September 8, 2022

FCC FACT SHEET*
Space Innovation; Mitigation of Orbital Debris in the New Space Age
Second Report and Order, IB Docket Nos. 22-271 and 18-313

Background: It is widely recognized that the growing challenge of orbital debris poses a significant risk to our nation's space ambitions. There are more than 4,800 satellites currently operating in orbit as of the end of last year, and projections for future growth in satellites suggest that there are many more to come. As the number of objects in space increases, so too does the probability of collision. Currently, it is recommended that operators with satellites in low-Earth orbit ensure that their spacecraft will re-enter Earth's atmosphere within 25 years following the completion of their mission. As part of our continued efforts to mitigate the generation of orbital debris, the *Second Report and Order* would shorten the timeframe required for satellite post-mission disposal to five years.

What the *Second Report and Order* Would Do:

- Adopt a "five-year rule," which would require space station operators planning disposal through uncontrolled re-entry into Earth's atmosphere to complete disposal as soon as practicable, and no more than five years following the end of mission.
- Specify that the new regulations apply to space stations ending their missions in or passing through the low-Earth orbit region below 2,000 kilometers.
- Apply the requirement to both U.S.-licensed satellites and systems, and non-U.S.-licensed satellites and systems seeking U.S. market access, under part 25 of the Commission's rules.
- Adopt a companion requirement for entities applying for part 5 experimental licenses for satellites or seeking to deploy amateur satellites under part 97 of the Commission's rules.
- Specify a grandfathering period of two years for the new requirement to reduce any potential burden on operators.
- Address the potential for waivers for certain types of research and scientific missions.

Before the
Federal Communications Commission
Washington, D.C. 20554

In the Matter of	)	
	)	
Space Innovation	)	IB Docket No. 22-271
	)	
Mitigation of Orbital Debris in the New Space Age	)	IB Docket No. 18-313

SECOND REPORT AND ORDER*

Adopted: [ ] **Released: [ ]**

By [the Commission]:

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I. INTRODUCTION

1. Today, the Federal Communications Commission takes a first step toward ushering in a new era for space safety and orbital debris policy. We do so by adopting a first-ever rule requiring non-geostationary satellite operators to deorbit their satellites after the end of their operations to minimize the risk of collisions that would create debris. Our action today formalizes a longstanding orbital debris guideline, updates it to better reflect the realities of today's space activities, and uniformly applies it to

* This document has been circulated for tentative consideration by the Commission at its September 29, 2022 open meeting. The issues referenced in this document and the Commission's ultimate resolution of those issues remain under consideration and subject to change. This document does not constitute any official action by the Commission. However, the Chairwoman has determined that, in the interest of promoting the public's ability to understand the nature and scope of issues under consideration, the public interest would be served by making this document publicly available. The FCC's *ex parte* rules apply and presentations are subject to "permit-but-disclose" *ex parte* rules. *See, e.g.*, 47 CFR §§ 1.1206, 1.1200(a). Participants in this proceeding should familiarize themselves with the Commission's *ex parte* rules, including the general prohibition on presentations (written and oral) on matters listed on the Sunshine Agenda, which is typically released a week prior to the Commission's meeting. *See* 47 CFR § § 1.1200(a), 1.1203.

space stations in LEO.

2. It is widely recognized that the growing challenge of orbital debris poses a risk to the nation's space ambitions. Defunct satellites, discarded rocket cores, and other debris now fill the space environment creating challenges for future missions. Moreover, there are more than 4,800 satellites currently operating in orbit as of the end of last year, and the vast majority of those are commercial satellites operating at altitudes below 2,000 km—the upper limit for LEO.[1] Many of these were launched in the past two years alone, and projections for future growth suggest that there are many more to come. As the number of objects in space increases, so too does the probability of collision.

3. At risk is more than the $279 billion-a-year satellite and launch industries and the jobs that depend on them.[2] Satellites connect the most remote locations in the world to high-speed broadband. They help us navigate unfamiliar roads, broadcast video to millions of viewers, connect us to financial services, and provide imagery that can help us monitor climate change and other environmental problems. When disaster strikes, satellites help organize first responders, the government, and humanitarian organizations and make it possible to coordinate effective relief efforts. Left unchecked, orbital debris could block all of these benefits and reduce opportunities across nearly every sector of our economy.

4. We believe strong compliance with post-mission disposal guidelines is an effective tool that can help stabilize the orbital debris environment. Currently, it is recommended that operators with objects in LEO ensure that their spacecraft are either removed from orbit immediately post-mission or left in an orbit that will decay and re-enter Earth's atmosphere within no more than 25 years to mitigate the creation of more orbital debris. However, we believe it is no longer sustainable to leave satellites in LEO to deorbit over decades. Accordingly, in this Report and Order, as part of our continued efforts to mitigate the generation of orbital debris, we shorten the 25-year benchmark for post-mission disposal of space stations[3] in LEO to five years. The regulations we adopt today are designed to ensure that the Commission's actions concerning radio communications, including licensing U.S. spacecraft and granting access to the U.S. market for non-U.S. spacecraft, promote the sustainable use of outer space without creating undue regulatory obstacles to new satellite ventures. This action by the Commission furthers the public interest in preserving viable options for future satellites and systems and the many services that those systems provide to the public.

II. BACKGROUND

5. There are multiple existing guidelines concerning orbital debris, none of which are legally binding. One of these is the longstanding guideline for deorbiting satellites within 25 years. The 25-year disposal guideline was first proposed by the National Aeronautics and Space Administration (NASA) in the 1990s in an effort to balance the mitigation of orbital debris while limiting propellant costs

[1] *See* Satellite Industry Association, *Commercial Satellite Industry Growing as it Continues to Dominate Expanding Global Space Business – SIA Releases 25th Annual State of the Satellite Industry Report* (Jun. 29, 2022), https://sia.org/commercial-satellite-industry-growing-as-it-continues-to-dominate-expanding-global-space-business-sia-releases-25th-annual-state-of-the-satellite-industry-report/ (SIA State of the Industry Report).

[2] *See* SIA State of the Industry Report.

[3] Throughout this Order, we use the terms "space station," "satellite," and "spacecraft." "Space station" is defined in the Commission's rules as "[a] station located on an object which is beyond, is intended to go beyond, or has been beyond, the major portion of the Earth's atmosphere." 47 CFR §§ 2.1, 25.103. This is consistent with terminology used by the International Telecommunication Union (ITU). ITU Radio Regulations (R.R.) 1.64. The Commission's rules define "satellite" as "[a] body which revolves around another body of preponderant mass, and which has a motion primarily and permanently determined by the force of attraction of that other body." 47 CFR § 2.1. In this Order we refer only to artificial satellites. The Commission's rules define "spacecraft" as "[a] man-made vehicle which is intended to go beyond the major portion of the Earth's atmosphere." 47 CFR §§ 2.1, 25.103. These terms are used interchangeably in this Order, but we observe that "satellite" and "spacecraft" are more broadly defined than "space station."

and complications imposed by performing a maneuver to a limited lifetime orbit.[4] Since then, it has been adopted by the space agencies of other nations, the Inter-Agency Space Debris Coordination Committee (IADC), and incorporated into a NASA Standard and the U.S. Government Orbital Debris Mitigation Standard Practices (ODMSP). Both the NASA Standard and ODMSP specify a maximum 25-year post-mission orbital lifetime, with the 2019 revised ODMSP stating that for spacecraft disposed of by atmospheric reentry, the spacecraft shall be "left in an orbit in which, using conservative projections for solar activity, atmospheric drag will limit the lifetime to as short as practicable but no more than 25 years."[5]

