FEDERAL COMMUNICATIONS COMMISSION

47 CFR Parts 5, 25, and 97

[IB Docket No. 18–313; FCC 20–54; FRS 16848]

Mitigation of Orbital Debris in the New Space Age

AGENCY: Federal Communications Commission.

ACTION: Proposed rule.

SUMMARY: In this document, the Commission seeks comment through a Further Notice of Proposed Rulemaking adopted on April 23, 2020, on additional amendments to its rules related to satellite orbital debris mitigation. A related Final rule document, the Report and Order, which adopts amendments to the Commission's satellite orbital debris mitigation rules is published elsewhere in this issue of the **Federal Register**.

DATES: Comments are due October 9, 2020. Reply comments are due November 9, 2020.

ADDRESSES: You may submit comments, identified by IB Docket No. 18–313, by any of the following methods:

- *Federal Communications Commission's Website: http://apps.fcc.gov/ecfs.* Follow the instructions for submitting comments.
- *People with Disabilities:* Contact the FCC to request reasonable accommodations (accessible format documents, sign language interpreters, CART, etc.) by email: *FCC504@fcc.gov* or phone: 202–418–0530 or TTY: 202–418–0432.

For detailed instructions for submitting comments and additional information on the rulemaking process, see the **SUPPLEMENTARY INFORMATION** section of this document.

FOR FURTHER INFORMATION CONTACT: Merissa Velez, 202–418–0751.

SUPPLEMENTARY INFORMATION: This is a summary of the Commission's Further Notice of Proposed Rulemaking (*FNPRM*), IB Docket No. 18–313, FCC 20–54, adopted on April 23, 2020, and released on April 24, 2020. The full text of this document is available at *https://docs.fcc.gov/public/attachments/FCC-20-54A1.pdf.* To request materials in accessible formats for people with disabilities, send an email to *FCC504@fcc.gov* or call the Consumer & Governmental Affairs Bureau at 202–418–0530 (voice), 202–418–0432 (TTY).

Comment Filing Requirements

Interested parties may file comments and reply comments on or before the dates indicated in the **DATES** section above. Comments may be filed using the Commission's Electronic Comment Filing System (ECFS).

- *Electronic Filers.* Comments may be filed electronically using the internet by accessing the ECFS, *http://apps.fcc.gov/ecfs.*
- *Paper Filers.* Parties who choose to file by paper must file an original and one copy of each filing. If more than one docket or rulemaking number appears in the caption of this proceeding, filers must submit two additional copies for each additional docket or rulemaking number.

Filings can be sent by commercial overnight courier, or by first-class or overnight U.S. Postal Service mail. All filings must be addressed to the Commission's Secretary, Office of the Secretary, Federal Communications Commission.

- Commercial overnight mail (other than U.S. Postal Service Express Mail and Priority Mail) must be sent to 9050 Junction Drive, Annapolis Junction, MD 20701. U.S. Postal Service first-class, Express, and Priority mail must be addressed to 445 12th Street SW, Washington, DC 20554.
- Effective March 19, 2020, and until further notice, the Commission no longer accepts any hand or messenger delivered filings. This is a temporary measure taken to help protect the health and safety of individuals, and to mitigate the transmission of COVID–19. See FCC Announces Closure of FCC Headquarters Open Window and Change in Hand-Delivery Policy, Public Notice, DA 20–304 (March 19, 2020). *https://www.fcc.gov/document/fcc-closes-headquarters-open-window-and-changes-hand-delivery-policy*.
- *Persons with Disabilities.* To request materials in accessible formats for people with disabilities (braille, large print, electronic files, audio format), send an email to *fcc504@fcc.gov* or call the Consumer & Governmental Affairs Bureau at 202–418–0530 (voice) or 202–418–0432 (TTY).

Ex Parte Presentations

The Commission will treat this proceeding as a ''permit-but-disclose'' proceeding in accordance with the Commission's *ex parte* rules. Persons making *ex parte* presentations must file a copy of any written presentation or a memorandum summarizing any oral presentation within two business days after the presentation (unless a different deadline applicable to the Sunshine period applies). Persons making oral *ex parte* presentations are reminded that memoranda summarizing the presentation must (1) list all persons attending or otherwise participating in the meeting at which the *ex parte* presentation was made, and (2) summarize all data presented and arguments made during the presentation. If the presentation consisted in whole or in part of the presentation of data or arguments already reflected in the presenter's written comments, memoranda or other filings in the proceeding, the presenter may provide citations to such data or arguments in his or her prior comments, memoranda, or other filings (specifying the relevant page and/or paragraph numbers where such data or arguments can be found) in lieu of summarizing them in the memorandum. Documents shown or given to Commission staff during *ex parte* meetings are deemed to be written *ex parte* presentations and must be filed consistent with rule 1.1206(b). In proceedings governed by rule 1.49(f) or for which the Commission has made available a method of electronic filing, written *ex parte* presentations and memoranda summarizing oral *ex parte* presentations, and all attachments thereto, must be filed through the electronic comment filing system available for that proceeding, and must be filed in their native format (*e.g.,* .doc, .xml, .ppt, searchable .pdf). Participants in this proceeding should familiarize themselves with the Commission's *ex parte* rules.

Paperwork Reduction Act

This document contains proposed new and modified information collection requirements. The Commission, as part of its continuing effort to reduce paperwork burdens, invites the general public and the Office of Management and Budget to comment on the information collection requirements contained in this document, as required by the Paperwork Reduction Act of 1995. In addition, pursuant to the Small Business Paperwork Relief Act of 2002, we specifically seek comment on how we might further reduce the information collection burden for small business concerns with fewer than 25 employees.

Synopsis

Further Notice of Proposed Rulemaking

This Further Notice of Proposed Rulemaking (*FNPRM*) seeks comment on additional amendments to the Commission's rules related to satellite orbital debris mitigation. The Commission seeks comment on rule revisions related to probability of accidental explosions, collision risk for multi-satellite systems, maneuverability

requirements, casualty risk, indemnification, and performance bonds tied to successful spacecraft disposal.

A. Probability of Accidental Explosions

Our existing orbital debris rules require that applicants provide a statement that the space station operator has assessed and limited the probability of accidental explosions during and after the completion of mission operations. We had not proposed to change this rule as part of the Notice, but observe that the ODMSP now includes a metric for assessing this objective. The ODMSP states in relevant part that ''[i]n developing the design of a spacecraft or upper stage, each program should demonstrate, via commonly accepted engineering and probability assessment methods, that the integrated probability of debris-generating explosions for all credible failure modes of each spacecraft . . . (excluding small particle impacts) is less than 0.001 (1 in 1,000) during deployment and mission operations.'' We seek comment on inclusion of this metric in our rules. Specifically, we propose to modify our rule such that applicants must include in the orbital debris statement a demonstration concerning limiting risk from accidental explosions and associated orbital debris during mission operations, including the 0.001 threshold. We seek comment on how the Commission should assess such demonstrations, noting that the ODMSP states that the demonstration should be ''via commonly accepted engineering and probability assessment methods.'' We also seek comments on the costs and benefits of incorporating a specific metric on this topic into our application disclosure rules.

B. Total Probability of Collisions With Large Objects

In response to the Notice, we received a number of differing views regarding whether the Commission should consider collision risk with large objects on a system-wide, *i.e.,* aggregate, basis, and if so, how. We believe these issues merit further discussion and expansion of the record on how the Commission should analyze multi-satellite NGSO systems, and in particular, large constellations in this context. The NASA Standard, also incorporated into the revised ODMSP, provides that the probability of collision with large objects (10 cm or larger) not exceed 0.001 (1 in 1,000) during the orbital lifetime of a single satellite. With improved access to space, it is increasingly possible to launch constellations of satellites that number in the hundreds or thousands. For deployments of satellites in such numbers, analysis of whether individual satellites in the system satisfy the 0.001 (1 in 1,000) metric on a per-satellite basis, absent any additional analysis, might not adequately address the ultimate probability of collision. While we believe these concerns can in many cases be addressed through sufficiently reliable mitigation measures such as maneuverability and orbit selection, these types of concerns form the basis for seeking comment here on how the Commission should review the collision risks associated with multi-satellite systems from the perspective of sustaining the space environment while at the same time encouraging deployment of new and innovative satellite systems designed to provide beneficial services to the U.S. public.

The revised ODMSP includes a new objective titled ''clarification and additional standard practices for certain classes of space operations.'' This objective includes a discussion of ''large constellations'' and lists a number of factors to be considered when looking at various aspects of these large constellations. In the context of a threshold for post-mission disposal reliability, the ODMSP guidance states that ''factors such as mass, collision probability, orbital location, and other relevant parameters should be considered.'' As we consider the ODMSP to use as a reference in the commercial and otherwise non-governmental context,[1] we seek comment on the role that this guidance should play in our rules, including how to analyze collision risk specifically when it comes to multi-satellite constellations.

First, we ask how the Commission should consider the collision risks associated with a system in its entirety as part of the licensing process. Is assessing the total probability of collision on a system-wide basis consistent with the public interest? Assuming that the Commission should consider collision risks on a system-wide basis as part of its licensing process, we seek comment on the process through which such collision risks should be considered. We seek comment on the factors that could be considered in performing an analysis, and if there are metrics or thresholds that can provide additional certainty to applicants regarding the Commission's review process.[2] For example, one possible approach could be to identify a system-wide collision probability metric or other metric that, if exceeded, would trigger further review. Such an approach could provide applicants with a clear safe harbor when designing their systems. For applicants exceeding the threshold, additional specific factors could be identified that the Commission would take into consideration as part of its further review. We seek comment on this approach, or whether there are other suitable indicators that might help to categorize some systems as lower-risk and some as requiring further analysis. Would this approach provide adequate regulatory certainty or is a bright-line rule that applies in all cases preferable? How should we balance the certainty provided by a bright-line rule with the flexibility provided by a safe harbor approach?

