

**Before the
Federal Communications Commission
Washington, DC 20554**

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

**REPLY COMMENTS OF
THE COMMERCIAL SMALLSAT SPECTRUM MANAGEMENT ASSOCIATION**

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TABLE OF CONTENTS

I.	SUMMARY AND INTRODUCTION.....	- 1 -
II.	“ONE-SIZE-FITS-ALL” RULES SHOULD BE AVOIDED, AND PERFORMANCE-BASED RULES SHOULD GOVERN.	- 2 -
A.	CONTROL OF DEBRIS RELEASED DURING NORMAL OPERATIONS AND MULTI-SATELLITE DEPLOYMENTS (NPRM ¶¶ 18-21, 40-41)	- 2 -
B.	MINIMIZING DEBRIS GENERATED BY RELEASE OF PERSISTENT LIQUIDS (NPRM ¶¶ 22-23) .-	3 -
C.	SAFE FLIGHT PROFILES (NPRM ¶¶ 24-25)	- 4 -
1.	Collision risk probability and consequence (NPRM ¶¶ 26-28).....	- 4 -
2.	Orbit selection (NPRM ¶¶ 29-35).....	- 7 -
3.	Tracking (NPRM ¶¶ 36-38).....	- 8 -
4.	Data sharing and maintaining ephemeris data (NPRM ¶¶ 36-38, 72-73).....	- 8 -
5.	Maneuverability (NPRM ¶ 39).....	- 10 -
6.	Design reliability (NPRM ¶¶ 42-43)	- 12 -
D.	POST-MISSION DISPOSAL (NPRM ¶¶ 44-45)	- 13 -
1.	Probability of success of disposal method (NPRM ¶¶ 46-57).....	- 13 -
2.	Post-mission lifetime (NPRM ¶¶ 58-59)	- 14 -
3.	Casualty risk assessment (NPRM ¶¶ 60-62)	- 16 -
E.	OPERATIONAL RULES (NPRM ¶ 69)	- 17 -
1.	Orbit raising/lowering (NPRM ¶¶ 70-71).....	- 17 -
2.	Telemetry, tracking, and command encryption (NPRM ¶¶ 74-75)	- 17 -
III.	AN INDEMNITY AGREEMENT REQUIREMENT SHOULD NOT BE REQUIRED. (NPRM ¶¶ 78-79)	- 18 -
IV.	INSURANCE REQUIREMENTS DO NOT INCENTIVIZE GOOD BEHAVIOR ON ORBIT. (NPRM ¶ 80)	- 19 -
V.	EXCEPT FOR INDEMNITY, INSURANCE, OR SIMILAR REQUIREMENTS, ANY NEW RULES SHOULD ALSO APPLY VIA LICENSE CONDITION TO A MARKET ACCESS GRANT TO NON-US APPLICANTS. (NPRM ¶¶ 85-87).....	- 20 -
VI.	CREATE A SUNSET RULE GRANDFATHERING IN EXISTING AND PENDING LICENSEES.	- 20 -
VII.	CONCLUSION	- 21 -

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I. SUMMARY AND INTRODUCTION

The Commercial Smallsat Spectrum Management Association (“CSSMA”) respectfully submits these reply comments in response to comments submitted in response to the Notice of Proposed Rulemaking issued by the Federal Communications Commission (“Commission” or “FCC”) in the above captioned proceeding.¹

CSSMA’s membership includes many of the leading operators, ground station service providers, manufacturing and component providers, and other service providers in the small satellite (“smallsat”) industry.² CSSMA seeks to create the conditions for a coordinated, transparent, and expedited spectrum coordination process among commercial smallsat spectrum users, government users, and other satellite and terrestrial users and to advocate and represent the members’ views on spectrum management and other policy matters that affect the smallsat community.

¹ See *Mitigation of Orbital Debris in the New Space Age*, Notice of Proposed Rulemaking and Order on Reconsideration, IB Docket No. 18-313, FCC 18-159 (rel. Nov. 19, 2018) (“*NPRM*”).

² CSSMA has forty-three (43) members. See *CSSMA*, cssma.space (last viewed Apr. 1, 2019).

As many commenters have stated and outlined below, any new requirements should be performance based and provide flexibility, scalability, and adaptability for operators to help maintain a thriving space industry in the United States.

II. “ONE-SIZE-FITS-ALL” RULES SHOULD BE AVOIDED, AND PERFORMANCE-BASED RULES SHOULD GOVERN.

A. Control of debris released during normal operations and multi-satellite deployments (NPRM ¶¶ 18-21, 40-41)

CSSMA reiterates its support for the use of dedicated post-launch deployment devices and that the operators of such devices should be responsible for their own respective licensing.³ Several re-contact mitigation strategies are available for such systems.⁴ However, CSSMA opposes a requirement to submit information pertaining to multi-satellite deployment operations for Commission review as operators and launch providers already have sufficient incentive to ensure these operations are successful. This view is supported by other commenters.⁵ As noted by Spaceflight, there are existing industry standards for risk mitigation during multi-satellite deployments.⁶

³ See Comments of Commercial Smallsat Spectrum Management Association, IB Docket No. 18-313, at 4 (filed Apr. 5, 2019) (“CSSMA Comments”). Several commenters support similar positions. *See, e.g.*, Comments of Global NewSpace Operators, IB Docket No. 18-313 at 6 (filed Apr. 5, 2019) (“NewSpace Operators Comments”).