6. The Commission adopted comprehensive rules on orbital debris in 2004, pursuant to its authority to determine whether the public interest would be served by the authorization of satellite communications systems.[6] The 2004 rules generally consisted of disclosure requirements that yielded information critical to the Commission's overall determination of whether the public interest would be served by approving the proposed operations. Applicants were required to include a statement that they have assessed and limited the amount of debris released in a planned manner during normal operations, and have assessed and limited the probability of the satellite becoming a source of debris by collisions with small debris.[7] Applicants also were required to state that they have assessed and limited the probability of accidental explosions during and after completion of mission operations.[8] The rules also required a statement that the satellite applicant has assessed and limited the probability of the satellite becoming a source of debris by collisions with large debris or other operational satellites.[9] Finally, applicants were required to include a statement detailing the post-mission disposal plans for the satellite as it enters its end-of-life stage, including the quantity of fuel—if any—that will be reserved for post-mission disposal maneuvers.[10]

7. Although not specifically codified in the Commission's 2004 rules, the Commission has consistently applied the 25-year benchmark in licensing decisions for NGSO systems. On November 15, 2018, recognizing that there had been a variety of technical and policy updates to orbital debris mitigation standards, policy, and guidance documents since 2004, the Commission adopted a *Notice of Proposed Rulemaking* seeking comment on a comprehensive update to its orbital debris rules to better reflect the significant increase in satellites and types of operations in orbit.[11] The Commission sought comment on issues ranging from minor updates codifying established metrics into existing rules to how to assess the risks posed by constellations of thousands of satellites, as well as topics such as economic incentives for

[4] *See* NASA Comments at 7 (filed Apr. 4, 2019).

[5] ODMSP 4-1.b. The updated U.S. Government Orbital Debris Mitigation Standard Practices (ODMSP) is available for download at: https://orbitaldebris.jsc.nasa.gov/library/usg_orbital_debris_mitigation_standard_practices_november_2019.pdf. In its National Orbital Debris Implementation Plan, the White House tasked NASA with studying whether space station operators should be required to dispose of defunct satellites earlier than the 25-year benchmark. *See* The Orbital Debris Interagency Working Group, Subcommittee on Space Weather, Security, and Hazards, of the National Science and Technology Council, *National Orbital Debris Implementation Plan* (2022), https://www.whitehouse.gov/wp-content/uploads/2022/07/07-2022-NATIONAL-ORBITAL-DEBRIS-IMPLEMENTATION-PLAN.pdf (NODIP).

[6] *See Mitigation of Orbital Debris*, IB Docket No. 02-54, Second Report and Order, 19 FCC Rcd 11567 (2004).

[7] 47 CFR § 25.114(d)(14)(i).

[8] 47 CFR § 25.114(d)(14)(ii).

[9] 47 CFR § 25.114(d)(14)(iii).

[10] 47 CFR § 25.114(d)(14)(iv).

[11] *Mitigation of Orbital Debris in the New Space Age,* IB Docket Nos. 18-313, 02-54, *Notice of Proposed Rulemaking*, 33 FCC Rcd 11352 (2018).

operators that would align with orbital debris mitigation best practices. As part of that effort, the Commission also sought comment on the 25-year benchmark and whether it was still a relevant guideline or whether a shorter deorbit deadline was appropriate for new systems.

8. The Commission adopted a *Report and Order* (*Order*) comprehensively updating the 2004 rules on April 24, 2020.[12] At the same time, the Commission adopted a *Further Notice of Proposed Rulemaking (FNPRM)* seeking comment on the probability of accidental explosions, collision risk for multi-satellite systems, maneuverability requirements, casualty risk, indemnification, and performance bonds tied to post-mission disposal. In the *Order*, the Commission maintained its existing rule requiring a statement detailing post-mission disposal plans for the space station at end of life and adopted a new requirement that applicants planning disposal by atmospheric re-entry specify the planned time period for post-mission disposal as part of the description of disposal plans for the space station. In the *FNPRM*, the Commission sought further comment on whether the 25-year benchmark for completion of NGSO post-mission disposal by atmospheric re-entry remains a relevant benchmark as applied to commercial or other non-Federal systems.[13]

9. Specifically, in the *FNPRM,* the Commission noted broad support in the record for shortening the 25-year benchmark and sought comment on alternative post-mission disposal lifetimes. The Commission sought comment on how to apply the ODMSP guidance that the post-mission lifetime be "as short as practicable but no more than 25 years," noting that incorporating only the 25-year metric into its rules may not incentivize commercial and other non-Federal operators to limit the post-mission orbital lifetime to "as short as practicable."[14] The Commission further asked whether a maximum 25-year limit on post-mission orbital lifetime would provide any incentive to operators to shorten the post-mission time in orbit or whether there is another preferable approach, such as a requirement for spacecraft to utilize propulsion, and if there were any potential scenarios in which spacecraft with maneuverability would remain in orbit for significant amounts of time following the conclusion of the mission.[15] The Commission also asked for input on whether these scenarios would be sufficiently unlikely to warrant a case-by-case approach or if a bright-line rule would be more appropriate in these circumstances.[16] The Commission presented a number of potential frameworks, including a safe-harbor provision, wherein operators would be encouraged to dispose of their spacecraft "as soon as practicable" but no more than five years following the end of the mission, and allow applicants to provide additional demonstrations in support of longer post-mission lifetimes for the Commission to consider.[17] The Commission sought comment on this proposal and asked whether five years would be sufficient for such a safe harbor provision or if there were any alternative timeframes that should be considered.[18]

III. DISCUSSION

10. This *Report and Order* requires all space stations ending their mission in, or passing through, the LEO region, and planning disposal through uncontrolled atmospheric re-entry following the completion of the mission to complete disposal as soon as practicable, and no later than five years after the end of the mission. As explained below, we find that the additional costs imposed on the industry from this rule will be outweighed by the national benefits that come from reducing the probability of

[12] *Orbital Debris in the New Space Age*, IB Docket No. 18-313, Report and Order and Further Notice of Proposed Rulemaking, 35 FCC Rcd 4156 (2020) (*Order* or *FNPRM)).*

[13] *Order*, 35 FCC Rcd at 4198-99, 4235-36, paras. 90, 169.

[14] *FNPRM*, 35 FCC Rcd at 4234-35 para. 169, ODMSP 4-1.b.

[15] *FNPRM,* 35 FCC Rcd at 4235 paras. 169, 171.

[16] *Id.* at 4235 para. 171.

[17] *Id.*

[18] *Id.*

costly collisions and the commensurate reduction in service outages, as well as from reducing the frequency of collision avoidance maneuvers, among others.

A. Promoting Space Safety Through Post-Mission Disposal Requirements

11. The *Order* and *FNPRM* sought comment on updating the longstanding 25-year benchmark for deorbiting satellites at the end of their missions.[19] We recognize the merits of shortening the 25-year period and agree with commenters who argue that a shorter benchmark would promote a safer orbital debris environment. We observe that the current benchmark, which was developed before proposed deployments of large satellite constellations, is too long to adequately address the threat of long-term debris generation.

12. In response to the Commission's discussion in the *Order* and *FNPRM*,[20] we received additional support in the record for reducing the 25-year benchmark, with many commenters echoing prior concerns that the 25-year benchmark is outdated and may no longer serve the public interest.[21] Commenters have identified that while the 25-year benchmark may be an effective standard to limit the rate of debris growth in LEO, it fails to account for the growth of the commercial space industry and does not consider the disruption to satellite operations due to the increased need for collision avoidance maneuvers.[22] According to Space Exploration Technologies Corp. (SpaceX), rules that hasten demise will be crucial in removing inactive objects and promoting a safer orbital debris environment.[23] To this end, many commenters assert that shortening the 25-year benchmark would not only address the threat of long-term debris generation, but would also address issues like the mounting number of conjunctions,[24] collision avoidance maneuvers, fuel costs and other operational expenditures, time concerns, and other considerations faced by operators as LEO becomes more populated.[25] The Consortium for Execution of Rendezvous and Servicing Operations (CONFERS) also contends that the increased need for collision avoidance maneuvers due to the congestion in LEO impacts the general public as well because it increases the likelihood of service disruptions.[26]

13. Some commenters argue that the 25-year benchmark remains relevant to sufficiently mitigate orbital debris generation, asserting that many organizations have studied and confirmed the

[19] This discussion addresses the Commission's analysis of the record and overall regulatory approach for reducing the 25-year benchmark. Other topics from the *FNPRM*, such as maneuverability, accidental explosion risk, and collision risks associated with large constellations, will be addressed at a later date.