We seek comment on the factors that could be relevant both in establishing a threshold or bright-line rule, and in assessing a system on a more detailed basis, for example, if the system risk exceeds a particular safe harbor. We seek comment on consideration of factors including per-satellite collision risk, maneuverability, number of satellites (potentially including constellation replenishment rate and replacement satellites), orbital lifetime, and/or size for NGSO satellites. Are there any other factors that could or should be considered? We note that as adopted in the Order, the calculation of the per-satellite collision risk using the NASA Debris Assessment Software, or higher fidelity model would already take into account the initial orbit and area-to-mass ratio of an individual satellite. When assessing total collision risk, should we attempt to make a bright-line distinction between large constellations and small systems, with different applicable metrics, or should we attempt to specify a metric that is scalable to both small and large multi-satellite systems? We also seek comment on whether we should establish a separate process for evaluation of system-wide collision risk for satellites that operate in the MEO region.[3]

[1] As noted, by its terms, the ODMSP applies to U.S. government activities, but provides a reference generally to promote efficient and effective space safety practices. ODMSP, Preamble.

[2] To the extent possible, we ask that commenters supporting or disagreeing with particular metrics provide analysis that includes sample constellation sizes, satellite area-to-mass ratio, deployment altitudes, and other potentially relevant considerations.

[3] We note that the ODMSP does not provide a separate metric for spacecraft operating in MEO for assessment of per-satellite probability of collision with large objects. *See* ODMSP, 3–1. The ODMSP does provide for a 100-year maximum orbital lifetime for use in the assessment, however, and as the *Order* specifies above, applicants planning to operate spacecraft in the MEO region can refer to

To the extent that we consider a particular threshold or safe harbor that would be applicable to multi-satellite NGSO systems, we seek comment on using total collision risk, *i.e.,* in the aggregate, as calculated as the sum of the probability of collision associated with each individual satellite in the system. Should we ask that applicants take into consideration replacement/replenishment satellites as part of this calculation, and if so, over what period of time? Is the 15 years that correlates with the typical licensing period for part 25 NGSO systems a reasonable period of time? [4] We observe that depending on the replenishment cycle of a constellation, the total number of satellites launched into orbit over the course of a license term could be significantly higher than the number of satellites authorized for operation at any given time. Are rapidly replenished satellites more likely to be deployed into lower orbits, however, where an individual satellite's collision risk would generally be lower? We seek comment on how the number of satellites could be calculated for purposes of analysis. In the Notice, we proposed to refer to the 0.001 probability of collision metric in assessing total collision probability as a whole. Some commenters agreed that total collision risk should be assessed, but disagreed about whether the 0.001 metric should apply. We seek comment on using a total collision probability metric as a threshold or safe harbor, and ask whether commenters may have different views on the application of a 0.001 probability of collision metric to the satellite constellation as a whole, if that metric was used only to identify those systems that would require additional review. In addition, is there a metric other than 0.001 that should be used as a threshold or safe harbor? We recognize that using a total collision risk metric would require that larger systems meet a lower per-satellite risk than smaller systems. Should the Commission consider another factor or factors entirely, such as number of satellites and mass?

We also seek comment on whether, and to what extent, reliability or failure rate of any maneuvering capabilities should be part of the Commission's review of collision risk. The Order specifies that for individual satellites, the probability of collision with large objects may be deemed zero, absent evidence to the contrary, during any period where the satellite is capable of maneuvering to avoid collisions. With respect to multi-satellite systems, we expect that most systems will have some maneuvering capabilities. We ask how we should evaluate or otherwise consider the likelihood that any individual satellites in a multi-satellite system will experience a failure of those maneuvering capabilities. Should we accept applicant's targeted reliability at face value, absent any evidence emerging to the contrary? Alternatively, are there methods for assessing proposed reliability rates or determining whether certain failure rates may raise concerns with collision risk? For purposes of developing a threshold or safe harbor, should the Commission ask applicants to assume a certain maneuverability failure rate when calculating total collision risk? An example of this would be if in processing applications, systems having a total collision probability of less than 0.001, calculated assuming a 10% failure of maneuvering capability, are considered low risk for total collision probability and thus deemed not to need any further analysis with respect to collision risk. We seek comment on this type of approach, whereby we consider an assumed failure rate value for purposes of a safe harbor, rather than the applicant's expected failure rate, since additional information may be required to support an expected maneuvering failure rate. We also seek comment on what might be a reasonable maneuverability failure rate for establishing a safe harbor, whether based upon an assumed reliability or expected reliability. Additionally, we ask how the collision risk associated with any failed satellites should be assessed. For example, should it be assumed that the maneuvering capability fails in the deployment orbit, in the orbit that presents the worst-case in terms of collision risk, some combination of both, or perhaps a range of orbits representing the expected range and duration of satellite operations? Are there methods by which we can apply historical data concerning the typical point in a satellite mission where failures occur in order to refine any analysis.

In the event that we were to adopt some type of safe harbor approach, we seek comment on the review process for those systems that may not meet the safe harbor. One aspect of a more detailed assessment might be taking a closer look at the possible failure rate of maneuverability. As an example, if an applicant did not satisfy the safe harbor, the applicant could provide a more detailed demonstration that its actual failure rate for its maneuvering capabilities is expected to be significantly lower than the assumed rate of the safe harbor. We seek comment. If the system is a larger one that will have multiple deployments, one approach could be to include a license condition that would require the applicant to provide additional demonstrations if the actual failure rate for the initial deployments is substantially higher than the expected failure rate expressed in its application. We seek comment on this approach and on other alternatives for assessing an expected failure rate on a more detailed basis.

We also seek comment on other aspects of a potentially more detailed review process for NGSO systems that cannot meet a particular safe harbor. Are there higher fidelity analyses that could provide the Commission with greater assurance that the risks are acceptable? Should applicants in these cases provide additional detail on the types of alternatives considered when designing their system, or measures that will be taken to reduce the total risk of collision? What measures might correlate with lower risk? Are there specific measures that can be specified in a rule, with a goal of minimizing the need for a case-by-case approach?

Some commenters suggest that operators may attempt to disguise the true size of their systems in order to accept risk in excess of any total or aggregate collision risk benchmark. Should we consider establishing additional rules, such as attribution rules, to address this concern, or could it can be adequately addressed on a case-by-case basis? In our experience, the operational characteristics of an application are often enough to indicate whether specific space stations are part of the same system or not, and we seek comment on addressing this issue through rule provisions at this time.

C. Maneuverability Above a Certain Altitude in LEO

In the Notice, the Commission sought comment on whether to adopt a requirement that all NGSO satellites

this 100-year value in calculating probability of collision on a per-satellite basis. *See also* Aerospace Comments at 8 (limiting the period of assessing collision probability to a finite time such as 100 years will make assessment feasible for satellites that have an orbital lifetime greater than 100 years).

[4] We note that any provisions regarding replacement satellites would only apply to systems authorized under part 25, excluding satellites licensed under the streamlined process, since replacement satellites are not contemplated as part of either a part 5 experimental or part 97 amateur space station authorization, or as part of the streamlined small satellite processes. Under the Part 25 rule, technically identical replacement satellites can be deployed without any limitation during a license term in order to maintain the authorized number of operational satellites. 47 CFR 25.113(i).

planning to operate above a particular altitude have propulsion capabilities reserved for station-keeping and to enable collision avoidance maneuvers, regardless of whether propulsion is necessary to de-orbit within 25 years. We received a number of comments suggesting that all NGSO satellites or systems deployed above 400 km in the LEO region should have the capability to maneuver sufficient to conduct collision avoidance during the time when the spacecraft are located above 400 km. We seek comment on adopting such a requirement, including the costs and benefits of such a requirement. Would requiring maneuverability above a particular altitude help to ensure that the burden for conducting collision avoidance maneuvers is more evenly distributed among operators, since all Commission-authorized satellites would have some collision avoidance capability when operating in the upper part of the LEO region? To what extent would such a requirement enhance space safety in the LEO region?

We recognize that the costs and benefits of this type of approach are likely to be contingent to some extent on the altitude selected as the cut-off for maneuvering capabilities. While the majority of commenters who agreed that a requirement was necessary suggested 400 km as an appropriate cut-off, some parties suggested alternative altitudes, such as 600 or 650 kilometers. We seek comment on these various options. We observe that in the Small Satellite Order, the Commission decided to adopt a 600 km cut-off for a propulsion requirement, but also that the Commission explicitly left open the topic for further discussion as part of this proceeding, stating that broader concerns about a safe operating environment in the LEO region, as well as issues related to satellites transiting through the ISS orbit would be addressed in this proceeding.[5] Some parties supporting a higher cut-off altitude note that academic and other research satellites, as well as commercial systems of small satellites, including CubeSats, are often deployed to altitudes between 400 km and 600 km. These commenters are generally concerned with the impact of a rule on the utility of CubeSats and on low-cost missions such as academic missions, since such small satellites may not have the volume or electrical capacity to support a propulsion system. Other commenters point out that a 400 km cutoff correlates with the approximate altitude where the ISS operates, and we seek comment on the extent to which a maneuverability requirement could help operators readily avoid the ISS, and thereby minimize the number of collision avoidance maneuvers that would need to be undertaken by the ISS. If we were to adopt a requirement tied to the operations of the ISS, we seek comment on requiring maneuverability during any period when satellites are ''located in the LEO region in an orbit with an apogee above 400 km,'' [6] for example, or whether there would be an alternative way to specify a cut-off orbital altitude. We observe that objects deployed below 400 km will typically re-enter Earth's atmosphere in a very short time, within a few years at most, and in some cases CubeSats are deployed from the ISS, spending their mission below that altitude. We seek comment on balancing the potential benefits associated with requiring maneuverability for spacecraft located above 400 km with the potential impact to certain categories of satellite missions.

We also seek comment on whether the impact of a maneuverability requirement on certain small satellite missions could be minimized, such as through a gradual phase-in of a maneuverability requirement, with a grandfathering period of several years to accommodate those satellites already in advanced design and construction stages. As technology continues to develop, is it increasingly feasible that even very small satellites could eventually accommodate propulsion systems or other generally reliable maneuvering capabilities? Alternatively, should we only apply such a requirement to larger systems of satellites, 100 or more for example, so that the number of non-maneuverable satellites overall above the ISS would be decreased without impacting academic and research missions or small commercial systems? Or should we provide a blanket exception for certain categories of satellites?