⁴ See NewSpace Operators Comments at 11. Deployers can make use of phased dispensing and variable deployment vectors to reliably separate spacecraft.

⁵ See Comments of The Boeing Company, IB Docket No. 18-313 at 24-25 (filed Apr. 5, 2019) (“Boeing Comments”); Comments of Spaceflight, Inc., IB Docket No. 18-313, at 4-6 (filed Apr. 5, 2019) (“Spaceflight Comments”); Comments of ORBCOMM Inc., IB Docket No. 18-313, at 14 (filed Apr. 5, 2019) (“ORBCOMM Comments”).

⁶ See Spaceflight Comments at 4-6.

AMSAT has requested that amateur space stations co-located on other spacecraft should be made exempt from any adopted orbital debris rules.⁷ Although the apparent intent of the statement is framed around the use of hosted payloads, CSSMA cautions the Commission to avoid granting such exemptions in a way that may apply to satellites temporarily co-located on deployment vehicles.

B. Minimizing debris generated by release of persistent liquids (NPRM ¶¶ 22-23)

CSSMA again recommends not taking premature action regarding the release of persistent liquids without evidence showing such liquids could cause an orbital debris risk.⁸ Of particular concern is the possibility of the FCC regulating alternative propellants without clear evidence basis that such propellants if released as designed and as part of normal operations will in fact persist in the orbital environment as droplets. CSSMA opposes any regulation of non-traditional propellants and propellant systems that simply identifies the type of liquid and does not also take into account the design and engineering specifics of the particular propulsion system, including the temperature at which such liquid is heated and the amount of material (in gaseous or other form) ejected from the propulsion system. These novel and highly technical risks highlight why it is premature to implement such regulation.

⁷ See Comments of Radio Amateur Satellite Corporation, IB Docket No. 18-313, at 8 (filed Apr. 5, 2019) (“AMSAT Comments”).

⁸ See CSSMA Comments at 5.

C. Safe flight profiles (NPRM ¶¶ 24-25)

1. Collision risk probability and consequence (NPRM ¶¶ 26-28)

CSSMA again supports using the proposed collision risk probabilities of 0.001 and 0.01 for large and small objects⁹ respectively when considering the collision risk of *single spacecraft*.¹⁰

CSSMA agrees with other commenters that constellation collision risks should be considered on an aggregate basis but not by simply applying the above-mentioned National Aeronautics and Space Administration (“NASA”) standards.¹¹ Indeed, as Boeing points out, the NASA standards for large and small object collision were expressly designed to be applied on a per-satellite basis and cannot reasonably be applied to systems in aggregate.¹² CSSMA notes that this is especially true if the premise that having a propulsion system equates to zero collision risk is rejected.

CSSMA suggests that these aggregate analyses should be subject to a more nuanced environmental impact assessment that prescribes a unique collision risk as a function of a

⁹ CSSMA and others believe the existing definition of large and small objects is satisfactory. *See* CSSMA Comments at 6-9; NewSpace Operators Comments at 6. However, CSSMA disagrees with the suggestion of OneWeb to define a large object as one that can break up another satellite, as this would offer little new value and would be challenging to define. *See* Comments of WorldVu Satellites Limited, IB Docket No. 18-313, at 17 (filed Apr. 5, 2019) (“OneWeb Comments”).

¹⁰ *See* Boeing Comments at 10-13; *See* Comments of Edward Lu, IB Docket No. 18-313 (filed Apr. 5, 2019); Comments of Association of Space Explorers, IB Docket No. 18-313, at 8 (filed Mar. 18, 2019) (“ASE Comments”); Comments of LeoSat MA, Inc., IB Docket No. 18-313 at 3 (filed Apr. 5, 2019) (“LeoSat Comments”).

¹¹ *See* ORBCOMM Comments at 7; OneWeb Comments at iii.