[20] *FNPRM*, 35 FCC Rcd at 4198, para. 88.

[21] *See, e.g.*, OneWeb Comments at 8-9; Astroscale Comments at 20; Consortium for Execution of Rendezvous and Servicing Operations (CONFERS) Comments at 5 (CONFERS Comments); Space Exploration Technologies Corp. Comments at 13 (SpaceX Comments) ("The current demise time of twenty-five years is significantly longer than necessary for most contemporary missions, given current technology."); Darren McKnight Comments at 4 (" . . . This reinforces the earlier assertion that the debris mitigation guidelines have not kept pace with space technology advancements.").

[22] Astroscale Comments at 20; Darren McKnight Comments at 2; OneWeb Comments at 9-10.

[23] SpaceX Comments at 14.

[24] The term "conjunction" refers to a prediction of a close approach between two space objects. Spacecraft operators typically assess conjunctions to determine whether additional actions are required, such as executing a collision avoidance maneuver.

[25] *See, e.g.*, Astroscale Reply Comments at 10; OneWeb at 8-9; CONFERS Comments at 5; Maxar Technologies Inc. Comments at 6 (Maxar Comments).

[26] CONFERS Comments at 5.

effectiveness of this standard in reducing the rate of orbital debris generation in LEO.[27] Most commenters who supported retaining that benchmark cite a report published by NASA's Orbital Debris Program Office, which stated that reducing the 25-year rule to a five-year rule would lead to a 10% debris reduction over 200 years, which NASA described as "not a statistically significant benefit."[28] However, other commenters note that the NASA analysis does not fully account for the risks of leaving defunct satellites in lower orbits for periods up to 25 years. According to one commenter, "the 200-year simulation used in this assertion aggregates cataloged debris from all of LEO" and "ignores debris generated below []800 km because debris at these altitudes washes out in decades."[29] That commenter further asserts that events below 850 km are not considered in NASA's analysis because they do not accumulate over the 200-year period, but these events may still significantly increase lethal, non-trackable (LNT)[30] collision risk and collision avoidance burdens for commercially-relevant altitudes.[31] LNTs are an important factor to consider in the orbital environment as they account for 97-98% of mission-terminating risk in LEO and cannot be mitigated by space traffic management (STM) or space situational awareness (SSA) alone,[32] even as SSA and STM capabilities continue to improve and these space objects become increasingly visible to operators.[33]

14. This commenter also argues that the 25-year benchmark encourages new satellites to be deployed below 650 km as such an altitude is "naturally compliant" with the 25-year benchmark and encourages massive, nonfunctioning hardware to be moved below 650 km from missions above 650 km, resting on the assumption that 25 years is not a long time.[34] However, for typical LEO satellites, 25 years represents five generations of spacecraft, performing 135,000 uncontrolled orbits, and transiting 800 active spacecraft and more as the population of LEO satellites grows.[35] As Astroscale has observed, operators formulating designs and plans to adhere to the maximum 25-year requirement has ultimately contributed to the increased congestion around and below the 600-650 km altitude range and the

[27] *See, e.g.*, Lynk Global Inc. Comments at 5 (Lynk Comments) ("Other reasonable steps can and should be taken toward achieving the "as short as practicable" standard even if this benchmark does not change."); Commercial Smallsat Spectrum Management Association Comments at 13 (CSSMA Comments) ("supports the maximum 25-year post-mission orbital lifetime, as many organizations have studied and confirmed the effectiveness of this standard to reduce the rate of debris growth in LEO."); Eutelsat S.A. Comments at 7 (Eutelsat Comments) ("The 25-year post mission disposal standard for atmospheric re-entry remains relevant for small NGSO systems…"); Kepler Communications Inc. Reply Comments at 4 (Kepler Reply Comments) ("Kepler agrees with the comments of Lynk and Eutelsat that the 25-year post-mission disposal standard remains relevant.").

[28] *See* J.C. Liou, M. Kieffer, A. Drew, and A. Sweet, "NASA Orbital Debris Program Office, Project Review: The 2019 U.S. Government Orbital Debris Mitigation Standard Practices," *Orbital Debris Quarterly News*, vol 20, no. 1, p. 5 (Feb. 2020), https://orbitaldebris.jsc.nasa.gov/quarterly-news/pdfs/odqnv24i1.pdf (*2020 NASA Orbital Debris Report*).

[29] Darren McKnight Comments at 2.

[30] "Lethal non-trackable" objects, or LNTs, are space objects that are 10 cm or smaller that are too small to be cataloged but still possess enough kinetic energy to disable a satellite upon impact. LNTs in LEO are primarily caused by the several hundred explosions of satellites and spent launch vehicle upper stages, but a few collision events have contributed to the LNT population as well.

[31] *See* Darren McKnight Comments at 2.

[32] Darren McKnight Comments at 2. *See also* T. Maclay and D. McKnight, *Space environment management: Framing the objective and setting priorities for controlling orbital debris risk*, 8 J. Space Safety Engineering 93-97 (2021).

[33] *See* Astroscale Comments at 20.

[34] Darren McKnight Comments at 3.

[35] *Id.*

associated increase in conjunctions and risk in LEO operations.[36] Astroscale notes that allowing an unlimited number of post-mission spacecraft to slowly deorbit for decades will increase the need for collision avoidance maneuvers, and outside of being disruptive to normal NGSO operations, the incremental capital and operational expenditures needed to conduct an increasing number of collision avoidance maneuvers would increase the financial burden on most NGSO operators.[37]

15. We find these arguments persuasive and agree with commenters that the threat of long-term debris generation is not the only relevant risk factor to consider in weighing shortening the benchmark, and any analysis concerning post-mission disposal lifetimes should account for the effects on the orbital environment raised by the commenters, such as the collision risks posed by LNT generation and increased collision avoidance burdens on operators. Accordingly, we conclude that shortening the 25-year benchmark for all missions is warranted and in the public interest.

16. The Commission initially proposed shortening the 25-year benchmark in the *FNPRM* to five years because commenters to the *Notice* had suggested that "post-mission orbital lifetimes on the order of five years may be appropriate in most cases."[38] Similarly, in addition to the general support we received for reducing the 25-year benchmark, the majority of commenters support reducing post-mission orbital lifetime to five years, as proposed in the *FNPRM*,[39] with some commenters recommending alternative benchmarks as short as one year.[40] We believe that a five-year post-mission orbital lifetime strikes an appropriate balance between meaningfully reducing risk while remaining flexible and responsive to a broader selection of mission profiles. We further believe that implementing a five-year post-mission disposal lifetime requirement is both practicable and feasible for LEO missions[41] and consistent with the ODMSP guidance, which advocates for limiting orbital lifetime to "as short as practicable."[42]

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[36] Astroscale Comments at 21. *See also* OneWeb Comments at 10.

[37] Astroscale Comments at 21.

[38] *FNPRM,* 35 FCC Rcd at 4235-36, para. 172.