Additionally, we seek comment on what types of maneuverability could be deemed sufficient to reliably conduct collision avoidance maneuvers for purposes of this type of rule. For example, comments from NASA suggest that space stations using differential drag may not in some instances be able to reliably perform collision avoidance, but other commenters suggest that differential drag should be deemed sufficient. Some parties suggest that the Commission adopt a particular performance-based threshold for maneuverability to ensure that satellites are capable of changing their trajectory to avoid collisions. For example, Amazon suggests that satellites should be capable of maneuvering at least 5 km within 48 hours of receiving a conjunction warning. We seek comment on whether there is a performance-based objective or other bright-line rule with respect to collision avoidance capabilities that the Commission could adopt that would provide certainty to applicants regarding their ability to satisfy any requirements in this area. Is the Amazon proposal in line with the type of maneuverability sufficient to conduct effective collision avoidance, or is a different demonstration of maneuverability appropriate? Should we consider how far in advance an operator would need to act if they deem a particular conjunction warning actionable? Do those operators with differential drag capabilities in fact use those capabilities to perform collision avoidance? Are there other indicia, such as ability of an operator to obtain accurate positional information for its satellites, that should be considered in assessing an applicant's ability to maneuver their satellites to avoid a collision? Is a bright line rule possible related to ''effective'' maneuverability, or a safe harbor provision? If case-by-case analysis is necessary, what type of analysis and/or supporting information should applicants provide to the Commission in order to facilitate review?

It is our understanding that on occasion a spacecraft will visit the ISS on a resupply mission, for example, then undock with the ISS and raise the spacecraft orbit to above the ISS before deploying satellites. If the Commission were to adopt a maneuverability requirement for space stations above 400 km, we seek comment on adopting a special exception for these types of missions, or addressing them on an ad hoc basis through the waiver process. We could consider factors such as whether these operations are already closely coordinated with NASA vis-à-vis the ISS, and are sufficiently unique that they are unlikely to result in a large numbers of non-maneuverable objects at altitudes above the ISS. We seek comment on these and any other relevant factors in evaluating

[5] *Small Satellite Order,* 34 FCC Rcd at 10392, 10394, 10395–96, paras. 42, 46, 48 Accordingly, we do not believe further consideration of the topic as part of this proceeding, including consideration of an altitude cut-off below 600 km, conflicts with the Commission's determination in the *Small Satellite Order.*

[6] For objects orbiting the Earth, the point in orbit that the object is farthest from the Earth is known as its ''apogee.'' The point in orbit that the object is closest to the Earth is known as the object's ''perigee.'' These terms are used in several places in part 25 of our rules. *See, e.g.,* 47 CFR 25.114(6).

exemptions or waiver requests for these special circumstances.

D. Post-Mission Orbital Lifetime

In the Notice, the Commission inquired 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. The 25-year benchmark has been applied in Commission licensing decisions for NGSO systems. The NASA Standard and ODMSP specify a maximum 25-year post-mission orbital lifetime, with the 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.'' Most commenters support a reduction in the 25-year benchmark as applicable to non-Federal systems, but others suggest that a 25-year benchmark is sufficient. We seek comment on how to apply the ODMSP guidance that the post-mission lifetime be ''as short as practicable but no more than 25 years.'' Incorporating the 25-year metric into our rules may not incentivize commercial and other non-Federal operators to limit the post-mission orbital lifetime to ''as short as practicable.'' We ask whether a maximum 25-year limit on post-mission orbital lifetime would provide operators with any incentive to shorten post-mission time in orbit, or whether another approach might be preferable to encourage shorter post-mission orbital lifetimes to the extent possible.

As an initial matter, in the Order we observed that specifying post-mission orbital lifetime may be unnecessary for those satellites that would have maneuverability during the period when they are located above 400 km or for those satellites deploying and operating below 400 km, so any rule we adopt could apply just to those satellites in the Low Earth Orbit region not meeting those descriptions. Accordingly, if the Commission were to adopt the maneuverability requirements specified above that would apply to all satellites, we believe that it may be unnecessary to adopt a rule setting an upper limit for post-mission orbital lifetime for space stations in the LEO region. We believe that if maneuverability were required for space stations located above 400 km, or 600 km, for example, space stations will re-enter Earth's atmosphere ''as soon as practicable,'' and well within 25 years, either because the space station already planned to operate below the specified altitude from which it would re-enter in a few years, or because the space station would be maneuvered down to an altitude below 400 km or 600 km, from which it would reenter within a few years. We seek comment. This approach has the benefit of being consistent with a shorter than 25-year post-mission disposal lifetime for spacecraft being disposed of by atmospheric re-entry, and is therefore consistent with the view of many commenters that acceptable post-mission disposal lifetimes should be reduced below 25 years for LEO spacecraft.

If there were some limited scenarios in which spacecraft with maneuverability will remain in orbit for significant amounts of time following the conclusion of the mission, more than five years, for example, we seek comment on whether the Commission should seek more information from the operator regarding the planned post-mission disposal lifetime, such as the reliability of collision avoidance during that extended period. Is there another approach that the Commission should take in such circumstances? Would these scenarios be sufficiently unlikely that a case-by-case approach would be reasonable, or is there a bright-line rule that should apply in what we believe would be these limited circumstances?

If the Commission does not adopt a maneuverability requirement of the type described above, we seek comment on what should be incorporated into the Commission's rules regarding post-mission lifetime for space stations disposed of by atmospheric reentry that would not otherwise re-enter within a short period of time either because of maneuverability or very low deployment/operational altitude. We note that some commenters to the Notice suggest that post-mission orbital lifetimes on the order of five years may be appropriate in many cases. Some commenters also argue that the Commission should avoid adopting a ''one-size-fits all'' rule for post-mission orbital lifetime. Taking into consideration these views, should we encourage operators to dispose of their spacecraft ''as soon as practicable'' by adopting a presumptively acceptable post-mission orbital lifetime of five years, for example, but allow applicants to provide additional demonstrations in support of a longer post-mission lifetime in circumstances when they are unable to achieve a five-year disposal? Is five years the right length of time for this type of a safe-harbor provision? Demonstrations in support of a longer post-mission lifetime could include information demonstrating that the applicant considered reasonable alternatives, as well as information regarding planned deployment orbit, and the ratio of the mission lifetime to the post-mission lifetime. Would this type of safe harbor approach provide sufficient certainty to applicants will enabling flexibility? Using the ODMSP guideline, what factors should the Commission consider in determining whether a particular post-mission orbital lifetime is ''as short as practicable?'' Or, should we simply 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?

E. Casualty Risk Assessment

Casualty Risk and Design for Demise or Targeted Re-entry. The revised ODMSP states that for those spacecraft disposed of by re-entry into Earth's atmosphere (either by disposal maneuver or using atmospheric drag alone) the risk of human casualty from surviving components with impact kinetic energies greater than 15 joules should be less than 0.0001 (1 in 10,000). The ODMSP also states that ''[d]esign-for-demise and other measures, including reusability and targeted reentry away from landmasses, to further reduce reentry human casualty risk should be considered.'' The Commission has long encouraged satellite designers to consider ''design for demise'' when choosing materials for satellite construction—and we observe that in some instances it may be relatively easy for a satellite design to select materials that will fully burn up in the atmosphere or have impact kinetic energies of less than 15 joules.

Given the guidance in the ODMSP, we seek comment on whether we should adopt additional rule revisions concerning strategies to lower casualty risk. For example, we could adopt a presumptively acceptable (*i.e.,* safe harbor) human casualty risk threshold of zero—achievable through either design for demise or planned targeted reentry, and only require additional information from applicants regarding casualty risk such as a description of whether the applicants had considered such strategies to lower casualty risk, where the calculated casualty risk is greater than zero. Under this approach, the Commission could approve satellites with casualty risk up to the maximum of 1 in 10,000, but asking applicants to provide additional information when the calculated casualty risk is greater than zero could help to ensure that applicants are considering strategies such as design for demise and targeted

re-entry, consistent with the ODMSP. We seek comment on the pros and cons of such an approach for ensuring that operators are not unnecessarily running casualty risk. As an alternative, are there other safe harbor approaches or bright-line rules with respect to design for demise and targeted re-entry that could be adopted by the Commission?

Cumulative Casualty Risk. We also seek to develop the record further on consideration of casualty risk on a system-wide basis. In response to the Notice, some commenters raised concerns with consideration of casualty risk on an aggregate basis. As noted, the revised ODMSP states, with respect to ''large constellations,'' that cumulative re-entry human casualty risk should be limited. Consistent with this guidance, we observe that large constellations could raise additional concerns about human casualty risk when calculated cumulatively for all the satellites in the constellation, even if each individual satellite has a casualty risk that is less than 1 in 10,000. While these concerns can in many cases be addressed through designing satellites for demise and direct re-entry strategies, we seek comment on reviewing the cumulative risk associated with larger systems to determine if such systems have in fact limited cumulative risk. We seek comment on whether there is a particular metric we should apply to multi-satellite systems? Should a cumulative metric apply based on the number of satellites in the system, similar to the ODMSP, which defines a ''large constellation'' as more than 100 satellites? Should the number of satellites include consideration of replacement/replenishment satellites over a 15-year license term? One approach could be a safe harbor similar to some of the concepts described above, wherein a system satisfying a 1 in 10,000, or other risk metric system-wide would satisfy the safe harbor threshold, such that no further analysis of risk would be required We seek comment on this safe harbor approach and a reasonable risk metric for a safe harbor. For systems not satisfying the safe harbor, applicants could provide the Commission with additional demonstrations that the applicants have limited the cumulative casualty risk associated with the system. In assessing these demonstrations, the Commission could consider factors such as the total number of satellites, the per-satellite casualty risk, and whether the applicant has considered factors such as targeted disposal—and, if so—the expected reliability of targeted disposal. We seek comment on this approach, and how the Commission should consider these or other factors in assessing cumulative casualty risk. Alternatively, should the Commission try to adopt a bright-line rule applicable in these cases, or is there a maximum cumulative risk above which the Commission should not authorize a system? Several commenters suggest that we consider a per-year or annualized casualty risk rate approach, and we alternatively seek comment on this approach and how it might be implemented as part of the licensing process. Similar to the discussion above regarding total collision risk, we additionally seek comment on whether we need to adopt attribution rules or other rules to address a situation where operators may attempt to disguise the true size of their systems in order to accept risk in excess of any cumulative risk benchmark.

