Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, DC 20554

Application of	)	
	)	
SPACE EXPLORATION HOLDINGS, LLC	)	Call Sign: S2983/3018
	)	
For Extension of Special Temporary Authority	)	File No. SAT-STA-20200610-00071
	)	

REPLY OF VIASAT, INC.

Viasat, Inc. renews its request that the Commission deny or defer consideration of the above-referenced application of Space Exploration Holdings, LLC ("SpaceX") for Special Temporary Authority ("STA") for 180 days to allow its satellites to communicate with earth stations during orbit-raising, de-orbiting, and early phases of operations.[1]

SpaceX seeks STA to operate at substantially different parameters than those authorized to date. SpaceX sought authority to conduct some transmissions at power levels 8x the level previously authorized. SpaceX also indicated that it will not always comply with the equivalent power flux density ("EPFD") limits (i) designed to ensure that SpaceX does not cause harmful interference to GSO FSS networks, and (ii) with which SpaceX's current license requires compliance all of the time,[2] not just "during almost all operations" (as the STA request proposes).[3]

Viasat petitioned to deny or defer the STA request because many questions exist about the information in the STA request, required analysis has not been provided, and additional

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1 *See* Request for Special Temporary Authority of Space Exploration Holdings, LLC, IBFS File No. SAT-STA-20200610-00071 (filed June 10, 2020) ("*STA Request*").

2 *See Space Exploration Holdings, LLC, Application for Approval for Orbital Deployment and Operating Authority for the SpaceX NGSO Satellite System*, Memorandum Opinion, Order, and Authorization, 33 FCC Rcd 3391 (2018), at ¶ 40 ("*SpaceX Initial Authorization*").

3 *STA Request*, at 2.

review and investigation are needed before the Commission could even contemplate granting this STA request.[4] Viasat also explained that it provides services to customers and operates satellites using frequencies that are the subject of the STA application.[5]

In response, SpaceX volunteered to reduce the proposed power increase from a factor of 8x to a factor of 5x, and included a limited, bounding analysis of downlink EPFD, but only with respect to that power increase in 100 megahertz of the Ku band.[6] SpaceX still has not provided an EPFD analysis with respect to all of its other proposed operations and frequencies when operating at injection orbit or during orbit raising. Nor did SpaceX address many of the other issues in Viasat's STA Petition.

1. The STA Request Remains Unjustified

It is now unequivocally clear from SpaceX's own statements that it is seeking expanded STA to provide the ability to launch satellites into lower injection orbits so that SpaceX can more quickly de-orbit failed Starlink satellites that SpaceX denominates "orbital debris"[7] (in this case, satellites that fail immediately after launch or otherwise are unreliable).[8] That is, SpaceX seeks authority to operate at substantially higher power levels to facilitate its ability to de-orbit failed or unreliable satellites that should not have been launched in the first place.

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4 *See generally* Petition to Deny or Defer of Viasat, Inc., IBFS File No. SAT-STA-20200610-00071 (filed Aug. 3, 2020) ("*Viasat STA Petition*").

5 *See id.* at 4-5.

6 *See* Response of Space Exploration Holdings, LLC, IBFS File No. SAT-STA-20200610-00071, at 2, 5 (filed Aug. 17, 2020) ("*SpaceX Response*").

7 *See id.* at 2 ("SpaceX's request to operate at higher power in very short bursts is a result of its ongoing efforts to enhance the safety of space for all who would operate there. As the Commission well knows, the atmospheric drag at lower altitudes ensures that any *orbital debris* will quickly re-enter and demise in the atmosphere." (emphasis supplied)).

8 *See STA Request*, at 1 ("SpaceX has recently begun inserting satellites at a very low orbital altitude – approximately 280 km. At that altitude, even in the unlikely event of an immediate satellite failure, spacecraft can be expected to demise in the atmosphere within a matter of weeks and thereby quickly remove any danger they could pose as *orbital debris*." (emphasis supplied)).