[39] *See, e.g.,* SpaceX Comments at 14 ("SpaceX supports the Commission's proposal to adopt a requirement that satellites in the LEO region be removed from orbit as soon as practicable, but no more than five years following the end of the mission."); Maxar Comments at 5 ("The Commission should reduce the post-mission orbital lifetime to 5 years.); Commercial Space Flight Federation Comments at 4 (CSF Comments) ("CSF recommends that the Commission adopt a requirement that satellites in LEO be removed from orbit as soon as is reasonably practical, and may not exceed five years following the end of the mission."); Aerospace Industries Association Comments at 1 (AIA Comments) ("AIA supports the adoption of a post mission disposal lifetime of five years for satellites that employ atmospheric reentry for disposal using reasonable assumptions of orbit insertion."); Iridium Communications Inc. Comments at ii (Iridium Comments) ("Once a satellite has reached the end of its useful life, the operator should endeavor to minimize the post-mission time in orbit, and should aim for a post-mission lifetime of no more than 5 years for satellites operating at altitudes of 2,000 km and below."); The Boeing Company Comments at 15-16 (Boeing Comments) (". . . Boeing would support the adoption of a five-year post-mission limit on orbital life absent a failure of the satellite."); Gerardo Inzunza Higuera Comments at 2.

[40] Myriota Pty Ltd. Comments at 9 (". . . the Commission should encourage operators to accelerate this disposal time to 15 years. . .); Alistair Funge Comments at 3 (advocating for a maximum post-mission orbital lifetime of one year for passive reentry and five years for spacecraft that are actively controlled); Letter from Darren McKnight, Senior Technical Fellow, LeoLabs, to Mr. Karl Kensinger, Satellite Division Chief, FCC, IB Docket No. 18-313, at 5-6 (filed Mar. 29, 2022) (Darren McKnight *Ex Parte*) ("It is suggested that the FCC replace the 25-yr rule with 90% reliability with a realized environmental burden (REB) based upon the 25-yr post mission disposal (PMD) threshold and the 90% reliability in an objective measurable criterion which if not adhered to (within a 90 days) launches will be halted.").

[41] *See e.g.,* Astroscale Comments at 20; Boeing Comments at 14-15; OneWeb Comments at 9.

[42] ODMSP 4-1(b).

17. In the *FNPRM*, the Commission considered whether specifying a post-mission orbital lifetime requirement would be necessary in light of potentially adopting a maneuverability requirement for spacecraft operating above 400 km.[43] The Commission observed the practical reality that space stations capable of conducting collision avoidance maneuvers or operating below 400 km would likely meet the objectives of limiting post-mission orbital lifetime[44] and noted that the decision to incorporate a separate provision into the Commission's rules regarding post-mission orbital lifetime would potentially depend on whether it ultimately adopted a maneuverability requirement, on which it sought comment in the *FNPRM*.[45] Although we do not adopt rules relating to maneuverability at this time, given the risks associated with the increasing congestion in the orbital environment and the strong support in the record for shortening permissible post-mission orbital lifetime, we believe it is appropriate to adopt a rule reducing the post-mission disposal orbital lifetime while the Commission continues to assess potential maneuverability requirements, additional measures with respect to large constellations, and other possible approaches to mitigation of debris risks.

18. Accordingly, we adopt a rule requiring space stations ending their mission in, or passing through, the LEO[46] region below 2000 km altitude and planning disposal through uncontrolled atmospheric re-entry to complete disposal as soon as practicable following end of mission, and no later than five years after the end of the mission. For purposes of administering this rule, we will define "end of mission" to be the time at which the individual spacecraft is no longer capable of conducting collision avoidance maneuvers. For spacecraft without collision avoidance capabilities, end of mission will be defined as the point in which the individual spacecraft has completed its primary mission, e.g. communications services, handling customer message traffic, remote-sensing, etc. Consistent with other requirements in part 25 of our rules, this requirement will also apply to entities seeking to access the U.S. market using a non-U.S.-licensed satellite or satellite system.[47] This requirement will also apply to small satellites licensed under the streamlined processes outlined in rule 25.122.[48] Additionally, the requirements adopted in this Report and Order will also apply to any entities applying for satellites licensed under part 5 of the Commission's rules,[49] as well as amateur satellites authorized under part 97.[50]

19. While the record indicates support for shortening the 25-year benchmark to five years in general, many commenters express that five years may still be too long for large constellations, given the greater risks for generating orbital debris that these systems may pose over extended periods of time.[51]

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[43] *Order* 35 FCC Rcd at 4198, 4235, paras. 89, 170.

[44] *See Order*, 35 FCC Rcd at 4198, 4235, paras. 89, 170. The Commission noted that one of the main goals of limiting orbital lifetime was avoiding collisions with large objects. Space stations operating below 400 km or capable of conducting collision avoidance maneuvers might reasonably be expected to meet this objective either through use of propulsion for collision avoidance or through operating at a low altitude where both orbital lifetime of the spacecraft and density of debris objects are low, or a combination of both strategies.

[45] *Order*, 35 FCC Rcd at 4198, para. 89.

[46] This would include space stations in an elliptical orbit with a perigee in LEO.

[47] *See* 47 CFR § 25.137.

[48] *See* 47 CFR § 25.122. Under the criteria for small satellite streamlined processing, applicants must certify that the planned total in-orbit lifetime for any individual space station must be six years or less. 47 CFR § 25.122(c)(2).

[49] *See* 47 CFR § 5.64 (special provisions for satellite systems).

[50] *See* 47 CFR § 97.207 (provisions relating to amateur space stations).

[51] Astroscale Holdings, Altius Space Machines, Inc., Nanoracks LLC, Orbitfab, Inc, Roccor, LLC, Spacebridge Logistics, Inc, Space Exploration Engineering, LLC, and Spacenav, LLC Comments at 16 (rec. Apr. 5, 2019) (Global NewSpace Operators Comments); Iridium Comments at 7 ("Larger satellite constellations should be held to even more rigorous standards for deorbit given the substantially greater risk that they pose to other operators over extended periods of time.").

Even among commenters that argued in favor of generally maintaining the 25-year benchmark, many expressed that a reduction for post-mission disposal for large constellations may be warranted.[52] The Commercial Smallsat Spectrum Management Association (CSSMA), for example, noted that NASA's considerations of large constellations in the debris environment have caused them to recommend that "immediate removal is the preferred [post-mission disposal] option."[53] We agree with commenters that large constellations impose specific risks to the orbital environment that may be mitigated by a shorter post-mission orbital lifetime. We will continue to assess whether a shorter post-mission disposal requirement, such as one year, would be appropriate for large constellations in light of the risks to the orbital environment posed by those systems.[54] In the interim, we will continue evaluating large constellations consistent with the revised rules, including conditioning authorizations as appropriate to address collision risk and post-mission disposal matters on a case-by-case basis.

20. Commenters also indicated that any updated rule should be performance-based as to how the requirements are met in order to maintain flexibility and better accommodate different technologies and mission profiles.[55] In this spirit, we decline to prescribe a specific method of post-mission disposal at this time. In adopting this five-year benchmark for LEO missions, we also considered the possibility that satellite failures may give rise to non-compliance. At this time, we decline to provide a blanket exception for satellite failures that was suggested by some commenters, as appropriate with the spirit of a performance-based objective.[56] However, the Commission will take into account the facts and circumstances surrounding any potential satellite failure, including matters beyond the operator's control and any steps taken by the operator to avoid non-compliance.

B. Grandfathering Existing Operations

21. We are aware that adopting a rule shortening the 25-year benchmark may impose a burden and increase costs for existing operators. In the past, if the Commission required licensees to modify their operations as a result of a change in the rules, the Commission has allowed those operators periods of time in order to minimize disruption to existing services, allow for amortization of the licensee's equipment costs, and facilitate a stable investment environment for operators.[57] In light of the

[52] CSSMA Comments at 14; Eutelsat Comments at 7 ("The 25-year post mission disposal standard for atmospheric re-entry remains relevant for small NGSO systems . . . but could potentially be lowered in the context of large constellations with propulsion capabilities . . ."); Kepler Reply Comments at 4 ("Kepler therefore supports Eutelsat's recommendation that the orbital lifetime limit requirement be adapted to a satellite system's size and type of maneuvering capability.").