F. Indemnification

In the Notice, we sought comment on the adoption of an indemnification requirement as part of a broader discussion of liability issues and economic incentives. In response to concerns and questions expressed by various commenters, we seek additional comments on this issue in order to obtain a fuller record. We also seek comment on whether any indemnification requirement should be addressed as a license condition and affirmed as part of the application process rather than as a separate agreement following licensing in order to address concerns raised by some commenters concerning the details of implementation.

As the Commission specified in the Notice and previously explained in detail in the 2004 Orbital Debris Order, under international law, the United States government could potentially be presented with a claim for damage resulting from private satellite operations. Specifically, the United States is party to two international treaties addressing liability arising from activities in outer space—the Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies (Outer Space Treaty) and the Convention on International Liability for Damage Caused by a Space Object (Liability Convention). The Outer Space Treaty and Liability Convention, were signed by the United States and ratified by Congress, and thus have the force and effect of federal law. Article VI of the Outer Space Treaty states in part that, ''State Parties to the Treaty shall bear international responsibility for national activities in outer space . . . whether such activities are carried on by governmental agencies or by non-governmental entities,'' and that, ''[t]he activities of non-governmental entities in outer space . . . shall require authorization and continuing supervision by the appropriate State Party to the Treaty.'' Under Article VII of the Outer Space Treaty, a State Party to the Treaty that ''launches or procures the launching of an object into outer space . . . 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 its natural or juridical persons by such object or its component parts on the Earth, in air or in outer space[.]'' [7] The Liability Convention specifies that liability rests with a ''launching state,'' which is defined as either (1) a State which launches or procures the launching of a space object, or (2) a State from whose territory or facility a space object is launched. The Liability Convention contains both strict liability (Article II) and fault-based liability (Article III) provisions. The launching state is strictly liable for damage caused by its space object on the surface of the earth or to an aircraft in flight. In the event of damage being caused elsewhere than on the surface of the earth to a space object of one launching state or to persons or property on board such a space object by a space object of another launching state, the launching state ''shall be liable only if the damage is due to its fault or the fault of persons for whom it is responsible.'' The treaty also provides for joint and several liability in certain circumstances, including where more than one State can be considered a ''launching state.''

Regardless of whether a particular claim results in a payment of compensation, the United States would incur costs in addressing such claims, and those costs would be borne by U.S. taxpayers. Thus, there is a connection between the Commission's issuance of a license for satellite communications and exposure of the U.S. government to claims under international law, particularly because the Commission is often the only agency reviewing an operator's plans for on-orbit operations and orbital debris mitigation, including post-mission disposal activities. Under these circumstances, conditioning Commission authorization on indemnification of the U.S. government

[7] Outer Space Treaty, Article VII. As the Commission noted in the 2004 *Orbital Debris Order,* the definition of ''space object'' includes ''component parts of a space object,'' which would arguably incorporate orbital debris resulting from satellite operations. *Orbital Debris Order,* 19 FCC Rcd at 11612–13, para. 109.

may be a reasonable step, given the absence of protections under international law of the protection from liability under U.S. law related to a licensing authority's exercise of its discretionary functions. We seek comment on these considerations.

Some commenters question whether an indemnification requirement is necessary because the U.S. government could initiate a civil action to secure recovery from the relevant operator. Boeing states that the U.S. could recover under a claim of contribution, claim of equitable tort indemnification, or claim of equitable apportionment. It does not appear that the theories Boeing presents have been tested in the context of the treaty-based liability involved here. We seek comment and any supporting legal analysis concerning whether these alternative avenues are in fact an available means for recovery with respect to the full range of claims that might arise under international law related to space activities. If so, and as observed by some commenters, an FCC indemnification requirement may be an unnecessary formal step to acknowledge an existing legal obligation of licensees engaged in space activities. We seek comment on this view. We also seek comment and supporting legal analysis on whether there are any applicable limitations on liability inherent in these alternative approaches to recovery. For example, are there any provisions in the governing laws that express a legislative intent to limit or exempt from liability activities that may trigger a claim under international law or that are extra-territorial in scope?

Several commenters request that the Commission provide additional legal analysis regarding Commission authority for adopting an indemnification requirement, or otherwise question the Commission's jurisdiction in this area.[8] As discussed in the Order, our conclusion is that the Commission has authority, pursuant to the Communications Act, to review and assess orbital debris mitigation plans as part of its public interest analysis in issuing licenses for space station communications. As noted, Title III of the Act provides for the licensing of radio communications, including satellite communications, only upon a finding that the ''public convenience, interest, or necessity will be served thereby.'' We consider an applicant's plan to mitigate orbital debris risks to be a relevant public interest factor in approving an applicant's space station operations, and the analysis undertaken by the Commission is designed to ensure that space systems reviewed by the Commission have sufficient plans to mitigate orbital debris, consistent with the public interest. We seek additional comment on whether the same sources of authority provide a sufficient basis for an indemnification requirement. As a policy matter, a clear indemnification requirement may strengthen the incentives of applicants to mitigate risk, by ensuring that licensee's consider in their planning and decision making the costs that could be associated with any claim brought under the relevant Outer Space Treaties. In this way, ensuring that the licensee has agreed to indemnify the U.S. government in those circumstances could be viewed as an economic aspect of ensuring that the more technical aspects of orbital debris mitigation are fully considered by licensees. Additionally, incorporating indemnification as part of a sufficient orbital debris mitigation plan may further the public interest by ensuring that U.S. taxpayers are not ultimately responsible for defraying costs resulting from the activities of non-government entities in the event of a claim under international law. We seek comment on these questions.

Several commenters to the Notice argue that in other regulatory contexts, Congress has directly addressed the role of regulatory agencies with respect to liability and indemnification issues, but argue that here, Congress has not provided the Commission with specific authority concerning indemnification. We seek comment and supporting legal analysis on whether these expressions of legislative intent preclude the adoption of an indemnification requirement for FCC. We observe that in several examples cited by commenters, Congress provided for indemnification related to specific types of activities and did not address FCC-licensed activities. We also note that in some instances, Congress has sanctioned acceptance of liability by the U.S. government within certain ranges. An example of this is the liability risk-sharing regime for commercial space transportation, addressed by statute and implemented by the FAA. Under the statute, launch or re-entry licensees obtain insurance to cover claims of third parties against launch or reentry participants, including the licensee, its customer, and the U.S. government and agencies and any contractors or subcontractors. The FAA sets insurance requirements based upon the FAA's determination of the maximum probable loss that would result from the licensed launch or reentry activities, within statutory ceilings. Subject to appropriations, the U.S. government may pay successful third-party liability claims in excess of the required maximum probable loss-based insurance, up to $1.5 billion (as adjusted for post-1989 inflation) above the amount of the maximum probable loss-based insurance. For claims in excess of the maximum probable loss-based insurance plus government indemnification, the licensee or legally liable party is responsible. We seek comment and any supporting legal analysis on whether the fact that Congress addressed third-party liability as it relates to, for example, launches authorized by the FAA, implies that Congress explicitly or implicitly precluded the Commission from addressing liability issues related its regulation under Title III, including review of on-orbit and disposal activities. We observe that the liability regime for launch activities specified by statute and in FAA rules does not appear to address post-launch issues arising from damages caused by a ''launch payload'' after a nominal launch is concluded.

In response to the Notice, Intelsat requests that the Commission conduct an analysis of whether other governmental agencies would be better suited to decide whether to impose indemnification requirements on space station licensees in the first instance. Specifically, Intelsat requests that we conduct an analysis with respect to the Department of State. We do not believe it is the Commission's role to opine on the suitability of agencies for particular activities. However, we seek comment on whether there are any authorities granted by statute or developed through regulation, in addition to those already identified in the record, that may have relevance to a possible FCC indemnification requirement. SIA also raises the question of whether there should be a distinction in an indemnification provision between liability based on fault and liability that results from the strict liability provision of the Outer Space Treaties. The Liability Convention includes some fault-based provisions, and some strict liability provisions (for damage caused

[8] *See* Intelsat Comments at 12; Space Logistics Comments at 13; Intelsat Comments at 12; Boeing Comments at 37–38; SIA Comments at 9; Telesat Comments at 11. *See also* SIA Apr. 15, 2020 *Ex Parte* Letter at 2 (stating that the Commission ''cites no statutory authority'' for this requirement); Space Logistics Comments at 13 (stating that the Commission cannot promulgate insurance or indemnification requirements under ancillary authority). Since we focus on the authority for the Commission to adopt an indemnification requirement as deriving from the same authority of the Commission to review debris mitigation plans, we do not address the issue of ancillary authority, but to the extent that commenters believe this issue may be relevant, we invite comment.

by its space object on the surface of the earth or to an aircraft in flight). For a claim brought under the Outer Space Treaties, a State party to the treaty could be found liable based upon the particular provision at issue, whether that provision was fault-based, or strict liability—in accordance with the terms of the treaty. SIA asks, in effect, whether, for strict liability, there should also be a determination of fault on the part of the non-governmental operator as a pre-condition to requiring indemnification, and if so, how such a determination might be made. We seek comment on the questions raised by SIA.

Costs. Most of the commenters addressing this issue in response to the Notice argue that the costs of the indemnification requirement to operators would outweigh any potential benefits. Some commenters argue that such a requirement would be contrary to U.S. national interests in promoting innovation and competitiveness and ensuring that the Unites States is the jurisdiction of choice for space activities. Along these lines, some parties suggest that an indemnification requirement could lead to forum shopping, wherein entities apply for licenses from foreign administrations rather than the United States. Some parties also ask the Commission consider including a cap on a U.S. licensee's potential liability, both in terms of timing and duration. We make several observations and seek additional comment on these issues, noting that we also seek to foster innovation and to encourage the development of new services and technology, and through the indemnification requirement would seek to achieve the goal of limiting taxpayer liability at a relatively minimal cost for responsible operators.