¹² *See* Boeing Comments at 10-11; *see also* Letter from Anne E. Sweet, NASA Representative to the Commercial Space Transportation Interagency Group Human Exploration and Operations Mission Directorate, Launch Services Office, NASA, to Marlene Dortch, Secretary, FCC, IB Docket No. 18-313 at 3 (filed Apr. 4, 2019) (regarding both the large and small collision risk targets, NASA themselves “[do] not recommend applying [these] requirement[s] in an aggregate manner for constellations”) (“NASA Letter”).

constellation's properties. Such analyses should account for several important considerations including total constellation size and spacecraft mass, among others, to account for the variable consequences of collisions with different spacecraft.¹³ Such an approach would also solve the problem of trying to impose stricter requirements on some constellations that are arbitrarily deemed to be "large" by incorporating their size directly into their quantitative risk assessment. Ultimately, CSSMA believes that the Commission (or another agency/organization) should develop a proper methodology for assessing the impact of large systems in space. Although NASA provided no further suggestions on this subject in its own letter, the NASA Orbital Debris Program Office published a study, in 2018, on the long-term effects of large constellations on the overall orbital debris environment.¹⁴ It concluded that acceptable debris rates could only be achieved if these constellations are able to maintain a post-mission disposal rate of 0.99 and a risk of accidental spacecraft explosion of 0.001. Indeed, operators seeking to utilize more of the shared orbital environment than others need to meet standards proportional to their total risk.

Some commenters have advocated that collision analyses should strictly occur on a per-satellite basis and should not need to account for the system to which they belong.¹⁵ CSSMA believes this approach to be wholly inadequate as it does nothing to incentivize large constellation operators to minimize the size of their systems.

The NewSpace Operators suggest that an applicant should only be required to submit a collision analysis if it "can quantify the risk of collision with a large object during its life," later

¹³ See CSSMA Comments at 7-8 (highlighting need for a more granular calculation of risk).

¹⁴ See J.-C. Liou, *et. al.*, *NASA ODPO's Large Constellation Study*, NASA Orbital Debris Quarterly News, Volume 22, Issue 3 at 4-7 (Sept. 2018), <https://www.orbitaldebris.jsc.nasa.gov/quarterly-news/pdfs/odqnv22i3.pdf>.

¹⁵ See Comments of Space Exploration Technologies Corp., IB Docket No. 18-313 at 14-16 (filed Apr. 5, 2019) (on its argument towards a per-satellite application of these rules, one which CSSMA believes is poorly justified) ("SpaceX Comments").

suggesting that amateur/experimental spacecraft operators might lack the resources to do so. This argument was explored by the Commission itself in its own response to a petition filed by AMSAT on the same topic.¹⁶ Among other things, the Commission concluded that AMSAT's arguments for exempting amateur operators from debris mitigation reporting requirements were without merit.¹⁷

In addition to several others,¹⁸ CSSMA vigorously opposes the existing practice of assuming that satellites equipped with propulsion are considered to have a 0% collision risk and strongly disagrees with the commenters that support this position.¹⁹ As CSSMA described in its original comments,²⁰ this approach is overly liberal in part because it assumes that such propulsion systems never fail and are capable of maneuvering with perfect effectiveness.²¹

CSSMA strongly opposes a requirement for applicants to account for planned systems in their own submitted collision analyses.²² Such considerations are naturally unreliable as planned systems frequently change and not all planned systems are publicly known (such as those being designed privately or for national security purposes).

¹⁶ See NPRM ¶¶ 101-113.

¹⁷ See *Id.* ¶ 111.

¹⁸ See OneWeb Comments at 16; Comments of Tyvak, IB Docket No. 18-313 (filed Apr. 8, 2019).

¹⁹ See Comments of SES Americom, Inc. and O3b Limited, IB Docket No. 18-313 at 2 (filed Apr. 5, 2019) ("SES Comments").

²⁰ See CSSMA Comments at 8-9.

²¹ See NewSpace Operators Comments at 6 (noting that maneuvering itself carries some amount of risk); ASE Comments at 8 (stating that maneuverable spacecraft should still conduct conjunction studies).

²² LeoSat echoed this position. See LeoSat Comments at 3.

2. Orbit selection (NPRM ¶¶ 29-35)

CSSMA²³ opposes Iridium's²⁴ and SpaceX's²⁵ assertion that the Commission use 400 km altitude at its breakpoint for the justification of orbit selection. The 400 km threshold is chosen simply due to that being the altitude of the crewed International Space Station ("ISS"). What happens in the future when a new space station is deployed at a higher altitude, hence obsoleting the 400 km threshold, or perhaps at a lower altitude thereby shifting the orbital limit even lower to an even less viable orbit regarding orbital lifetime? The majority of smallsats, particularly cubesats, simply do not have the volumetric and electrical capacity to support a propulsion system. A chemical propulsion system is far too large for a cubesat. Electric propulsion systems at 1/4U to 1U comprise a significant, and often unavailable, volume of a cubesat, and they often require a few hundred watts of power that a cubesat usually cannot provide. Furthermore, as NASA pointed out,²⁶ an electric propulsion system is not particularly more effective at collision avoidance than attitude modulation methods given they too are slow-acting.²⁷

Cubesats are very small (much smaller cross-sectional area) relative to other satellites and thus pose a much smaller potential conjunction area for a collision. Imposing an orbital limit of 400 km for propulsion-less satellites would render them non-commercially viable with generally less than 1-year lifetimes, thereby eliminating the whole class of cubesats from serving the

²³ See CSSMA Comments at 9-11.