[53] CSSMA Comments at 14.

[54] While there currently is not a unified definition as to what is considered a "large constellation," we observe that the ODMSP defines a constellation consisting of 100 or more operational spacecraft cumulative as a large constellation. *See* ODMSP 5-1.

[55] *See, e.g.,* CONFERS Comments at 5; Boeing Reply Comments at 11; Charles Lee Mudd Jr. Comments at 5 (Mudd Comments); Kepler Reply Comments at 1.

[56] Boeing Comments at 15-16; Astroscale Comments at 7-8; Kuiper Systems LLC Comments at 11.

[57] *See, e.g., Amendment to the Commission's Rules Regarding a Plan for Sharing the Costs of Microwave Relocation*, First Report and Order and Further Notice of Proposed Rule Making, 11 FCC Rcd 8825 at para. 67 (1996) (establishing a ten-year sunset period in the transition of the 2 GHz band from existing fixed microwave services to broadband Personal Communications Services to allow incumbent fixed service licensees to amortize the full costs of their purchased equipment*); Amendment of Part 2 of the Commission's Rules to Allocate Spectrum Below 3 GHz for Mobile and Fixed Services to Support the Introduction of New Advanced Wireless Services, including Third Generation Wireless Systems et al.*, Ninth Report and Order, 21 FCC Rcd 4473 at para. 44 (2006) (establishing a fifteen-year sunset period in the transition of spectrum bands from Broadband Radio Service and Fixed Microwave Service to Advanced Wireless Service and Mobile Satellite Service); *Redesignation of the 17.7-19.7 GHz Frequency Band, Blanket Licensing of Satellite Earth Stations in the 17.7-20.2 GHz and 27.5-30.0 GHz*

(continued….)

potential financial and mission-planning impact of this new requirement, a transition period sufficient to permit operators to adjust their mission timelines and operations is in the public interest and supported by the record.[58] We find that the reduction in potential operator burden resulting from grandfathering certain satellites and authorizations from the five-year post-mission disposal requirement outweighs the risks of continued orbital congestion that could result from grandfathering as it would better facilitate compliance with the rule.

22. Accordingly, satellites already in orbit are exempt from the new requirement. For satellites already authorized by the Commission that have not yet been launched, we will provide a grandfathering period of two years, beginning on September 29, 2022, in order to allow operators to incorporate the five-year post-mission disposal requirement into their mission objectives. We believe a two-year period strikes a reasonable balance that will advance the goals of the reduced post-mission orbital lifetime while providing time for any necessary adjustments by operators in order to continue existing services and adjust planned operations. New licensees and existing applicants with authorized satellites to be launched after September 29, 2024, must comply with the five-year post-mission disposal requirement, though in individual cases the Commission will consider waivers requesting additional time for systems with existing authorizations that extend beyond the two-year period. For pending applications, we will continue to process them consistent with the current rules. For any applications granted involving space stations that would exceed the five-year limit, those space stations would need to be launched prior to September 29, 2024.

23. In some cases, already-authorized systems may require approval of a modification to update their license or grant to reflect alterations in system characteristics in order to achieve compliance. Accordingly, any licensee or grantee with a license or market access grant that does not specify a five-year or shorter post-mission disposal period, as required by the new rule, must file an application for a modification with respect to any satellites to be launched after September 29, 2024**,** including any replacement satellites, specifying the new post-mission disposal timeline. These modification applications must be filed no later than March 29, 2024, to provide the Commission with sufficient time to process the modification requests before the conclusion of the two-year grandfathering period.

C. Additional Flexibility for Academic and Research Missions

24. We observe that there may be circumstances that warrant a waiver of the five-year post-mission disposal requirement.[59] NASA, for example, expressed concern that a five-year limit would impact NASA Science Mission Directorate's (SMD's) CubeSat missions, which rely on natural decay of orbit to manage post-mission orbital lifetime and impose greater limits on acceptable launch opportunities.[60] NASA's comments do not address whether it expects changes in available launch

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Frequency Bands, and the Allocation of Additional Spectrum in the 17.3-17.8 GHz and 24.75-25.25 GHz Frequency Bands for Broadcast Satellite-Service Use, Report and Order, 15 FCC Rcd 13430 at para. 71 (2000) ("We believe that it is contrary to the public interest and not conducive to a stable investment environment to make terrestrial fixed operators, who currently serve the public, pay for relocation costs after . . . a short [three to five year] period of time.").

[58] Iridium Comments at 7 ("Improving on the 25-year standard undoubtedly imposes a cost on operators . . . the Commission should only apply such standards to future authorized systems to avoid imposing a substantial and unforeseen burden on existing operators."); Mudd Comments at 5; NASA Comments at 13.

[59] Boeing Comments at 16 ("Satellite license applicants, particularly those requesting experimental authority, should also be permitted to secure longer reentry periods for good cause, such as to accommodate unique experimental payloads."); Mudd Comments at 4 ("... should a particular license applicant require a longer EOL term, the FCC can require more significant demonstrations "in support of a longer post-mission lifetime" . . .); AIA Comments at 1 ("Exempt small experimental spacecraft in orbit between 400 to 600 kilometers should be permitted longer reentry periods with good cause.); Global NewSpace Operators Comments at 16.

[60] NASA Comments at 13.

opportunities if a five-year post-mission orbital lifetime requirement is adopted for commercial operators, and it appears that NASA will complete in the near future additional work to quantify the costs and benefits for its missions.[61] In any event, we acknowledge the public interest benefits of scientific research missions[62] and recognize the possibility that there may be specific scientific objectives that are not achievable at lower altitudes that would comply with the five-year post-mission disposal requirement. While we do not adopt a blanket waiver for these types of missions, we will consider such missions as a special category for purposes of analyzing waiver requests.

25. In determining whether research and scientific missions warrant a waiver of the five-year post-mission disposal requirement, some factors we may consider include the level of government funding, coordination, and oversight of the mission, the need to conduct research at altitudes in which a five-year post-mission disposal requirement may be unduly burdensome, the predictability of mission trajectory and associated burdens on other operators, unique spacecraft characteristics, and whether the mission involves any unusual risks to the space environment.

26. Applicants requesting waiver of the five-year post-mission disposal requirement should consider submitting certain information to facilitate the Commission's analysis as to whether a waiver is warranted, including a statement describing the unique mission and research objectives that could not be achieved at a lower altitude, as well as a document of anticipated findings and a description of any plans for publishing or producing a report of such findings. Operators may provide a survey of outstanding research and missions indicating that the proposed operations would satisfy a unique area of research, including any findings and actions of other government agencies and educational institutions that support the importance of the mission. We note that a general statement that the mission is for the general education and practical experience of future space-oriented professionals, while laudable, is in itself unlikely to make a mission sufficiently unique to warrant a waiver.[63] In addition, there should be a direct nexus between the orbital altitude at which the research is to be conducted and the need for a waiver, unrelated to whether there is a particular "rideshare" launch available to the altitude range sought.

27. We are also sensitive to the needs of government-supported missions.[64] Operators seeking a waiver consistent with this guidance should also consider providing a statement identifying specific facts demonstrating that their proposed mission supports and serves a government purpose. Demonstrations should include, if applicable, participation in government research programs, the level of government oversight, how any government funds were used for the development and operation of the proposed mission,[65] as well as government support for launch operations, including ridesharing agreements through NASA. The Commission will consider statements demonstrating that the proposed mission is at least 50% funded by the U.S. government, excluding funding for launch operations, as

[61] *See* NODIP 1.7.1. NASA is the lead agency tasked with "[r]eevaluat[ing] [the] ODMSP, including deorbit guidelines, by prioritizing a short-term study to better understand the impact of changing deorbit requirements for the USG, specifically the potential benefits and cost in reducing the deorbit timelines."