We seek comment on the actual costs that operators believe they will incur as a result of this requirement as proposed in the draft rule (*i.e.,* without adopting a ''cap'' on liability), including the costs to those entities that are publicly traded. We observe that operators would have the choice whether or not to purchase insurance to cover certain liabilities, depending on individualized needs. Although the Order does not adopt an insurance requirement at this time, we seek comment on the availability and costs of insurance, noting that some other countries require insurance for the types of activities that would be covered by the proposed indemnification requirement. Some parties characterize the uncertainty associated with liability as an issue from the perspective of filings with the Securities and Exchange Commission (SEC). Additionally, we seek comment on potential costs of indemnification for non-commercial entities, such as those that may be applying under the Commission's experimental or amateur rules, while observing that the operation of a space station, may present the same risks in terms of potential U.S. government liability regardless of whether the operator is an amateur, non-profit, commercial entity, etc.

We observe that several other countries require indemnification and insurance as part of their licensing processes. We seek comment and legal analysis on the extent to which indemnification and insurance requirements are used in the regulatory structures of other countries, and the extent to which these requirements are a substantial or dominant consideration as operators select the country in which they base their ''regulatory home.''

We seek comment on a concern raised by a number of commenters related to capping potential liability for a U.S. licensee under any indemnification requirement. We seek comment on whether a cap on the amount of any indemnification requirement, as included in a number of indemnification requirements adopted by other countries, would serve the public interest. We also seek comment on whether, to the extent any such cap implies that the Commission is making a determination concerning the scope of risk accepted on behalf of the United States, such a determination is within the scope of the Commission's authority. Additionally, if an upper limit on the indemnification were to be adopted, we seek comment on a value for that upper limit. We observe that the United Kingdom, for example, has adopted a cap of 60 million euros (per-satellite, since satellites are licensed individually) that applies to those missions not considered higher-risk. We seek comment on whether a comparable amount, converted to U.S. dollars, would be a reasonable cap on indemnification of the U.S. government by licensees in these circumstances.

Implementation. In the Notice, the Commission sought comment on the means to execute documents related to indemnification, and proposed rule text implementing the requirement. After further consideration and in response to comments that noted some potential issues with the procedures proposed, we are seeking comment on whether an indemnification requirement should be implemented through license condition, or through a document provided by the licensee prior to license grant. For example, should any indemnification requirement be implemented by having applicants include a signed statement regarding indemnification, which will be standardized, along with the other information provided in their application. We seek comment on this proposal and on any specific terms or conditions of indemnification that might be appropriate. In describing the obligation of licensees in our application rules, we propose language that is similar to what we proposed in the Notice, but in response to comments make clear that any indemnification obligation would be associated with claims brought under the Outer Space Treaties.

We also seek comment on any implementation issues related to any adoption of an indemnification requirements. As a possible approach, applicants whose applications for U.S. licenses are pending at the time the rule becomes effective could be required to file an amendment with the indemnification statement. We seek comment. We also seek comment on the treatment that should be afforded to existing licensees, including in the event of license modification filed after any requirement is adopted. Additionally, we seek comment on the appropriate approach for assignments and transfers of licenses.

Additionally, we seek comment on alternative implementation arrangements. SIA suggests that it may be appropriate for satellites in orbit or under construction as of November 15, 2018, the date the Notice was adopted, to be grandfathered. We seek comment on whether any indemnification requirement should be associated with the timing of licensing or construction of particular satellites, rather than with the timing of when the license is granted, or whether there are other benchmarks that should define applicability of any requirement adopted.

Market Access. We seek comment on the issue of indemnification by market access grantees, in other words, non-U.S.-licensed space stations granted access to the United States market.[9] In the majority of instances we would not require an indemnification agreement for a non-U.S.-licensed operator authorized for U.S. market access, as the relevant countries will have taken actions that associate the satellite operations with their national regulatory structure and will have identified the relevant State parties to the Outer Space Treaty. However, there are some cases

[9] We note that this could also include an application filed by an earth station operator requesting communications with a non-U.S.-licensed satellite, either under parts 5 or 25.

in which the goals of any indemnification requirement might be served by requiring indemnification from operators of satellites granted market access. For example, some countries submit filings to the ITU on behalf of a satellite operator, but decline to take any responsibility with respect to the provisions of the Outer Space Treaties. In a situation where there is no other country taking such responsibility, and the applicant has substantial connections to the United States, to the point that those predominate perception of the country that may be responsible for supervision, indemnification may be appropriate. We seek comment on whether in these cases, involving so-called ''flag of convenience,'' requiring indemnification may be appropriate for licensing purposes. We also seek comment on any specific factual and regulatory indicators that should be used to identify such cases. Should factors such as registration of the satellite with the United Nations, ownership and operation of the space station by a U.S. company from a U.S. network control center, or other factors be considered?

Other Unique Implementations. We observe that in some instances the United States, through a government contract promulgated by an agency or other entity (*e.g.,* NASA), may have agreed to indemnify an operator against certain claims. In these instances where an operator believes that the United States has indemnified the operator, we propose that the applicant could provide a demonstration of these circumstances, which would provide a basis for exempting the applicant from the indemnification requirement. We seek comment on this and any other unique situations in which an indemnification requirement might run contrary to allocations of responsibility between governmental and non-governmental actors, established in law or regulation. As an example, University Small-Satellite Researchers suggest that in some cases state institutions, such as universities, may not be able to accept liability and risk for third parties due to sovereign immunity provisions. We seek comment on any possible limitations in this area that should be considered. To the extent that the bar on indemnification of third parties is associated with concerns about waiving governmental immunity, we observe that the third party in this instance would be the federal government, and we believe this may present a different factual scenario for universities when it comes to waiving governmental immunity. However, we seek comment and supporting legal analysis on this point.

Additionally, AMSAT and ARRL suggest that we add the word ''owners'' to an indemnification provision in the amateur rules, so that the owners of an amateur satellite could be the indemnifying parties rather than the individual amateur licensees. We seek comment on this approach, and also on how to define ''owner'' for purposes of the amateur rules. We further seek comment on how we would ensure that the indemnification requirement remains valid in the event that the ownership changes for an amateur space station.

G. Performance Bond for Successful Disposal

In the Notice, the Commission had mentioned bonds as an example of an economic incentive, but had not made a specific proposal. In this Further Notice, we seek comment on whether a performance bond tied to successful post-mission disposal may be in the public interest, as applicable to space station licensees. Essentially, we seek comment on adopting a requirement that space station licensees post a surety bond, similar to what they already do for spectrum use, that would be returned once the space stations authorized have successfully completed post-mission disposal. What are the costs and benefits of a performance bond approach?

In response to the mention of a post-mission disposal bond in the Notice, some commenters expressed disagreement with the idea. According to Eutelsat, a performance bond requirement related to satellite end-of-life would cover what are typically unanticipated events that occur despite a proponent's best effort, and collection under a performance bond would not mitigate the result of such unanticipated events. We believe this topic is worth further discussion, however, and observe that there may be benefits to a performance bond, despite the fact that even where the bond is forfeited the unsuccessful satellites would remain in orbit. Several commenters to the Notice suggest that there is difficulty in ensuring that entities follow through with their planned orbital debris mitigation plan. SpaceX, for example, states that once the government adopts verifiable requirements, the government should tie its rules to a rigorous enforcement framework that penalizes the generation of debris and reflects the seriousness of the harm such debris inflicts. We observe, first, that while anomalous events are unanticipated, there are steps that an operator can take to reduce the probability of anomalous events, including testing, and design redundancies, and second, that with a bond in place tied to successful disposal, an operator may decide to begin end-of-life disposal procedures at an earlier stage if the satellite begins experiencing technical issues. We seek comment, however, on how to address situations where there may be a satellite anomaly or the disposal plan changes for reasons outside of an operator's control. We also observe that further developing the record could contribute to further conversations about how to fund future efforts toward active debris removal.[10] We seek comment on these potential benefits and on generally whether a post-mission disposal bond could help to ensure that operators comply with orbital debris mitigation best practices.

Additionally, we seek comment on the impact of a disposal bond on U.S. licensing of satellite systems and U.S. satellite industry innovation, including innovation by smaller providers, entrepreneurs, and new entrants to the satellite industry. We recognize that there may be complexities in structuring a bond that would cover satellite end-of-life, and that maintaining a bond over a longer period of time than is required our current bond regime could potentially result in increased costs to licensees. We seek comment. A disposal bond may need to be maintained for 15 years or longer, depending on the specific disposal plans for the satellite or system, and we seek comment on whether there are ways of structuring a bond requirement to reduce costs to licensees. Are there different issues that need to be considered with a longer time period? What happens if the ownership of the satellite/license changes over time? Although a performance bond tailored to this scenario may not currently exist, we also seek comment on whether a Commission rule could help to drive the market toward the creation of an

[10] The viability of forfeited performance bonds as a source of funding for active cleanup of debris in orbit is outside the scope of this proceeding. *See, e.g.,* ORBCOMM Comments at 20 (stating that it is not clear if the Commission could ever establish a program to use forfeited de-orbit bonds to pay for the retrieval of spacecraft that were not successfully de-orbited); Sirius XM Comments at 10 (stating that fees obtained from penalizing rogue operators could be used to fund debris removal efforts); Satellite DFR Comments at 4 (the Commission or other regulatory entity should develop and fund a comprehensive program to begin removing debris from Earth orbit); Secure World Foundation Comments at 9 (stating that the removal of debris will need to be funded by governments—and stating that a government-supported technology development program, coupled with government purchase of service contracts, is the best way to develop this capability).

appropriate bond instrument that would allow operators to satisfy this rule. Additionally, we seek comment on what other countries doing to ensure post-mission disposal. Would adoption of a bond requirement encourage entities to seek licenses outside the United States?

In addition to the orbital debris mitigation plan submitted by operators at the application-stage, there are a number of decisions by operators during and after the spacecraft mission which should be made in alignment with orbital debris mitigation best practices and culminate in successful disposal of the spacecraft. Are application-stage requirements sufficient in all cases to incentivize operators to make decisions consistent with orbital debris mitigation best practices throughout the mission and post-mission lifetime of the spacecraft? We seek comment on whether a performance bond can help to ensure post-mission disposal satellite reliability in instances where it may be difficult to assess, for example, where the operator's application-stage demonstration includes ensuring reliability through extensive testing of its satellites. Would a performance bond be another way to ensure the accuracy of the licensee's reliability estimate for post-mission disposal and to further discourage deployments that would potentially result in negative long-term impacts to the orbital environment? Should a potential bond requirement apply to both NGSO and GSO satellite licensees?

