth in the IADC and UNCOPUOUS Guidelines, States can signal their commitment to promoting a safe space environment. States should continue to call out unacceptable behavior on the world stage and develop standards and norms by which international space players are expected to operate.

In addition, the increasingly influential role of commercial space actors like SpaceX and Blue Origin in the global launch marketplace may exert pressure on China and others to limit their reliance on uncontrolled reentry. According to Melissa Durkee,

> private activity that is attributed to the state becomes 'state practice' for the purpose of treaty interpretation or customary international law formation. Moreover, as a matter of realpolitik, private actors standing in the shoes of the state can force states into a reactive posture, easing the commercially preferred rules into law through the power of inertia and changes to the status quo.[166]

For example, the SpaceX Starship rocket, one of the largest and "most powerful" launch vehicles ever built, is a reusable rocket equipped with controlled reentry technology,[167] setting an example for other launchers globally. As both US commercial space

---

[165] Dickey, *supra* note 70, at 1.

[166] Melissa (MJ) Durkee, *Interstitial Space Law*, 97 WASH. U. L. REV. 423, 481 (2019).

[167] *See* SpaceX, *Starship: Service to Earth Orbit, Moon, Mars and Beyond*, https://www.spacex.com/vehicles/starship/ (last visited Nov. 14, 2023).

enterprises, and a burgeoning commercial space industry in China, develop innovative technologies and demonstrate the ability to reenter their rockets in a controlled, safe fashion, additional pressure may be exerted on CNSA to conform to "norms" that may develop into customary international law. To promote public safety and protect non-spacefaring countries from space objects reentering the atmosphere in an uncontrolled manner, China should consider amending its existing regulations to include codification of the guidelines recommended by IADC and/or UNCOPUOS, or otherwise require civil and commercial space actors to consider the impacts of reentry of their space vehicles and other space objects. Indeed, Dr. Li Shouping has called on China to introduce binding legislation codifying the UNCOPUOUS Guidelines—as a first step toward the development of a Chinese national space law.[168]

B. Improve US-China Communication Channels

i. Improve Communication Between US and China on Space Safety Issues.

Currently, the US and China lack a guaranteed line of communications with respect to space issues, including issues of space safety. For example, during the 2007 ASAT test, the 2020 alleged near-collision of the Tiangong space station and Starlink satellites, and the balloon situation in February 2023, both the US and Chinese sides were unable to identify their counterparts in the other country, slowing communication and increasing tension.[169] In order to improve communication between the two space powers, perhaps the US could designate a single US administrative agency as the single point of contact for communications with China on space safety matters. Recent conversations in Washington[170] have indicated that either the FAA or the Department of Commerce may be given the responsibility of overseeing "novel" space activities. China

---

[168] Li, *supra* note 132, at 252.

[169] *See, e.g.*, Jeff Foust, *China Proposes Formal Lines Of Communication With US On Space Safety*, SPACENEWS (Feb. 15, 2022), https://spacenews.com/china-proposes-formal-lines-of-communication-with-u-s-on-space-safety/.

[170] Theresa Hitchens, *White House Nears Plan to Assign Regulatory Authorities for "New" Space Activities*, BREAKING DEFENSE, (Feb. 23, 2023), https://breakingdefense.com/2023/02/white-house-nears-plan-to-assign-regulatory-authorities-for-new-space-activities/.

should also designate a point of contact for space communication—in that event, at least there would be a point of contact on each side to call when space safety issues emerge. This could be step one on the road to preventing catastrophic misunderstandings between two space powers.

ii. Reconsider the Wolf Amendment.

The Wolf Amendment, discussed in more detail in Part IV.A above, has been criticized for being both ineffective at its intended purpose and prohibitive of meaningful communication between the US and China in space.[171] Critics have pointed out that since 2011, the US has not seen the desired changes in China's human rights policies, technological advancement, and policies toward technological espionage that inspired the Wolf Amendment's enactment in the first place.[172] Moreover, since the Wolf Amendment's enactment, China has grown rapidly in its economic position, global influence, and space capabilities. The Long March 5B rocket, and China's standalone space station that it delivers into orbit, were