[62] *See, e.g.,* AIA Comments at 1, Boeing Comments at 14-16, Open Research Institute Comments at 4-5, NASA Comments at 13.

[63] If the only purpose of the mission is to provide students with hands-on participation in space activities, this may not justify consideration for a waiver of the post-mission disposal rule we adopt here. However, operators seeking a waiver of the five-year post-mission disposal rule may submit for the Commission's consideration a statement demonstrating that the educational purposes of the mission would not be served should students participate in a mission with a post-mission disposal lifetime of fewer than five years.

[64] *See* NASA Comments at 13.

[65] Operators can demonstrate government funding in a number of ways, including involvement with assorted NASA programs like the Educational Launch of Nanosatellites (ELaNa) initiative, the CubeSat Launch Initiative, and the Technology Educational Satellite (TechEdSat) series, National Science Foundation (NSF) grants, and various other government satellite programs.

government-supported, in order to facilitate equitable analysis of this demonstration.

D. Costs-Benefits

28. This rule may impose additional costs on the industry, including in some instances fuel and other costs for more rapid decommissioning needed to accommodate the shortened post-mission disposal timeframe, and opportunity costs associated with certain entities altering their mission plans to comply with the rule. However, as we discuss above, this is intended to incrementally slow the growth of orbital debris, particularly in LEO, with its increasing numbers of satellites.[66] Moreover, we find that this rule will slow the growth of collision avoidance maneuvers, saving fuel costs.[67] Faster deorbiting may also foster technological progress as firms are able to implement newer socially-valuable technologies over a shortened time horizon that might not have been implemented under the 25-year guidelines.[68] Further, launch services will likely evolve to provide initial deployments compatible with the five-year post-mission disposal benchmark, thereby avoiding or reducing impacts on "rideshare" customers.

29. While it is difficult to quantify the economic value of the orbital debris mitigation measures adopted today, we find that the benefits of the rule in terms of reducing the probability of costly collisions and commensurate reduction in service outages, as well as reducing the frequency of collision avoidance maneuvers, outweigh any costs resulting from the rule. In the U.S. and globally, satellites provide voice, video, audio, and data services, filling coverage gaps and serving markets difficult to reach terrestrially, such as aviation and maritime. In the U.S. alone, satellite service revenue for 2021 comprised $45.2 billion.[69] This does not take into account the benefits that consumers derive from these services, nor benefits such as scientific progress that satellites effectuate. Collisions resulting from orbital debris harm the public by degrading the service quality that consumers receive and harm entities such as satellite-based service providers that are unable to carry out their mission or may face lost revenue and costs associated with outages and the need to launch new spacecraft.

IV. PROCEDURAL MATTERS

30. *Regulatory Flexibility Act.* The Regulatory Flexibility Act of 1980 (RFA), as amended, requires that an agency prepare a final regulatory flexibility analysis "whenever an agency promulgates a final rule under [5 U.S.C. § 553], after being required by that section or any other law to publish a general notice of proposed rulemaking."[70] An Initial Regulatory Flexibility Analysis (IRFA) was incorporated into the *FNPRM*.[71] The Commission sought written public comment on the possible significant economic impact on small entities regarding the proposals addressed in the *FNPRM*, including comments on the IRFA.[72] A Final Regulatory Flexibility Analysis is set forth in Appendix B. The Commission's Consumer and Governmental Affairs Bureau, Reference Information Center, will send a copy of this Second Report and Order, including the FRFA, to the Chief Counsel for Advocacy of the Small Business Administration (SBA).[73]

31. *Paperwork Reduction Act*. This document contains new or modified information collection requirements subject to the Paperwork Reduction Act of 1995 (PRA), Public Law 104-13. It

[66] CSSMA Comments at 14; SpaceX Comments at 14; OneWeb Comments at 9-10.

[67] Astroscale Comments at 20.

[68] OneWeb Comments at 10; *see also,* The European Space Agency, *Automating collision avoidance* (Oct. 22, 2019), https://www.esa.int/Space_Safety/Space_Debris/Automating_collision_avoidance.

[69] Satellite Industry Association Comments, GN Docket No. 22-203 (rec. July 1, 2022) at 20.

[70] 5 U.S.C. § 604(a).

[71] *FNPRM,* 35 FCC Rcd at 4282-4285, Appendix E.

[72] *Id.*

[73] *See* 5 U.S.C. § 603(a).

will be submitted to the Office of Management and Budget (OMB) for review under Section 3507(d) of the PRA. OMB, the general public, and other Federal agencies will be invited to comment on the new or modified information collection requirements contained in this proceeding. In addition, we note that pursuant to the Small Business Paperwork Relief Act of 2002, Public Law 107-198, see 44 U.S.C. 3506(c)(4), we previously sought specific comment on how the Commission might further reduce the information collection burden for small businesses with fewer than 25 employees.

32. *Congressional Review Act.* [[The Commission will submit this draft Second Report and Order to the Administrator of the Office of Information and Regulatory Affairs, Office of Management and Budget, for concurrence as to whether this rule is "major" or "non-major" under the Congressional Review Act, 5 U.S.C. § 804(2).]] The Commission will send a copy of this *Second Report and Order* to Congress and the Government Accountability Office pursuant to 5 U.S.C. §801(a)(1)(A).

33. *Additional Information.* For additional information on this proceeding, please contact Alexandra Horn, International Bureau, Satellite Division, alexandra.horn@fcc.gov.

V. ORDERING CLAUSES

34. IT IS ORDERED, pursuant to sections 1, 4(i), 301, 303, 307, 308, 309, and 310 of the Communications Act of 1934, as amended, 47 U.S.C. §§ 151, 154(i), 301, 303, 307, 308, 309, and 310, that this Second Report and Order IS ADOPTED, the policies, rules, and requirements discussed herein ARE ADOPTED, and parts 5, 25, and 97 of the Commission's rules ARE AMENDED as set forth in Appendix A.

35. IT IS FURTHER ORDERED that the amendments of the Commission's rules to section25.283(e),), set forth in Appendix A, ARE ADOPTED, effective thirty days from the date of publication in the Federal Register. The other amendments to the Commission's rules set forth in Appendix A contain new or modified information collection requirements that require review and approval by the Office of Management and Budget under the Paperwork Reduction Act, and WILL BECOME EFFECTIVE after the Commission publishes a notice in the Federal Register announcing such approval and the relevant effective date.

36. IT IS FURTHER ORDERED that the Commission's Consumer and Governmental Affairs Bureau, Reference Information Center, SHALL SEND a copy of this Second Report and Order, including the Final Regulatory Flexibility Analysis, to the Chief Counsel for Advocacy of the Small Business Administration.

37. IT IS FURTHER ORDERED that the Commission SHALL SEND a copy of this Second Report and Order in a report to be sent to Congress and the Government Accountability Office pursuant to the Congressional Review Act, *see* 5 U.S.C. § 801(a)(1)(A).

Federal Communications Commission

Marlene H. Dortch

Secretary

APPENDIX A

Final Rules

The Federal Communications Commission amends 47 CFR, parts 5, 25, and 97, as follows:

PART 5 – EXPERIMENTAL RADIO SERVICE

1. The authority citation for Part 5 continues to read as follows:

Authority: 47 U.S.C. 154, 301, 302, 303, 307, 336, unless otherwise noted.

2. Amend § 5.64, by revising paragraph (b)(7)(iv)(A) to read as follows:

§ 5.64 Special provisions for satellite systems.