We also seek comment on some basic implementation issues that would be associated with a disposal bond requirement, such as the question of what constitutes a successful disposal. For NGSO systems, what factors would be considered in determining an appropriate upfront amount for the bond? To what extent would factors such as satellite mass, number of satellites, expected orbital lifetime of a failed satellite, or collision probability of a failed satellite over time be considered, and how would those factors be weighted? [11] Taking into consideration both the costs to licensees of a full or partially forfeited bond and the costs to future space operations associated with having failed satellites remain on orbit, what is a reasonable amount for a surety bond for an NGSO system? As one example, we seek comment on the following formula, where the forfeited amount would be based upon any undisposed objects remaining in orbit and undisposed at the conclusion of the license term, beyond those accounted for in the licensee's calculation of the probability of successful disposal. The amount of the bond would also take into consideration the mass of the objects and the number of years that an individual undisposed satellite would remain in orbit longer than 25 years, up to a maximum of 200 years per object. We seek comment on this approach generally, and welcome comment on any alternatives to the specifics of this proposal. For the actual forfeited bond calculation for NGSO licensees, the amount could be calculated as follows:

FA = ((M–EM) * ((Y–25) * (O–E.O.))

Where FA is the forfeited amount to be paid in dollars, M is the total undisposed mass in orbit in kilograms, EM is the expected undisposed mass in orbit in kilograms, and Y is the mean of the remaining years in orbit for any individual undisposed object, up to a maximum of 200 years per object, O is the total number of undisposed objects in orbit, and E.O. is the expected number of undisposed objects in orbit. The result would be rounded to the nearest $10,000. We observe that this formulation would result in a forfeited bond of zero for any space station or system deploying into an orbit in which, using conservative projections for solar activity, atmospheric drag will limit the spacecraft's time in orbit to 25 years or less. In this example, therefore, licensees of space stations fitting this description would not be required to post a surety bond. We seek comment. In addition, we seek comment on whether we should provide an exemption from the requirement to post a bond where the maximum forfeited bond under this formula or a different formulation would be less than a certain amount, for example, $10,000. We observe that the bond in this example would be most significant for those NGSO systems consisting of a large mass and which would have satellites remaining in orbit for a significant number of years beyond 25 years in the event of a failure. We also seek comment on whether we should incorporate the collision probability of the failed satellites over time, with a higher collision probability resulting in a higher forfeited bond.

Continuing with the example above, the initial surety bond for NGSO licensees could be calculated as follows:

BA = (TM)*((Y–25)(TO))

Where BA is the amount of the bond in dollars, TM = the total mass of the satellite system, Y = number of years that an individual satellite will remain in orbit if it fails in the deployment orbit, and TO = total number of objects in orbit. The bond amount (BA) could also be capped, for example, at a maximum of $100,000,000 for any system. We seek comment on this formula, including, whether certain variables should be modified to incorporate different factors such as individual satellite mass, as well as on the potential monetary amounts and whether those amounts are sufficient to provide an economic incentive for operators.

As a simpler alternative for NGSO systems, default could be based upon the failure to dispose according to the expected disposal reliability, or failure to dispose according to the expected disposal reliability taking into consideration satellite mass. Under this alternative, a licensee would post a bond of $10,000,000, for example, and forfeit the bond if the disposal did not satisfy the disposal reliability metric stated in the application. The amount of the initial bond could vary depending on factors such as mass, number of spacecraft, and number of years in orbit. What costs on both sides should be taken into account when determining a reasonable amount? Is, for example, $20,000 per satellite reasonable if the satellite is deployed to an orbit where it will remain for thousands of years? Should a bond be most significant for those NGSO systems consisting of a large mass and which would have satellites remaining in orbit for a significant number of years beyond 25 years in the event of a failure? We seek comment on these various alternatives, and on whether there is another approach that would incentivize NGSO operators to achieve high disposal reliability.

If a bond were applied to GSO licensees, a successful disposal could be based on disposal in accordance with § 25.283(a) of the Commission's rules within a certain period of time following the conclusion of operations, such as six months following the conclusion of operations. We seek comment on defining successful disposal for purposes of a GSO disposal bond. As one example, the bond could be forfeited based upon the length of time the space station was in orbit before it was determined that disposal could not be successfully completed. Under this approach, the longer the space station is maintained on-orbit before the attempted disposal or anomaly causing inability to dispose of the spacecraft, the higher the amount of the bond forfeited. We observe that the

[11] As one example, a surety bond could be calculated through a formula that takes into account the mean number of years on orbit for a potential failed satellite, the mean satellite mass, and the total number of satellites in the system. Such a formula could also take into account the collision probability of failed satellites over time.

longer that a GSO space station operates, generally the more susceptible that space station is to malfunction that could put successful disposal at risk. This example would take into consideration this observation, and the amount to be forfeited in the event of a failed disposal would be determined according to the following formula:

FA = $5,000,000*(Y)

Where FA is the amount to be paid in dollars, and Y is calculated as follows: If the satellite operates for less than 15 years then Y = 1; if the satellite operates between 15 and 20 years, then Y = 2; and if the satellite operates for more than 20 years, then Y = two plus the total number of operational years, minus 20. We seek comment.

As part of the above example, a GSO licensee could be required to post an initial surety bond, in the amount of, for example, $5,000,000. For each license extension thereafter, the GSO licensee would then increase the bond in an amount that would cover the additional five-year term, up to the maximum that would be forfeited if the satellite operates for that full five-year term.[12] In other words, if the operator seeks a five-year extension of the license, from 15 to 20 years, then the operator would increase the bond amount by an additional $5,000,000. We seek comment on this specific example, and on the concept of an increasing bond with successive license extensions. We also seek comment on the monetary amounts involved and whether those amounts, or alternative amounts would be sufficient to provide an economic incentive for operators. What are the factors that we should consider in setting a bond amount and structuring the bond for GSO licensees? Is there evidence to justify, for example, doubling the bond for extending a GSO satellite's license beyond 15 years or similarly, to support significant increases for each year beyond 20 years? As a simpler alternative, default could be based on whether or not the GSO licensee successfully disposed of the space station, with a single bond amount, $10,000,000 dollars, for example, due if the space station is not disposed of in accordance with the Commission's rules. We seek comments on these various alternatives, on the appropriate bond amount, and whether there is another approach that would incentivize GSO operators to achieve high disposal reliability.

We also seek comment on whether we should consider any other factors with respect to a failed disposal, such as failure to fully vent pressurized vessels, or failure to perform a targeted, controlled reentry into Earth's atmosphere. Additionally, we seek comment on the timing of a bond requirement, if one were to be adopted. For example, would it be reasonable to require licensees to post a surety bond related to post-mission disposal within 30 days following grant of their license? Or, would we require the operators to post a surety bond closer to the date of launch, for example, 90 days prior to launch? We further seek comment on how and when the Commission could make a determination that either the disposal was successful and the bond may be released or that the licensee would need to forfeit a certain amount. For example, should operators file a statement with the Commission specifying the details of the disposal, including those details relevant to determining whether the disposal was successful and to what extent?

Additionally, we seek comment on whether a bond should apply to grantees of U.S. market access. We observe that the post-mission disposal may be addressed in some instances by a different administration, and thus the post-mission disposal bond may overlap with existing requirements in this instance. If such a requirement did not apply to market access grantees, how would this impact U.S. operators? If such a requirement were to apply to both market access grantees and U.S.-licensed systems, how would this impact the availability of satellites services in the United States?

Under the NGSO example above referencing a specific formula, small-scale systems, including but not limited to those authorized under the experimental, amateur, or part 25 streamlined small satellite process are unlikely to need to post a bond, both because we would expect a typically small number of satellites in a particular system and because the deployment orbit for those types of missions often results in the spacecraft re-entering within 25 years as a result of atmospheric drag. We seek comment on whether we would still apply the bond to NGSO systems authorized under either an experimental or amateur authorization, and on whether a categorical exemption would be necessary for small systems licensed under part 25, such as under the NGSO streamlined small satellite process, since under certain formulations, those types of licensees would typically not be required to post a disposal bond as practical matter. Alternatively, if we adopt a simplified type of approach for NGSO systems that relies on the licensee meeting the disposal reliability metric indicated in the application, for example, we seek comment on the applicability of that alternative approach to experimental, amateur, or small-scale systems such as those that would be authorized through the part 25 streamlined small satellite process.

Finally, we seek comment on whether there are alternative approaches to a bond that should be considered, such as a corporate guarantee, and on the pros and cons of such alternative approaches.

Ordering Clauses

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 Further Notice of Proposed Rulemaking *is adopted*.

It is further ordered that the Commission's Consumer and Governmental Affairs Bureau, Reference Information Center, *shall send* a copy of this Further Notice of Proposed Rulemaking, including the Initial Regulatory Flexibility Analysis, to the Chief Counsel for Advocacy of the Small Business Administration.

Initial Regulatory Flexibility Analysis

As required by the Regulatory Flexibility Act of 1980, as amended (RFA), the Commission has prepared this present Initial Regulatory Flexibility Analysis (IRFA) of the possible significant economic impact on a substantial number of small entities by the policies and rules proposed in this Further Notice of Proposed Rulemaking. Written public comments are requested on this IRFA. Comments must be identified as responses to the IRFA and must be filed by the deadlines specified in the Notice for comments. The Commission will send a copy of this *FNPRM,* including this IRFA, to the Chief Counsel for Advocacy of the Small Business Administration (SBA). In addition, the *FNPRM* and IRFA (or summaries thereof) will be published in the **Federal Register**.