²⁴ See Comments of Iridium, IB Docket No. 18-313 at 6-7, 9 (filed Apr. 5, 2019) ("Iridium Comments").

²⁵ See SpaceX Comments at 8.

²⁶ See NASA Letter ¶ 4 ("[E]ven when active collision avoidance is being performed and mitigation actions are being pursued, the collision risk with large objects is not and should not be presumed to be zero.").

²⁷ See NASA Letter ¶ 15.

public interest in innovative low-cost services that several cubesat constellation operators are now providing.

3. Tracking (NPRM ¶¶ 36-38)

In addition to CSSMA,²⁸ several other commenters have expressed support for a requirement that applicants provide a statement of sufficient spacecraft trackability.²⁹ However, CSSMA opposed a specification of any particular type of tracking technology, which is a position also supported by Boeing.³⁰

KTi has suggested that the Commission mandate the use of an independent tracking solution, such as its own product, on all licensed spacecraft.³¹ Such a requirement would impose unnecessary costs on operators. The level of trackability needed to maintain a safe orbital environment can already be attained by a multitude of existing, well-established active or passive tracking methods. The Commission should simply require a certification that spacecraft can be tracked reliably by any one of these widely available technologies.

4. Data sharing and maintaining ephemeris data (NPRM ¶¶ 36-38, 72-73)

CSSMA supports a requirement to share any available ephemeris data with both the 18th Space Control Squadron (“SCS”) (or civilian equivalent) and with other operators *upon the*

²⁸ See CSSMA Comments at 11.

²⁹ See NewSpace Operators Comments at 8; ORBCOMM Comments at 8; OneWeb Comments at iii; Iridium Comments at 7 (supporting a requirement that all spacecraft be trackable by some kind of passive means).

³⁰ See Boeing comments at 21-22 (suggesting that NGSO operators be given discretion on whether to use active/passive tracking methods, but if active, they should provide the characteristics of the tracking signal.).

³¹ See Comments of Keplerian Technologies, Inc., IB Docket No. 18-313 at 11-13 (filed Apr. 15, 2019) (“KTi Comments”).

*receipt of a conjunction notice.*³² CSSMA agrees with others that data sharing exchanges should respect owner/operator intellectual property and proprietary information and thus should be limited to only the information necessary to describe explicit maneuvers, initial deployment, or conjunction avoidance.³³ CSSMA agrees with Boeing that satellite maneuverability or status data should be shared using any reasonable method identified by the providing operator.³⁴

To improve overall space situational awareness and cooperation, many operators, including some CSSMA members, already share much of this data voluntarily.³⁵ CSSMA also believes that operators should be *encouraged but not mandated* to maintain a regularly updated, publicly available repository of ephemeris and maneuverability data, which is a view supported by other commenters.³⁶ CSSMA and other commenters have noted the reliability of operator-generated data cannot always be guaranteed, and thus it should be used only to supplement any data gathered by a formal entity like the 18th SCS.³⁷

³² See CSSMA Comments at 11-12; Comments of Viasat, IB Docket No. 18-313 at 2 (filed Apr. 5, 2019) (“ViaSat Comments”); KTi Comments at 14; Comments of Lockheed Martin, IB Docket No. 18-313 at 12 (filed Apr. 5, 2019) (“Lockheed Comments”); LeoSat Comments at 4 (supporting operators to take all practical steps to mitigate conjunction-associated risk.); SES Comments at 2 and LeoSat Comments at 8 (broadly supporting the Commission’s proposals to share ephemeris data).

³³ See KTi Comments at 13-14; Boeing Comments at 22; Comments of Secure World Foundation, IB Docket No. 18-313 at 4 (filed Apr. 5, 2019) (“SWF Comments”); LeoSat Comments at 4 (stating support for the sharing of ephemeris data).

³⁴ See Boeing Comments at 22.

³⁵ See Lockheed Comments at 11, 17; Iridium Comments at 8.

³⁶ See CSSMA Comments at 12; Lockheed Comments at 17 (opposing mandatory sharing requirements, supporting the encouragement of voluntary sharing). Several CSSMA members already provide such publicly available information. See, e.g., *Planet Labs Public Orbital Ephemerides*, Planet, <http://ephemerides.planet-labs.com/> (last viewed Apr. 3, 2019); *Open TLE Service*, Spire, tle.spire.com (last viewed Apr. 3, 2019). To obtain the ephemeris data for any particular satellite, type in the Spire satellite’s NORAD ID after “tle.spire.com/” in the URL bar.

³⁷ See CSSMA Comments at 11-12, 15; NewSpace Operators Comments at 18.

5. Maneuverability (NPRM ¶ 39)

Most commenters supported the notion that new system applicants should note their systems' maneuverability characteristics as a means to assist with conjunction or disposal of their debris. One commenter, LeoSat, believes that providing such detail will disclose competitive technology.³⁸ CSSMA, nonetheless, remains convinced that just revealing the category of maneuverability of all space stations will not disadvantage any applicant significantly and that the disclosed information will indeed assist in conjunction avoidance maneuvers, which must take place under certain rapid-response conditions.³⁹ Under such circumstances, such relevant information could be critical. Also, such information must be in the right place at the right time. Hence, CSSMA remains convinced that disclosure of the ability to maneuver, for all space vehicles, remains in the best interest of the public and all who share orbital space, now and in the future.