---

[171] *See, e.g.*, SECURE WORLD FOUNDATION, *supra* note 158 ("If you look at what was Congressman Frank Wolf's purpose, which was to try to isolate the Chinese into more closely abiding with our norms in human rights, it did not accomplish its purpose at all. If we're looking at slowing [the Chinese space] program or keeping [China] from developing a space program, it did not do that at all. Whatever its purposes were, [the Wolf Amendment] did not end up doing any of that, because we already had safeguards in place to keep them from getting our technology…. Unfortunately, what it has done is caused us to now be on the outside, looking as China presses forward with their 50-year aerospace program and doing things that some people say they're moving at an incredible pace."); Makena Young, *Bad Idea: The Wolf Amendment (Limiting Collaboration with China in Space)*, CTR. FOR STRAT. & INT'L STUD., (Dec. 4, 2019), https://www.csis.org/analysis/bad-idea-wolf-amendment-limiting-collaboration-china-space ("…since the first iteration of [the Wolf A]mendment, the U.S. has not seen the desired changes in Chinese human rights policies that the Wolf Amendment was intended to spur"); *Trouble in the Stars: The Importance of US-China Bilateral Cooperation in Space*, HARVARD INT'L REV., (Oct. 27, 2019), https://hir.harvard.edu/trouble-in-the-stars-the-importance-of-us-china-bilateral-cooperation-in-space/ ("the [Wolf A]mendment proves contrary to its own intents and actually increase[s] the risk of war in space…. when the United States refuses to cooperate with China, it gives the impression that US policymakers do not view space as a multilateral environment."); Jeff Foust, *Defanging the Wolf Amendment*, THE SPACE REV. (Jun. 3, 2019), https://www.thespacereview.com/article/3725/1 (*quoting* Todd Harrison, director of the Aerospace Security Project at CSIS, during an April 25 hearing on China's space activities by the US-China Economic and Security Review Comm'n: "[t]he Wolf Amendment, I believe, has largely proven ineffective in what it is was trying to do. It's not slowing China down.").

[172] *See generally id*.

developed independently of existing international cooperation efforts in the International Space Station. As the Center for Strategic and International Studies (CSIS) argues, there could be strategic and national security benefits for the US to allow limited cooperation with China:

> As China grows as a space power, US cooperation in selected civil space projects could be one of the best ways to understand the goals and capabilities of the Chinese space agency. Moreover, it would establish avenues of communication and trust between the two nations that could be mutually beneficial in the future. The Wolf Amendment's statutory exclusion of US – Chinese bilateral cooperation in space has only incentivized China to accelerate its space development programs, creating a serious challenger to US leadership in this vital domain of exploration. History has shown that when the US cooperates with foreign competitors in civil space projects, it enhances NASA's leadership role. The Wolf Amendment has neither discouraged Chinese space ambitions or altered China's behavior on human rights—it has only muddled our relationship with China and created an opening for a challenger to NASA's leadership role in space exploration.[173]

While legislative change is slow in the US and walking back a legal requirement widely seen as a needed restriction on China would not be a politically popular position given the current state of the US-China relationship, there may be other ways to improve US communication with China. Finding ways to do so may be key to encouraging the international development of strong safety norms and controlled reentry practices and would be consistent with the US policy goal of remaining the world leader and norm-setter in space launch activities.

VI. CONCLUSION

In conclusion, while not prohibited by international space law, the uncontrolled reentry of China's Long March 5B contravenes current international norms and, in its current state, poses a continuing risk to public safety—particularly, and unfairly, impacting non-spacefaring nations. In comparison to the US legal and policy

---

[173] Young, *supra* note 171.

landscape, which includes detailed safety protocols, risk limitations, and disclosure requirements for both launch and reentry, China's existing domestic space regulations do not provide sufficient protections to people and property at risk of damage from large, uncontrolled, reentering rocket bodies. To address this gap, the US, commercial space actors, and other countries should continue to establish norms and set precedent by (1) signing on to and codifying international guidelines and agreements promoting safe space launch and reentry practices, and (2) continuing to demonstrate safe, controlled launch and reentry. Reusable rockets or spaceplanes with controlled reentry technology exist, and China has demonstrated these capabilities. A system flavored with "Chinese specifics" can still adhere to international norms and guidelines. If China wants to join the world stage in outer space, its behaviors—and its regulatory regime—need to advance, not hinder, the minimization of collision risk from uncontrolled reentry.