A. Need for, and Objectives of, the Proposed Rules

The *FNPRM* proposes several changes to 47 CFR parts 5, 25, and 97. Principally, it seeks comment on and proposes to:

(1) Include a metric in the Commission's rules regarding the probability of accidental explosions during and after the completion of satellite mission operations;

(2) Specify how the Commission will assess probability of collision with large

[12] Different increases in the bond amount for license extensions shorter than five years could also be considered.

objects and casualty risk on a system-wide basis;

(3) Adopt an applicant certification that NGSO space stations will have capability to perform collision avoidance maneuvers during any period when the space stations are located above 400 km in altitude;

(4) Adopt a requirement that space station licensees indemnify the United States against any costs associated with a claim brought under a provision of the Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies, or the Convention on International Liability for Damage Caused by Space Objects related to the facilities that are the subject of the license; and

(5) Adopt a bond requirement for space station licensees under part 25 of the Commission rules, tied to successful disposal of the spacecraft following the end of the mission.

B. Legal Basis

The proposed action is authorized under sections 1, 4(i), 301, 303, 307, 308, and 309 of the Communications Act of 1934, as amended, 47 U.S.C. 151, 154(i), 301, 303, 307, 308, and 309.

C. Description and Estimate of the Number of Small Entities to Which the Proposed Rules May 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 adoption of proposed rules. The RFA generally defines the term ''small entity'' as having the same meaning as the terms ''small business,'' ''small organization,'' and ''small governmental jurisdiction.'' In addition, the term ''small business'' has the same meaning as the term ''small business concern'' under the Small Business Act. 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). Below, we describe and estimate the number of small entity licensees that may be affected by adoption of the proposed rules.

Satellite Telecommunications and All Other Telecommunications

Satellite Telecommunications. This category 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.'' Satellite telecommunications service providers include satellite and earth station operators. The category has a small business size standard of $35 million or less in average annual receipts, under SBA rules. For this category, U.S. Census Bureau data for 2012 show that there were a total of 333 firms that operated for the entire year. Of this total, 299 firms had annual receipts of less than $25 million. Consequently, we estimate that the majority of satellite telecommunications providers are 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. 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. Establishments providing internet services or voice over internet protocol (VoIP) services via client-supplied telecommunications connections are also included in this industry. 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. For this category, U.S. Census Bureau data for 2012 show that there were 1,442 firms that operated for the entire year. Of those firms, a total of 1,400 had annual receipts less than $25 million and 15 firms had annual receipts of $25 million to $49, 999,999. Thus, the Commission estimates that the majority of ''All Other Telecommunications'' firms potentially affected by our action can be considered small. We estimate, however, that some space station applicants applying under part 25 of the Commission's rules would qualify as small entities affected by these rule changes. If the Commission were to apply the bond requirement to amateur and experimental space station licensees, then additional small entities would be affected by the rule changes.

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

The proposed rules would contain a few additional application disclosures relevant to small entities, including certification of maneuverability and demonstration regarding probability of accidental explosions. With respect to the maneuverability certification, some applicants may need to consider modifications to their satellite design and operational plans to achieve the maneuverability certification.

We observe that most small entities do not launch and operate large satellite constellations and so we believe that proposals for operators to perform certain calculations in the aggregate are not likely to be burdensome. The rules proposed require a system-level assessment to be conducted in several areas for any systems consisting of more than one space station. Some small entities may apply for and operate multiple space stations, and thus this requirement would apply to some small entities as well. However, we believe conducting these assessments is not more significant than the type of technical analysis that an applicant will already be performing in preparing its application for Commission.

The bond requirement proposed in the *FNPRM* would require part 25 space station licensees to submit a demonstration to the Commission that they have posted a bond that meets the requirements specified in the Commission's rules. The space station licensee would then need to maintain the bond over the course of the license term, until the disposal of the spacecraft. The *FNPRM* seeks comment on methods to structure the bond requirement that may reduce costs, and on whether to exempt experimental, amateur, and other categories likely to be relevant to small entities.

E. Steps Taken To Minimize Significant Economic Impact on Small Entities, and Significant Alternatives Considered

The RFA requires an agency to describe any significant, specifically small business, alternatives that it has considered in reaching its proposed 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 rules 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.''

The proposals in the *FNPRM* would further clarify the authorization process by specifying additional disclosures in the rules, thereby providing applicants, including small entities, with a more

complete view of the information that the Commission needs during a typical license or authorization process in order to adequately assess the applicant's orbital debris mitigation plan. The *FNPRM* also specifically seeks comment on the use of performance, rather than prescriptive, or design, standards in the context of the maneuverability certification.

We also seek comment on whether the impact of a maneuverability requirement on certain small satellite missions could be minimized, such as through a gradual phase-in of the requirement.

In addition to seeking comment regarding the structure of the bond, the *FNPRM* seeks comment on the appropriate monetary amount for the bond, which could affect the extent of the impact on small entities. Additionally, for NGSO licensees, the *FNPRM* seeks comment on whether default should be tied to a certain number of undisposed space stations or undisposed mass in orbit. The resolution of this question could affect the extent of the impact of default on small entities, which may in some instances have fewer NGSO space stations in orbit than large entities. The *FNPRM* seeks comment on some approaches that could eliminate a bond requirement altogether for most small entities.

F. Federal Rules That May Duplicate, Overlap, or Conflict With the Proposed Rules

None.

List of Subjects in 47 CFR Parts 5, 25, and 97

Reporting and recordkeeping requirements, Satellites.Federal Communications Commission.

Marlene Dortch,

Secretary.

Proposed Rules

For the reasons discussed in the preamble, the Federal Communications Commission proposes to amend 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.

■ 2. Amend § 5.64 by revising paragraphs (b)(3), (b)(4)(i) introductory text, (b)(4)(i)(A) and (D), (b)(7)(iv)(B)(*2*), and adding paragraph (c) to read as follows:

§ 5.64 Special provisions for satellite systems.

* * * * *

(b) * * *

(3) A statement that the space station operator has assessed and limited the probability, during and after completion of mission operations, of accidental explosions or of release of liquids that will persist in droplet form. This statement must include a demonstration that the integrated probability of debris-generating explosions for all credible failure modes of the space station (excluding small particle impacts) is less than 0.001 (1 in 1,000) during deployment and mission operations. Energy sources include chemical, pressure, and kinetic energy. This demonstration should address whether stored energy will be removed at the spacecraft's end of life, by depleting residual fuel and leaving all fuel line valves open, venting any pressurized system, leaving all batteries in a permanent discharge state, and removing any remaining source of stored energy, or through other equivalent procedures specifically disclosed in the application;

(4) * * *

(i) Where the application is for an NGSO space station or system, the following information must also be included:

(A) A demonstration that the space station operator has assessed and limited the probability of collision between any space station of the system and other large objects (10 cm or larger in diameter) during the total orbital lifetime of the space station, including any de-orbit phases, to less than 0.001 (1 in 1,000). The probability shall be calculated using the NASA Debris Assessment Software or a higher fidelity assessment tool. The collision risk may be assumed zero for a space station during any period in which the space station will be maneuvered effectively to avoid colliding with large objects. For systems consisting of multiple space stations, the statement must also include an assessment of the total probability of collision, calculated as the sum of the probability of collision associated with each individual space station. Where the total probability of collision exceeds 0.001 (1 in 1,000) assuming a 10% failure rate of any maneuvering capability at an orbit that presents the worst case for collision risk, the statement must include an additional demonstration of the expected failure rate of maneuverability, and the orbit where the operator would expect most failures to occur, and calculate the total probability of failure based on those assumptions.

* * * * *

(D) The statement must disclose the accuracy, if any, with which orbital parameters will be maintained, including apogee, perigee, inclination, and the right ascension of the ascending node(s). In the event that a system will not maintain orbital tolerances, *e.g.,* its propulsion system will not be used for orbital maintenance, that fact should be included in the debris mitigation disclosure. Such systems must also indicate the anticipated evolution over time of the orbit of the proposed satellite or satellites. All systems should describe the extent of satellite maneuverability, whether or not the space station design includes a propulsion system. For space stations deployed into the portion of the low-Earth orbit region above 400 km, the operator must certify that the space stations will be designed with the maneuvering capabilities sufficient to perform effective collision avoidance throughout the period when the space stations are above 400 km.

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(7) * * *

(iv) * * *

(B) * * *

(*2*) An assessment as to whether portions of any individual spacecraft will survive atmospheric re-entry and impact the surface of the Earth with a kinetic energy in excess of 15 joules, and demonstration that the calculated casualty risk for an individual spacecraft using the NASA Debris Assessment Software or a higher fidelity assessment tool is less than 0.0001 (1 in 10,000). For systems consisting of multiple space stations, the statement must also include an assessment of the total casualty risk associated with the system, calculated as the sum of the casualty risk associated with each individual space station. If this total casualty risk exceeds 0.0001 (1 in 10,000), the statement must also include a description of strategies considered to reduce collision risk, such as designing the satellites with materials more likely to demise upon reentry and/or targeted re-entry, and the extent to which those strategies were incorporated into the mission profile.

(c) Applicants must submit a signed statement stating that upon issuance of a license by the Commission, the licensee will be responsible for indemnifying the United States against any costs associated with a claim brought under a provision of the Treaty on Principles Governing the Activities of States in the Exploration and Use of

Outer Space, including the Moon and Other Celestial Bodies or Convention on International Liability for Damage Caused by Space Objects related to the facilities that are the subject of the license.

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 paragraphs (d)(14)(iii), (d)(14)(iv)(A)(*1*) and (*4*), (d)(14)(vii)(D)(*2*)(*ii*),and (d)(14)(viii), and adding (d)(14)(ix) to read as follows:

§ 25.114 Applications for space station authorizations.

* * * * *

(d) * * *

(14) * * *

(iii) A statement that the space station operator has assessed and limited the probability, during and after completion of mission operations, of accidental explosions or of release of liquids that will persist in droplet form. This statement must include a demonstration that the integrated probability of debris-generating explosions for all credible failure modes of the space station (excluding small particle impacts) is less than 0.001 (1 in 1,000) during deployment and mission operations. Energy sources include chemical, pressure, and kinetic energy. This demonstration should address whether stored energy will be removed at the spacecraft's end of life, by depleting residual fuel and leaving all fuel line valves open, venting any pressurized system, leaving all batteries in a permanent discharge state, and removing any remaining source of stored energy, or through other equivalent procedures specifically disclosed in the application;

(iv) * * *

(A) Where the application is for an NGSO space station or system, the following information must also be included:

(*1*) A demonstration that the space station operator has assessed and limited the probability of collision between any space station of the system and other large objects (10 cm or larger in diameter) during the total orbital lifetime of the space station, including any de-orbit phases, to less than 0.001 (1 in 1,000). The probability shall be calculated using the NASA Debris Assessment Software or a higher fidelity assessment tool. The collision risk may be assumed zero for a space station during any period in which the space station will be maneuvered effectively to avoid colliding with large objects. For systems consisting of multiple space stations, the statement must also include an assessment of the total probability of collision, calculated as the sum of the probability of collision associated with each individual space station. The total estimated number of space stations deployed over a 15-year period, including any replacement space stations, must be used for this calculation. Where the total probability of collision exceeds 0.001 (1 in 1,000) assuming a 10% failure rate of any maneuvering capability at an orbit that presents the worst case for collision risk, the statement must include an additional demonstration of the expected failure rate of maneuverability, and the orbit where the operator would expect most failures to occur, and calculate the total probability of failure based on those assumptions.