There was more interest expressed regarding the issue of methods and means of maneuverability of space vehicles. And, there was a more divided opinion among commenters regarding the issue of mandatory use by operators of "propulsion" means specifically versus other more general means of "maneuverability." Three commenters, Iridium; Maxar; and SpaceX,⁴⁰ seem to be of the opinion that only a propulsive capability is adequate to avoid risk to ISS and other existing Non-Geostationary-Satellite Orbit ("NGSO") networks. CSSMA particularly wishes to reply to the comments of Iridium, which stated:

At a minimum, the Commission's proposal should refer to "propulsion" rather than "maneuverability." Non-propulsive methods of maneuvering satellites

³⁸ See LeoSat Comments at 5.

³⁹ See CSSMA Comments at 12-15.

⁴⁰ See Iridium Comments at 6; Comments of Maxar Technologies Inc., IB Docket No. 18-313 at 13 (filed Apr. 5, 2019) ; SpaceX Comments at 8.

remain largely experimental and it is unclear whether they are capable of effectively reducing collision risk. Satellites that lack propulsion systems have limited ability to avoid collision and to conduct end-of-life maneuvers. As a result, they pose a risk of harm to existing NGSO networks. The Commission should adopt 400 km as the upper altitude at which space stations without propulsion should be permitted to operate.⁴¹

CSSMA takes no issue with the notion that any space system with an effective propulsion system is more capable of reducing the risk of an in-space collision. However, CSSMA rejects the argument that this method is the ONLY effective way of avoiding collision. As CSSMA has demonstrated in its initial comments to the *NPRM*,⁴² differential drag as a method of conjunction avoidance and as a means of constellation control has not only been demonstrated analytically but, much more significantly, is being used operationally by multiple smallsat system operators as a means of conjunction control and orbit maintenance. This issue is largely one of cost and current technology availability.

The Commission should support a commercial space policy that facilitates opportunities for space actors having varying business plans and technologies and not attempt to pick winners and losers.⁴³ Propulsion technology for low cost systems is rapidly evolving at the time of this *NPRM*, and for a few years yet, this technology is the one that is “largely experimental.” CSSMA would not accept the terms “experimental” nor “effective” as they apply to the concept of a well-designed differential drag system operating in conjunction with a suitable attitude

⁴¹ Iridium Comments at 6-7.

⁴² See CSSMA Comments at 12-15.

⁴³ See, e.g., *Inquiry Concerning the Deployment of Advanced Telecommunications Capability to All Americans in A Reasonable & Timely Fashion, & Possible Steps to Accelerate Such Deployment Pursuant to Section 706 of the Telecommunications Act of 1996*, Report, 14 FCC Rcd 2398 ¶ 5 (1999) (“Our role is not to pick winners and losers, or to select the best technology to meet consumer demand.”); *Creation of Low Power Radio Service*, Report and Order, 15 FCC Rcd 2205 (2000) (Statement of Chairman William Kennard) (“[I]t is not the business of the FCC to pick winners and losers.”).

control system (“ACS”) used by any space vehicle.⁴⁴ The Commission should be open to progressively operating systems, which have chosen for economic reasons to use differential drag as an effective means of preventing collisions and controlling satellite positioning within their orbit planes.

For this very same reason, CSSMA rejects Iridium’s notion that the term “propulsion” must be used in new regulations instead of “maneuverability,” more generally, as the only method of orbit control. CSSMA is joined in this view by OneWeb, ORBCOMM, Boeing, and NewSpace Operators. In its comments, OneWeb suggests that all new applicants be required to “demonstrate [the] capability to execute timely and effective collision avoidance maneuvers.”⁴⁵ CSSMA supports this additional suggestion. Clearly, any means/method of collision avoidance should be able to be demonstrated. And, that should also apply to all systems using propulsive means of collision avoidance.

6. Design reliability (NPRM ¶¶ 42-43)

CSSMA applauds the general consensus against design reliability requirements as put forward by the Commission.⁴⁶ Many commenters, such as Boeing and NewSpace Operators, share the position with CSSMA that design reliability of .999 is an unreasonable way to address the greater issue of satellite post mission disposal.⁴⁷ NASA also notes in its letter that it only believes that “0.90 MD reliability for individual spacecraft” is necessary.⁴⁸ NASA further notes

⁴⁴ CSSMA notes that a suitable ACS is necessary in order to operate either via differential drag or by means of propulsion.

⁴⁵ OneWeb Comments at 14.

⁴⁶ See CSSMA Comments at 15-16.

⁴⁷ See Boeing Comments at 25-26; NewSpace Operators at 12.