* * * * *

(b) * * *

(7) * * *

(iv) * * *

(A) The statement must include a demonstration that the probability of success of the chosen disposal method will be 0.9 or greater for any individual space station. For space station systems consisting of multiple space stations, the demonstration should include additional information regarding efforts to achieve a higher probability of success, with a goal, for large systems, of a probability of success for any individual space station of 0.99 or better. For space stations under paragraph (b)(7)(ii) of this section that will be terminating operations in or passing through the low-Earth orbit region below 2000 km altitude, successful disposal is defined as atmospheric re-entry of the spacecraft within five years or less following completion of the mission. For space stations under paragraph (b)(7)(iii) of this section, successful disposal will be assessed on a case-by-case basis.

* * * * *

PART 25 – SATELLITE COMMUNICATIONS

3. The authority citation for Part 25 continues to read as follows:

Authority: 47 U.S.C. 154, 301, 302, 303, 307, 309, 310, 319, 332, 605, and 721, unless otherwise noted.

4. Amend § 25.114, by revising paragraph (d)(14)(vii)(D)(1) to read as follows:

§ 25.114 Applications for space station authorizations.

* * * * *

(d) * * *

(14) * * *

(vii) * * *

(D) * * *

(1) The statement must include a demonstration that the probability of success of the chosen disposal method will be 0.9 or greater for any individual space station. For space station systems consisting of multiple space stations, the demonstration should include additional information regarding efforts to achieve a higher probability of success, with a goal, for large systems, of a probability of success for any individual space station of 0.99 or better. For space stations under paragraph (d)(14)(vii)(B) of this section ending their mission in or passing through the low-Earth orbit region below 2000 km altitude, successful disposal is defined as atmospheric re-entry of the spacecraft within five years or less following completion of the mission. For all other space stations under paragraph (d)(14)(vii)(B) and paragraph (d)(14)(vii)(C) of this section, successful disposal will be assessed on a case-by-case basis.

* * * * *

5. Amend § 25.283, to add paragraph (e) as follows:

§ 25.283 End-of-life disposal.

* * * * *

(e) *low-Earth orbit space stations.* For space stations ending their mission in or passing through the low-Earth orbit region below 2000 km altitude and planning disposal through uncontrolled atmospheric re-entry, disposal must be completed as soon as practicable following end of mission, and no later than five years after the end of the mission. For purposes of this provision, "end of mission" will be defined as the time at which the individual spacecraft is no longer capable of conducting collision avoidance maneuvers. For spacecraft without collision avoidance capabilities, end of mission will be defined as the point in which the individual spacecraft has completed its primary mission.

PART 97 – AMATEUR RADIO SERVICE

6. The authority citation for Part 97 continues to read as follows:

Authority: 47 U.S.C. 151-155, 301-609, unless otherwise noted.

7. Amend § 97.207, by revising paragraph (g)(1)(vii)(D)(1) to read as follows:

§ 97.207 Space station.

* * * * *

(g) * * *

(1) * * *

(vii) * * *

(D) * * *

(1) The statement must include a demonstration that the probability of success of the chosen disposal method will be 0.9 or greater for any individual space station. For space station systems consisting of multiple space stations, the demonstration should include additional information regarding efforts to achieve a higher probability of success, with a goal, for large systems, of a probability of success for any individual space station of 0.99 or better. For space stations under paragraph (g)(1)(vii)(B) of this section that will be terminating operations in or passing through the low-Earth orbit region below 2000 km altitude, successful disposal is defined as atmospheric re-entry of the spacecraft within five years or less following completion of the mission. For space stations under paragraph (g)(1)(vii)(C) of this section, successful disposal will be assessed on a case-by-case basis.

* * * * *

APPENDIX B

Final Regulatory Flexibility Analysis

As required by the Regulatory Flexibility Act of 1980 (RFA), as amended,[74] an Initial Regulatory Flexibility Analysis (IRFA) was incorporated in the Further Notice of Proposed Rulemaking, *Mitigation of Orbital Debris in the New Space Age* (*FNPRM*), released in April 2020 in this proceeding.[75] The Commission sought written public comment on the proposals in the *FNPRM*, including comment on the IRFA. No comments were filed addressing the IRFA. This present Final Regulatory Flexibility Analysis (FRFA) conforms to the RFA.[76]

A. Need for, and Objectives of, the Order:

This Order adopts a rule requiring stations ending their mission in or passing through the low-Earth orbit region below 2000 km altitude and planning disposal through uncontrolled atmospheric re-entry following the completion of the mission, to complete as soon as practicable following end of mission, and no later than five years after the end of the mission. Adoption of this rule is a significant step in updating the Commission's rules on orbital debris mitigation. Updates to the Commission's rules on orbital debris mitigation are informed by the Commission's experience gained in the licensing process and address updates in mitigation guidelines and practices as well as market developments. Adoption of this rule will ensure that applicants for a Commission space station license or authorization, or grant of market access, will not contribute to orbital congestion longer than necessary. This action will help ensure that Commission decisions are consistent with the public interest in space remaining viable for future satellites and systems and the many services those systems provide to the public.

B. Summary of Significant Issues Raised by Public Comments in Response to the IRFA

No comments were filed that specifically addressed the IRFA.

C. Response to Comments by the Chief Counsel for Advocacy of the Small Business

Pursuant to the Small Business Jobs Act of 2010, which amended the RFA, the Commission is required to respond to any comments filed by the Chief Counsel for Advocacy of the Small Business Administration (SBA), and to provide a detailed statement of any change made to the proposed rules as a result of those comments.[77] The Chief Counsel did not file any comments in response to the proposed rules in this proceeding.

D. Description and Estimate of the Number of Small Entities to Which the Rules Will Apply

The RFA directs agencies to provide a description of, and, where feasible, an estimate of, the number of small entities that may be affected by the rules adopted herein.[78] The RFA generally defines the term "small entity" as having the same meaning as the terms "small business," "small organization," and "small governmental jurisdiction."[79] In addition, the term "small business" has the same meaning as

[74] *See* 5 U.S.C. § 603. The RFA, *see* 5 U.S.C. § 601-612, has been amended by the Small Business Regulatory Enforcement Fairness Act of 1996, (SBREFA) Pub. L. No. 104-121, Title II, 110 Stat. 857 (1996).

[75] *Orbital Debris in the New Space Age*, IB Docket No. 18-313, Second Report and Order and Further Notice of Proposed Rulemaking, 35 FCC Rcd 4156 (2020).

[76] *See* 5 U.S.C. § 604.

[77] 5 U.S.C. § 604(a)(3).

[78] *Id.*

[79] 5 U.S.C. § 601(6).

the term "small business concern" under the Small Business Act.[80] A "small business concern" is one which: (1) is independently owned and operated; (2) is not dominant in its field of operation; and (3) satisfies any additional criteria established by the Small Business Administration (SBA).[81] Below, we describe and estimate the number of small entities that may be affected by the adoption of the final rules.

Satellite Telecommunications. This industry comprises firms "primarily engaged in providing telecommunications services to other establishments in the telecommunications and broadcasting industries by forwarding and receiving communications signals via a system of satellites or reselling satellite telecommunications."[82] Satellite telecommunications service providers include satellite and earth station operators. The SBA small business size standard for this industry classifies a business with $38 million or less in annual receipts as small.[83] U.S. Census Bureau data for 2017 show that 275 firms in this industry operated for the entire year.[84] Of this number, 242 firms had revenue of less than $25 million.[85] Additionally, based on Commission data in the 2021 Universal Service Monitoring Report, as of December 31, 2020, there were 71 providers that reported they were engaged in the provision of satellite telecommunications services.[86] Of these providers, the Commission estimates that approximately 48 providers have 1,500 or fewer employees.[87] Consequently using the SBA's small business size standard, a little more than half of these providers can be considered small entities.