We also know that failures of SpaceX satellites cannot be deemed "unlikely" (as SpaceX wrongly claims),[9] given the significant experiential Starlink failure rates reported to date.[10] We do not know the full nature or scope of the problem that SpaceX seeks to solve with this STA, in part because it has not reported failures at injection orbit, and in part because SpaceX continues to stonewall the Commission and the public by refusing to address why failure levels that it once said were unfathomable are occurring, and why the failure rate in fact is increasing.[11] Nor do we know the root causes of these failures, or whether the infant mortality causes (*i.e.,* causes of early failure) will also likely cause failures later on – on the way to, or while at, operational orbit. And any such later failures that significantly impair spacecraft maneuverability could require that a satellite passively de-orbit over a period of approximately 5 years,[12] and not merely "within a matter of weeks" (as SpaceX claims).[13] In the meantime, those non-maneuverable satellites pose a risk of collisions — the kinds of collisions that fragment spacecraft and send large debris clouds into orbits hundreds of kilometers away that can take decades or even more than a century to passively de-orbit.[14]

SpaceX now asserts in response that it needs only a 5x power increase to support lower injection orbits (reduced from the original 8x increase).[15] SpaceX attempts to justify its modified

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9 *Id.*

10 *See* Petition to Deny or Defer of Viasat, Inc., IBFS File No. SAT-MOD-20200417-00037, at 14-16, 21-23, 31-32 (filed July 13, 2020) ("*Viasat Modification Petition*"); Reply of Viasat, Inc. in Support of its Petition to Deny or Defer, IBFS File No. SAT-MOD-20200417-00037, at 2-3, 16-24 (filed Aug. 7, 2020) ("*Viasat Modification Reply*").

11 *See Viasat STA Petition,* at 2-3; *Viasat Modification Petition,* at 14-16, 21-23, 31-32; *Viasat Modification Reply,* at 2-3, 16-24.

12 *See Viasat Modification Reply,* at 9.

13 *STA Request,* at 1. SpaceX makes varying statements in about the length of time it will take for failed satellites to de-orbit from the injection orbit, stating that it will take "a matter of days," *SpaceX Response,* at 2, and later in the same document that it will happen "within less than a month," *id.* at 6.

14 *See Viasat Modification Petition*, at 3, 7, 17, 36; *Viasat Modification Reply*, at 3, 4, 10-11, 21.

15 21 dBm instead of 23 dBm.

power increase as being part of "its ongoing efforts to enhance the safety of space for all who would operate there."[16] Putting aside for the moment the still-unresolved interference issues presented by this proposed power increase, *it bears emphasis that the need to use lower injection orbits is a problem of SpaceX's own making*: the desire to de-orbit failed or otherwise unreliable satellites that never should have been launched. This is particularly true when one considers that SpaceX assured the Commission that its failure rates would be "nowhere near" 1%, yet it has reported failures rates above injection orbit, at only about $1/10^{th}$ into satellite lifetime, of 2x to 3x that level—failure rates that can be expected to grow over the remaining design lifetime.[17]

Further, SpaceX's attempts to minimize the duration of its proposed use of this higher power level are inconsistent, even within the same document. SpaceX claims that these communications are at a "higher power level in a very small number of cases for very short duration."[18] Yet, in the same document, SpaceX goes on to say that, for a full month, the satellites will attempt to communicate in three-day cycles at their authorized power for 24 hours and then at their proposed increased power level for 48 hours.[19] Thus, SpaceX asks to operate potentially *all* of its satellites at increased power levels for 20 days a month.[20]

Thus, solving SpaceX's failure to honor its commitments to the Commission through an STA that provides enhanced ability to launch and dispose of unreliable satellites cannot be viewed as a public interest benefit. This is particularly true when a much safer and far-less-risky solution is requiring that SpaceX satisfy an underlying premise of its launch authority—building

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16 *SpaceX Response,* at 2.