⁴⁸ See NASA Letter ¶ 17.

that “a design reliability of .999 per spacecraft cannot be justified from a technical or cost perspective.”⁴⁹

Other groups recognize the faults of a .999 standard but attempt to improve it with problematic recommendations. For example, despite Iridium’s assertion that it is near impossible to assess reliability until a spacecraft is in orbit, it recommends that a sizable panel comprised of the Commission and “other satellite operators” determine reliability based on design information.⁵⁰ This suggestion falters on two counts. First, the proposed solution of determining reliability based on design plans does not resolve the proposed problem of the impossibility of determining reliability before the spacecraft is deployed. Second, a panel of the Commission and an undefined number of satellite operators increases the level of complexity without cap in the review process, creating perverse incentives and potential regulatory flight.

D. Post-mission disposal (NPRM ¶¶ 44-45)

1. Probability of success of disposal method (NPRM ¶¶ 46-57)

Once again, CSSMA only addresses success of disposal for constellations below 650 km as most if not all of its operators operate in this region; it supports a post-mission disposal success rate of 1.0, applied on an aggregate basis, below the 650 km orbital altitude.⁵¹ Though Lockheed accurately stated that “requiring a specific probability of success appears arbitrary and unnecessary” for spacecraft deorbiting through atmospheric drag,⁵² there may be non-propulsive spacecraft that rely on atmospheric drag that will need to be below 650 km to meet applicable

⁴⁹ *See id.*

⁵⁰

⁵¹ *See* CSSMA Comments at 16.

⁵² Lockheed Comments at 13.

post-mission lifetime requirements, which is why CSSMA believes this new guideline is sensible.

Other commenters suggest other reliability requirements above 650 km; however, CSSMA does not comment on those proposals.

CSSMA agrees with Boeing, Lockheed, and OneWeb that the Commission should not adopt a proposal requiring NGSO satellites to automatically initiate disposal procedures in the event of a loss of control. Such measures are unlikely to be successful, uncontrolled, and unpredictable.⁵³ “initiating automatic maneuvers following a loss of power or other loss of contact is extremely risky and would likely have significant unintended consequences for the operator and for other operators.”⁵⁴ Instead, other methods (such as redundancy in critical systems) would be more effective in preventing debris.⁵⁵ CSSMA agrees with Lockheed Martin’s urging of the Commission to engage in greater consultations in this area.⁵⁶

2. Post-mission lifetime (NPRM ¶¶ 58-59)

CSSMA opposes comments supporting a post-mission lifetime not exceeding operational life by 2X (de-orbit period same as operational life) or 5 years maximum.⁵⁷ CSSMA strongly disagrees with comments that “the Commission should require LEO operators at altitudes below 2,000 km to deorbit satellites by atmospheric re-entry within a maximum of five years of the end of each satellite’s operational life” and that “requiring deorbit should not impose a tremendous burden on operators as the additional cost to deorbit within 5 years rather than 25 is relatively

⁵³ See Boeing Comments at 28-29; Lockheed Comments at 14; OneWeb at 27.

⁵⁴ Lockheed Comments at 14.

⁵⁵ See Boeing Comments at 28-29.

⁵⁶ See Lockheed Comments at 14 (recognizing that it is not ripe today for a proposed rule).

⁵⁷ See CSSMA Comments at 16-17; OneWeb Comments at iii.

minor and such measures will significantly improve the debris population in LEO.”⁵⁸ Instead, CSSMA supports NASA’s recommendation that the need for propulsion be driven by the spacecraft’s ability to meet the 0.001 lifetime collision risk rule and the 25-year rule.”⁵⁹

CSSMA also supports NASA’s comment that

the 25-year disposal guideline was established as a balance of limiting growth in the debris environment with limiting propellant costs and the complications imposed by performing a maneuver to a limited lifetime orbit. NASA first proposed the requirement in the 1990’s and since then, it has been adopted by the space agencies of other nations and by the Inter-Agency Space Debris Coordination Committee (IADC) after a thorough technical assessment. Further, NASA analyzed the guideline for large constellations over a 200-year period and found that it remained a sufficient benchmark for limiting the growth in the debris environment. The effects of solar activity on orbital lifetime is a second-order effect and accounting for these variations is not justified. If the effect on the orbital lifetime yielded 25.5 years rather than 25 years, the effect on the overall orbital debris environment is very small and does not justify additional design cost.⁶⁰

NASA points out that there is no need to change the 25-year rule as it was created after thorough technical assessment and “found that it remained a sufficient benchmark for limiting the growth in the debris environment” for large constellations over a 200-year period.⁶¹ For some CSSMA members, not only will implementing the proposed re-entry within a maximum of five years be a tremendous burden, it will drive them out of business because they will not be able to meet the requirement. It is important that the Commission consider the impact that changes to existing orbital rules on post-mission lifetime may have on current authorized satellite operators and operators that have applied for authorization. CSSMA urges the FCC to consider that any changes to post-mission lifetime could result in companies going out of business and seriously

⁵⁸ Iridium Comments at 8.