* * * * *

(*4*) The statement must disclose the accuracy, if any, with which orbital parameters will be maintained, including apogee, perigee, inclination, and the right ascension of the ascending node(s). In the event that a system will not maintain orbital tolerances, *e.g.,* its propulsion system will not be used for orbital maintenance, that fact should be included in the debris mitigation disclosure. Such systems must also indicate the anticipated evolution over time of the orbit of the proposed satellite or satellites. All systems should describe the extent of satellite maneuverability, whether or not the space station design includes a propulsion system. For space stations deployed into the portion of the low-Earth orbit region above 400 km, the operator must certify that the space stations will be designed with the maneuvering capabilities sufficient to perform effective collision avoidance throughout the period when the space stations are above 400 km.

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(vii) * * *

(D) * * *

(*2*) * * *

(*ii*) An assessment as to whether portions of any individual spacecraft will survive atmospheric re-entry and impact the surface of the Earth with a kinetic energy in excess of 15 joules, and demonstration that the calculated casualty risk for an individual spacecraft using the NASA Debris Assessment Software or a higher fidelity assessment tool is less than 0.0001 (1 in 10,000). For systems consisting of multiple space stations, the statement must also include an assessment of the total casualty risk associated with the system, calculated as the sum of the casualty risk associated with each individual space station. The total estimated number of space stations deployed over a 15-year period, including any replacement space stations, must be used for this calculation. For applications for either a single space station or multiple space stations, where portions of any individual spacecraft will survive atmospheric re-entry and impact the surface of the Earth with a kinetic energy in excess of 15 joules, the statement must also include a description of strategies considered to reduce casualty risk, such as use of materials designed to demise upon reentry and/or targeted re-entry, and the extent to which those strategies were incorporated into the mission profile.

(viii) Applicants must submit a signed statement stating that the licensee will be responsible for indemnifying the United States against any costs associated with a claim brought under a provision of the Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies or Convention on International Liability for Damage Caused by Space Objects related to the facilities that are the subject of the license.

(ix) For non-U.S.-licensed space stations, the requirement to describe the design and operational strategies to minimize orbital debris risk can be satisfied either by submitting the information required of U.S.-licensed space stations, or by demonstrating that debris mitigation plans for the space station(s) for which U.S. market access is requested are subject to direct and effective regulatory oversight by the national licensing authority.

* * * * *

■ 5. Add § 25.166 under the center heading ''*Forfeiture, Termination, and Reinstatement of Station Authorization*'' to read as follows:

§ 25.166 Surety bonds for successful post-mission disposal.

(a) For all space stations licenses issued after [DATE], the licensee must post a surety bond specific to successful post-mission disposal within 30 days of the grant of its license. Failure to post a bond will render the license null and void automatically.

(1) An NGSO licensee:

(i) Must have on file a surety bond requiring payment in the event of default as defined in paragraph (a)(1)(ii) of this section, determined according to

the following formula: BA = (TM)*((Y–25)(TO)). BA is the amount of the bond in dollars, TM is the total mass of the satellite system, Y is the number of years that an individual satellite will remain in orbit if it fails in the deployment orbit, and TO is the total number of objects in orbit. The bond amount (BA) would be capped at a maximum of $100,000,000 for any system.

(ii) Will be considered in default if any undisposed objects remain in orbit and undisposed at the conclusion of the license term, beyond those accounted for in the licensee's calculation of the probability of successful disposal. In the case of default, the NGSO licensee will be responsible for the amount determined according to the following formula, and rounded to the nearest $10,000. FA = (M–EM) * ((Y–25)*(O–EO)). FA is the amount to be paid in dollars, M is the total undisposed mass in orbit in kilograms, EM is the expected undisposed mass in orbit in kilograms, Y is the mean of the remaining years in orbit for any individual undisposed object, up to a maximum of 200 years per object, and O is the total number of undisposed objects in orbit, and EO is the expected number of undisposed objects in orbit.

(2) A GSO licensee:

(i) Must have on file a surety bond requiring payment in the event of default as defined in paragraph (a)(2)(ii) of this section in the amount of $5,000,000. If the licensee is granted a modification to extend the length of its license by up to five years, the surety bond on file must be increased by $5,000,000, and by an additional $5,000,000 for a subsequent extension of up to five years. For any additional years of license extension authorized by the Commission, the surety bond on file must be increased to an amount that would satisfy the formula in paragraph (a)(2)(ii) of this section.

(ii) Will be considered in default if the licensed space station is not disposed of in accordance with the statement specified in §§ 25.114(d)(14)(iv) and 25.283 within 6 months following conclusion of operations. In the case of default, the NGSO licensee will be responsible for the amount determined according to the following formula: FA = $5,000,000*(Y), where FA is the amount to be paid in dollars, and Y is calculated as follows: If the satellite operates for less than 15 years then Y = 1; if the satellite operates between 15 and 20 years, then Y = 2; and if the satellite operates for more than 20 years, then Y = two plus the total number of operational years, minus 20.

(b) The licensee must use a surety company deemed acceptable within the meaning of 31 U.S.C. 9304 *et seq.* (See, *e.g.,* Department of Treasury Fiscal Service, Companies Holding Certificates of Authority as Acceptable Sureties on Federal Bonds and As Acceptable Reinsurance Companies, 57 FR 29356, July 1, 1992.) The bond must name the U.S. Treasury as beneficiary in the event of the licensee's default. The licensee must provide the Commission with a copy of the performance bond, including all details and conditions.

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 paragraphs (g)(1)(iii) introductory text, (g)(1)(iv)(A)(*1*) and (*4*), (g)(1)(vii)(D)(*2*)*(ii)* and adding paragraph (h), to read as follows:

§ 97.207 Space station.

* * * * *

(g) * * *

(1) * * *

(iii) A statement that the space station operator has assessed and limited the probability, during and after completion of mission operations, of accidental explosions or of release of liquids that will persist in droplet form. This statement must include a demonstration that the integrated probability of debris-generating explosions for all credible failure modes of the space station (excluding small particle impacts) is less than 0.001 (1 in 1,000) during deployment and mission operations. Energy sources include chemical, pressure, and kinetic energy. This demonstration should address whether stored energy will be removed at the spacecraft's end of life, by depleting residual fuel and leaving all fuel line valves open, venting any pressurized system, leaving all batteries in a permanent discharge state, and removing any remaining source of stored energy, or through other equivalent procedures specifically disclosed in the application;

(iv) * * *

(A) * * *

(*1*) A demonstration that the space station operator has assessed and limited the probability of collision between any space station of the system and other large objects (10 cm or larger in diameter) during the total orbital lifetime of the space station, including any de-orbit phases, to less than 0.001 (1 in 1,000). The probability shall be calculated using the NASA Debris Assessment Software or a higher fidelity assessment tool. The collision risk may be assumed zero for a space station during any period in which the space station will be maneuvered effectively to avoid colliding with large objects. For systems consisting of multiple space stations, the statement must also include an assessment of the total probability of collision, calculated as the sum of the probability of collision associated with each individual space station. Where the total probability of collision exceeds 0.001 (1 in 1,000) assuming a 10% failure rate of any maneuvering capability at an orbit that presents the worst case for collision risk, the statement must include an additional demonstration of the expected failure rate of maneuverability, and the orbit where the operator would expect most failures to occur, and calculate the total probability of failure based on those assumptions.

* * * * *

(*4*) The statement must disclose the accuracy, if any, with which orbital parameters will be maintained, including apogee, perigee, inclination, and the right ascension of the ascending node(s). In the event that a system is not be maintained to specific orbital tolerances, *e.g.,* its propulsion system will not be used for orbital maintenance, that fact should be included in the debris mitigation disclosure. Such systems must also indicate the anticipated evolution over time of the orbit of the proposed satellite or satellites. All systems should describe the extent of satellite maneuverability, whether or not the space station design includes a propulsion system. For space stations deployed into the portion of the low-Earth orbit region above 400 km, the operator must certify that the space stations will be designed with the maneuvering capabilities sufficient to perform effective collision avoidance throughout the period when the space stations are above 400 km.

* * * * *

(vii) * * *

(D) * * *

(2) * * *

(*ii*) An assessment as to whether portions of any individual spacecraft will survive atmospheric re-entry and impact the surface of the Earth with a kinetic energy in excess of 15 joules, and demonstration that the calculated casualty risk for an individual spacecraft using the NASA Debris Assessment Software or a higher fidelity assessment tool is less than 0.0001 (1 in 10,000). For systems consisting of multiple space stations, the statement must also include an assessment of the

total casualty risk associated with the system, calculated as the sum of the casualty risk associated with each individual space station. For applications for either a single space station or multiple space stations, where portions of any individual spacecraft will survive atmospheric re-entry and impact the surface of the Earth with a kinetic energy in excess of 15 joules, the statement must also include a description of strategies considered to reduce casualty risk, such as use of materials designed to demise upon reentry and/or targeted re-entry, and the extent to which those strategies were incorporated into the mission profile.

(h) At least 90 days prior to the planned launch of the space station, the licensee grantee or owner of each space station must submit a signed statement stating that upon issuance of a license by the Commission, the license grantee or owner will be responsible for indemnifying the United States against any costs associated with a claim brought under a provision of the Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies or Convention on International Liability for Damage Caused by Space Objects related to the facilities that are the subject of the license.

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