APPENDIX A

Selected text of Guideline B.9 from the Guidelines for the Long-term Sustainability of Outer Space Activities of the Committee on the Peaceful Uses of Outer Space, United Nations Office for Outer Space Affairs:[174]

> 1. States and international intergovernmental organizations should have in place procedures for furnishing to other States and/or the Secretary-General of the United Nations, via designated entities, as soon as practicable and with updates if necessary, information on the forecasted uncontrolled reentry of potentially hazardous space objects that are under their jurisdiction and control, and communicating the hazards associated with such events . . .
>
> 2. States and international intergovernmental organizations with relevant technical capabilities and resources and/or States and international intergovernmental organizations which exercise jurisdiction over the objects forecast to re-enter the atmosphere *should assist each other (in a proactive manner and/or in responding to a request) to improve the reliability of results when predicting the uncontrolled reentry of potentially hazardous space objects, such as by tracking the objects and generating information on their trajectory*. States and international intergovernmental organizations should cooperate to build capacity in the area of monitoring uncontrolled space object re-entries.
>
> 3. When feasible and without prejudice to furnishing preliminary information on possible hazardous events associated with the uncontrolled reentry of space objects, the procedures referred to above should be employed during the final phase of the orbital flight of a space object. The procedures should be used until the termination of the ballistic flight of the space object has been confirmed, as well as in the event of the

---

[174] (Emphasis added). Full text available here: Comm. on the Peaceful Uses of Outer Space, Rep. of the Comm. on Its Sixty-Second Session, Annex II, U.N. Doc A/74/20 (2019) https://www.unoosa.org/res/oosadoc/data/documents/2021/stspace/stspace79_0_html/st_space79E.pdf.

identification of the space object or its fragments that reach the surface of the Earth.

4. States and international intergovernmental organizations should furnish in a timely fashion relevant information they may have at their disposal, as practicable, to support addressing risks from uncontrolled re-entries. The contents and attributes of such information should, to the extent practicable, be relevant to raising awareness, where appropriate, of possible contingencies associated with high-risk uncontrolled re-entries. States and international intergovernmental organizations should designate appropriate entities that are authorized to provide, request and receive such information.

5. States and international intergovernmental organizations should consider applying design techniques to minimize the risk associated with fragments of space objects surviving uncontrolled reentry.

6. Without prejudice to Article 5 of the Agreement on the Rescue of Astronauts, the Return of Astronauts and the Return of Objects Launched into Outer Space, the State(s) having jurisdiction over the territory on which a space object or its component parts have been discovered or are presumed to have reached the surface of the Earth, should respond to any request for timely consultations by the State or international intergovernmental organization with jurisdiction and control over the object. In such consultations, the State or international intergovernmental organization exercising jurisdiction and control over the object should advise and, if mutually agreed, assist the potentially affected State(s) in the search for and identification, assessment, analysis, evacuation and return of the object or its fragments. State(s) on whose territory a space object or its component parts have been discovered or are presumed to have reached the surface of the Earth should respond to requests from the State or international intergovernmental organization with jurisdiction and control over the object to follow appropriate procedures for, inter alia, identification, assessment, and analysis of the space object or its component parts, to avoid the harmful effects of any hazardous materials which could have survived the uncontrolled reentry.

APPENDIX B

Selected text of 14 CFR § 450.101(b):

(b) ***Reentry risk criteria.*** For any reentry, an operator may initiate the deorbit of a vehicle only if all risks to the public satisfy the criteria in this paragraph (b). The following criteria apply to each reentry, other than a suborbital reentry, from the final health check prior to initiating deorbit through final impact or landing:

(1) ***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 reentry vehicle will be determined by the Administrator on a case-by-case basis.

(i) The risk to all members of the public, excluding persons in aircraft and neighboring operations personnel, must not exceed an expected number of 1×10^{-4} casualties.

(ii) The risk to all neighboring operations personnel must not exceed an expected number of 2×10^{-4} casualties.

(2) ***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 flight of a launch vehicle will be determined on a case-by-case basis.

(i) The risk to any individual member of the public, excluding neighboring operations personnel, must not exceed a probability of casualty of 1×10^{-6} per reentry.

(ii) The risk to any individual neighboring operations personnel must not exceed a probability of casualty of 1×10^{-5} per reentry.

(3) ***Aircraft risk.*** A reentry 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 1×10