⁵⁹ NASA Letter ¶ 10.

⁶⁰ NASA Letter ¶ 21.

⁶¹ NASA Letter ¶¶ 10, 21.

harm U.S. innovation and competitiveness in the smallsat industry unless the FCC grandfathers existing or pending systems to provide them additional time to evolve their technology and business plans. It is particularly relevant for NGSO operators operating under 650 km within the context of existing post-mission orbit lifetime.

If the FCC rules that post-mission lifetimes must be less than 25 years, NGSO smallsat operators that have built their businesses, including the technology of their satellites and the financing to support commercial business operations, under the 25-year post-mission orbit lifetime regulatory standard may potentially no longer be able to continue business activities. CSSMA supports the FCC and other U.S. government agencies incentivizing operators to accelerate post-mission de-orbit and end-of-life activities so long as such incentivization is truly voluntary and not required by regulation.

3. Casualty risk assessment (NPRM ¶¶ 60-62)

CSSMA supports a human casualty risk assessment having to include all objects that would have an impacting kinetic energy in excess of 15 joules as it is consistent with the NASA-STD. Boeing and Iridium agree.⁶² CSSMA reiterates that any casualty risk justifications should only be required only if the risk is greater than the NASA-STD of 1:10,000, which should be codified as the risk threshold.⁶³

CSSMA opposes Iridium's proposal to have operators revisit the re-entry casualty risk annually on a system-wide basis.⁶⁴ Such a requirement would be unduly burdensome and pose

⁶² See CSSMA Comments at 17-18; Boeing Comments at 32-33; Iridium Comments at 10.

⁶³ See CSSMA Comments at 17; Boeing Comments at 32-33; NASA Letter ¶ 22.

⁶⁴ See Iridium Comments at 10.

unnecessary additional administrative requirements for the regulating entity. Such assessments can be provided with the initial application submission.

CSSMA agrees with SpaceX that to assess this metric better the government should work to improve its existing measurement tool, NASA's Debris Assessment Software ("DAS"): "[a]s configured currently, DAS does not account for a number of factors that affect the actual likelihood of harm to people on the ground from extant space debris, which could result in distortive and inaccurate results."⁶⁵

E. Operational rules (NPRM ¶ 69)

1. Orbit raising/lowering (NPRM ¶¶ 70-71)

CSSMA reiterates that EESS/MetSat/Space Ops bands, which CSSMA members already use on a non-exclusive and shared basis, should remain free of mandatory coordination requirements during orbit raising and end-of-life TT&C operations.⁶⁶

2. Telemetry, tracking, and command encryption (NPRM ¶¶ 74-75)

The CSSMA reiterates its position that critical satellite command and control links be cryptographically protected using a method at the discretion of the operator.⁶⁷ The security requirements for other links in the system should be at the discretion of the operator based on the business security requirements or as required by other applicable regulations for the satellite system.

The CSSMA notes the comments of Providence Access Company and appreciates its sentiments about the difficulty implementing effective encryption systems, especially if the

⁶⁵ SpaceX Comments at 18.

⁶⁶ See CSSMA Comments at 18-19.

⁶⁷ See CSSMA Comments at 19-20.

system is a self-developed reinvention.⁶⁸ However, its proposal to require National Security Agency (“NSA”) approval of a security implementation based on CNSSP-12 is going too far. The CNSSP-12 is designed to meet the security requirements of the U.S. Government and requires the use of NSA-approved cryptography equipment. These requirements may be beyond the scope of the security requirements and equipment expense for a commercial system not serving the U.S. Government. Furthermore, its proposal to require end-to-end encryption on *all* command links is ill-conceived as it is without regard to a channel control system such as one with an Adaptive Coding and Modulation technique used with the DVB-S2 transmission protocol return link or a satellite ranging system. These systems have very low latency requirements for proper operation and would be hampered by long-loop circuit driven by an encryption system that cannot be installed locally at the ground station terminal due to the inability to maintain the security of the encryption system or that the export of such equipment is prohibited or otherwise controlled by export laws.

III. AN INDEMNITY AGREEMENT REQUIREMENT SHOULD NOT BE REQUIRED. (NPRM ¶¶ 78-79)

The CSSMA strongly opposes any requirement on space station licensees to indemnify the United States against any costs associated with a claim brought against the United States related to the authorized facilities.⁶⁹ Others also submitted comments opposing this requirement,

⁶⁸ See Comments of Providence Access Company, IB Docket 18-313 at 6 (filed Apr. 5, 2019).

⁶⁹ See CSSMA Comments at 20-21.

including comments by Boeing,⁷⁰ Lockheed,⁷¹ SIA,⁷² Sirius,⁷³ Spaceflight,⁷⁴ Space Logistics,⁷⁵ and AMSAT.⁷⁶

CSSMA strongly agrees with Lockheed.