All Other Telecommunications. The "All Other Telecommunications" category is comprised of establishments primarily engaged in providing specialized telecommunications services, such as satellite tracking, communications telemetry, and radar station operation.[88] This industry also includes establishments primarily engaged in providing satellite terminal stations and associated facilities connected with one or more terrestrial systems and capable of transmitting telecommunications to, and receiving telecommunications from, satellite systems.[89] Establishments providing Internet services or voice over Internet protocol (VoIP) services via client-supplied telecommunications connections are also

[80] 5 U.S.C. § 601(3) (incorporating by reference the definition of "small-business concern" in the Small Business Act, 15 U.S.C. § 632). Pursuant to 5 U.S.C. § 601(3), the statutory definition of a small business applies "unless an agency, after consultation with the Office of Advocacy of the Small Business Administration and after opportunity for public comment, establishes one or more definitions of such term which are appropriate to the activities of the agency and publishes such definition(s) in the Federal Register."

[81] 15 U.S.C. § 632.

[82] *See* U.S. Census Bureau, 2017 NAICS Definition, "517410 Satellite Telecommunications," https://www.census.gov/naics/?input=517410&year=2017&details=517410.

[83] *See* 13 CFR § 121.201, NAICS Code 517410.

[84] *See* U.S. Census Bureau, 2017 Economic Census of the United States, Selected Sectors: Sales, Value of Shipments, or Revenue Size of Firms for the U.S.: 2017, Table ID: EC1700SIZEREVFIRM, NAICS Code 517410, https://data.census.gov/cedsci/table?y=2017&n=517410&tid=ECNSIZE2017.EC1700SIZEREVFIRM&hidePreview=false.

[85] *Id.* The available U.S. Census Bureau data does not provide a more precise estimate of the number of firms that meet the SBA size standard. We also note that according to the U.S. Census Bureau glossary, the terms receipts and revenues are used interchangeably, *see* https://www.census.gov/glossary/#term_ReceiptsRevenueServices.

[86] Federal-State Joint Board on Universal Service, Universal Service Monitoring Report at 26, Table 1.12 (2021), https://docs.fcc.gov/pubId.lic/attachments/DOC-379181A1.pdf.

[87] *Id.*

[88] *See* U.S. Census Bureau, 2017 NAICS Definition, "517919 All Other Telecommunications," https://www.census.gov/cgibin/sssd/naics/naicsrch?input=517919&search=2017+NAICS+Search&search=2017.

[89] *Id.*

included in this industry.[90] The SBA has developed a small business size standard for "All Other Telecommunications," which consists of all such firms with annual receipts of $35 million or less.[91] For this category, U.S. Census Bureau data for 2012 show that there were 1,442 firms that operated for the entire year.[92] Of those firms, a total of 1,400 had annual receipts of less than $25 million and 15 firms had annual receipts of $25 million to $49, 999,999.[93] Thus, the Commission estimates that the majority of "All Other Telecommunications" firms potentially affected by our action can be considered small.

E. Description of Projected Reporting, Recordkeeping, and Other Compliance Requirements for Small Entities

The Order amended rules that are applicable to space station operators requesting a license or authorization from the Commission, or entities requesting that the Commission grant a request for U.S. market access. Specifically, the revised rules now require space stations ending their mission in or passing through the low-Earth orbit region below 2000 km altitude and planning disposal through uncontrolled atmospheric re-entry following the completion of the mission, to complete disposal as soon as practicable following end of mission, and no later than five years after the end of the mission.

Applicants requesting authorization from the Commission must already comply with existing operational requirements, including those related to orbital debris mitigation and post-mission disposal. Operators must prepare and provide a disclosure as part of their application detailing their orbital debris mitigation plan. There may be fuel and other costs for more rapid decommissioning needed to accommodate the shortened post-mission disposal timeframe and opportunity costs associated with certain entities altering their mission plans to comply with the rule. However, this rule will slow the growth of collision avoidance maneuvers, saving fuel costs. Faster deorbiting may also foster technological progress as firms are able to implement newer socially-valuable technologies over a shortened time horizon that might not have been implemented under the 25-year guidelines. Further, launch services will likely evolve to provide initial deployments compatible with the five-year post-mission disposal benchmark, thereby avoiding or reducing impacts on "rideshare" customers.

F. Steps Taken to Minimize the Significant Economic Impact on Small Entities, and Significant Alternatives Considered

The RFA requires an agency to describe any significant alternatives that it has considered in developing its approach, which may include the following four alternatives (among others): "(1) the establishment of differing compliance or reporting requirements or timetables that take into account the resources available to small entities; (2) the clarification, consolidation, or simplification of compliance and reporting requirements under the rule for such small entities; (3) the use of performance rather than design standards; and (4) an exemption from coverage of the rule, or any part thereof, for such small entities."[94]

The Order requires all space stations ending their mission in or passing through the low-Earth orbit region below 2000 km altitude and planning disposal through uncontrolled atmospheric re-entry following the completion of the mission, to complete disposal as soon as practicable following end of

[90] *Id.*

[91] *See* 13 CFR § 121.201, NAICS Code 517919.

[92] *See* U.S. Census Bureau, 2012 Economic Census of the United States, Table ID: EC1251SSSZ4, Information: Subject Series - Estab and Firm Size: Receipts Size of Firms for the U.S.: 2012, NAICS Code 517919, https://data.census.gov/cedsci/table?text=EC1251SSSZ4&n=517919&tid=ECNSIZE2012.EC1251SSSZ4&hidePreview=false.

[93] *Id.* The available U.S. Census Bureau data does not provide a more precise estimate of the number of firms that meet the SBA size standard of annual receipts of $35 million or less.

[94] 5 U.S.C. § 603(c)(1)-(4).

mission, and no later than five years after the end of the mission. The Commission has elected to provide a two-year grandfathering period to provide additional time for small entities to comply with this rule. This Order also codifies a post-mission disposal lifetime requirement of five years or less, thus providing a clear and objective benchmark for small entities to comply with. Additionally, the Commission has opted to adopt this new requirement as a performance-based rule, instead of prescribing specific design standards or requirements.

G. Report to Congress

The Commission will send a copy of this Second Report and Order, including this FRFA, in a report to be sent to Congress pursuant to the Congressional Review Act.[95] In addition, the Commission will send a copy of the Report and Order, including this FRFA, to the Chief Counsel for Advocacy of the SBA. A copy of this Second Report and Order and FRFA (or summaries thereof) will also be published in the Federal Register.[96]

[95] 5 U.S.C. § 801(a)(1)(A).

[96] *See* 5 U.S.C. § 604(b).

APPENDIX C

List of Commenters Referenced in this Report and Order

Comments

Aerospace Industries Association (AIA)

Alistair Funge

Astroscale

Charles Lee Mudd Jr.

Commercial Smallsat Spectrum Management Association (CSSMA)

Commercial Space Flight Federation (CSF)

Consortium for Execution of Rendezvous and Servicing Operations (CONFERS)

Darren McKnight

Eutelsat S.A. (Eutalsat)

Gerardo Inzunza Higuera

Iridium Communications Inc. (Iridium)

Kuiper Systems LLC (Kuiper)

Lynk Global, Inc. (Lynk)

Maxar Technologies Inc.

Myriota Pty Ltd. (Myriota)

National Aeronautics and Space Administration (NASA)

Open Research Institute

Space Exploration Technologies Corp. (SpaceX)

The Boeing Company (Boeing)

WorldVu Satellites Limited (OneWeb)

Reply Comments

Astroscale

The Boeing Company (Boeing)

Kepler Communications Inc. (Kepler)

Ex Parte Filings

Darren McKnight