This area is one where the Commission needs to tread carefully to ensure that actions it proposes do not undercut the U.S. satellite industry or negatively affect the competitiveness of U.S. industry players in the world arena. Imposing stringent indemnification obligations on U.S. applicants and licensees while other countries impose less stringent or no obligations could dissuade satellite applications from seeking U.S. authorizations, heighten forum shopping, and ultimately undermine the United States' stated goal of maintaining leadership in space.⁷⁷

IV. INSURANCE REQUIREMENTS DO NOT INCENTIVIZE GOOD BEHAVIOR ON ORBIT. (NPRM ¶ 80)

All the commenters⁷⁸ that addressed this issue agreed with CSSMA⁷⁹ that insurance requirements should not be required. Insurance requirements do not provide incentives toward good behavior.⁸⁰ For example, insurance products for NGSO systems are not mature enough as they do not accommodate pricing models that take into factors such as collision risk.⁸¹ Moreover, the absence of an insurance requirement has not resulted in unrecovered liability for

⁷⁰ See Boeing Comments at 39.

⁷¹ See Lockheed Comments at 18-19.

⁷² See Comments of Satellite Industry Association, IB Docket No. 18-313 at 9 (filed Apr. 5, 2019).

⁷³ See Comments of Sirius XM Radio Inc., IB Docket 18-313 at 9 (filed Apr. 5, 2019) ("Sirius-XM Comments").

⁷⁴ See Spaceflight Comments at 6.

⁷⁵ See Comments of Space Logistics, LLC, IB Docket 18-313 at 11 (filed Apr. 5, 2019) ("Space Logistics Comments").

⁷⁶ See AMSAT Comments at 5.

⁷⁷ Lockheed Comments at 18-19.

⁷⁸ See NewSpace Operators Comments at 19; ViaSat Comments at 2; Boeing Comments at 37-38; SWF Comments at 11; LeoSat Comments at 9; Sirius-XM Comments at 9; Space Logistics Comments at 9.

⁷⁹ See CSSMA Comments at 21-23.

⁸⁰ See Boeing Comments at 37-38; SWF Comments at 11.

⁸¹ See NewSpace Operators Comments at 19.

the U.S. government or individuals.⁸² Finally, many Geostationary-Satellite Orbit operators already maintain third-party policies for business reasons, so additional requirements would be unnecessary.⁸³

V. EXCEPT FOR INDEMNITY, INSURANCE, OR SIMILAR REQUIREMENTS, ANY NEW RULES SHOULD ALSO APPLY VIA LICENSE CONDITION TO A MARKET ACCESS GRANT TO NON-US APPLICANTS. (NPRM ¶¶ 85-87).

CSSMA agrees with most commenters that all rules adopted as a result of this proceeding should be made applicable to non-U.S. applicants, at least those with a significant U.S. commercial presence.⁸⁴ However, for reasons that CSSMA and others have discussed,⁸⁵ these operators should be exempt from any rules pertaining to indemnity or insurance requirements.⁸⁶ CSSMA also supports the existing practice of assessing the effective oversight of foreign licensing authorities and requiring from applicants a statement demonstrating compliance with their respective administration's orbital debris regulations.⁸⁷

VI. CREATE A SUNSET RULE GRANDFATHERING IN EXISTING AND PENDING LICENSEES.

CSSMA⁸⁸ agrees with the comment of NewSpace Operators that “for operators already in-orbit, it is not practical to apply new debris mitigation requirements retroactively.”⁸⁹ CSSMA urges the FCC to consider that any changes could result in companies going out of business and seriously harm U.S. innovation and competitiveness in the smallsat industry unless the FCC

⁸² See Boeing Comments at 37-38.

⁸³ See Space Logistics Comments at 10.

⁸⁴ See NewSpace Operators Comments at 20; SpaceX Comments at 8; SWF Comments at 9; Comments of EchoStar Satellite Operating Corporation and Hughes Network Systems, LLC, IB Docket No. 18-313 at 2 (filed Apr. 5, 2019); KTi Comments at 17.

⁸⁵ See CSSMA Comments at 23-24.

⁸⁶ See Viasat Comments at 2; Telesat Comments at 12. Many commenters, including CSSMA, have opposed indemnification/insurance requirements for all applicants outright, regardless of origin.

⁸⁷ See Viasat Comments at 2 (sharing this support of foreign regulatory oversight).

⁸⁸ See CSSMA Comments at 24.

⁸⁹ NewSpace Operators Comments at 23.

grandfathers existing or pending systems to provide them with additional time to evolve their technology and business plans. It is particularly relevant for NGSO operators operating under 650 km within the context of existing post-mission orbit lifetime.

VII. CONCLUSION

CSSMA again applauds the Commission's efforts to create a safe and sustainable orbital environment and looks forward to assisting the Commission and other relevant Federal agencies and organizations contemplate new orbital debris mitigation guidelines.

CSSMA reminds the Commission that "one-size-fits-all" rules should be avoided, and performance-based rules should govern.

Respectfully submitted,

CSSMA

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