17 *See Viasat Modification Petition,* at 21-22, 28-29 (citing Letter from William M. Wiltshire, Counsel to SpaceX, to Jose P. Albuquerque, Chief, Satellite Division, FCC, IBFS File No. SAT-LOA-20161115-00118, at 4 (filed April 20, 2017) ("*April 20 Response*")).

18 *SpaceX Response,* at 1.

19 *See id.* at 3.

20 *See id*.

reliable satellites at the outset.[21] The issues with these unreliable satellites are the apparent "design flaw[s]," "matter[s] of convenience," and "cost savings" to which Viasat referred in its STA Petition,[22] and which SpaceX refuses to address.[23] They also are the types of matters that the Commission has said warrant careful examination:

> In appropriate circumstances, the Commission could subsequently modify the license in accordance with Section 316 of the Communications Act to *address a rate of failure that departs materially from the expected reliability level, since that departure would affect the public interest assessment underlying grant of the license*.[24]

As Viasat has detailed, these circumstances undoubtedly are present in this case.[25]

2. The Impact of the Revised 5X Power Increase Is Not Fully Analyzed

As noted above, in response to Viasat's STA Petition, SpaceX has volunteered to reduce from 8x to 5x its proposed power increase for transmit telemetry, tracking, and command ("TT&C") operations within the 12.15-12.25 GHz band segment.[26] Viasat again notes that it provides extremely critical applications to certain customers in this spectrum for whom even "occasional" randomly occurring interference could be very damaging.

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[21] The Commission's original grant of authority for Starlink references in multiple places both a SpaceX response to a Commission inquiry about the reliability of the SpaceX satellites, and a supplemental application that addressed orbital debris risk management. *See SpaceX Initial Authorization*, at ¶¶ 3, 5, 12, 38. The SpaceX response assured, among other things: "SpaceX will construct its spacecraft to specifications and tolerances designed to ensure that failure rates are nowhere near the [1, 5 or 10 percent] levels postulated in this question." *April 20 Response*, at 4. The supplemental application assured: "SpaceX intends to incorporate the material objectives set forth in this application into the technical specifications established for design and operation of the SpaceX System." Space Exploration Holdings, LLC, IBFS File No. SAT-LOA-20170726-00110 (filed July 26, 2017), Attachment A, at 25.

[22] *Viasat STA Petition,* at 2-3. Viasat has explained—and SpaceX does not deny—that SpaceX has evidenced a "dispose and replace" approach to satellite deployment, and declining launch costs and economies of scale have *eliminated* SpaceX's incentives to achieve safe-space operations. *See Viasat Modification Petition*, at 29-31, 35-37.

[23] *See STA Response,* at 3-4

[24] *Mitigation of Orbital Debris in the New Space Age,* Report and Order and Further Notice of Proposed Rulemaking, 35 FCC Rcd 4156 (2020), at ¶ 99 (footnote omitted) (emphasis supplied).

[25] *See Viasat Modification Petition*, at 26-37.

[26] *See SpaceX Response*, at 2.

SpaceX's new and partial interference analysis as to this power increase proposal is deficient. SpaceX provides a bounding analysis, not an analysis derived by running the EPFD software that the Commission otherwise utilizes to evaluate EPFD compliance.[27] SpaceX also assumes an "average" distance from satellite to Earth, and not the closest distance to Earth when a satellite is in an elliptical injection orbit. Thus, SpaceX does not provide a "worst-case" bounding analysis, even though it claims to do so.[28] For example, SpaceX's analysis ignores the fact that the August 18, 2020 Starlink launch injection orbit was *elliptical* with a 207 km perigee, and a 370 km apogee.

3. Potential Exceedance of EPFD Levels Remains Unexamined

SpaceX also requested authority for "communications with six Ku-band earth stations to test the communications payload on each of its satellites; and communications with five Ka-band gateway earth stations to test the communications payload on each of its satellites."[29] While SpaceX claims in its response filing that "clearly the request is far more limited,"[30] the SpaceX application continues to:

- Request STA so the Starlink constellation can communicate with earth stations "during the orbit-raising and de-orbit phases and *early operations* of its satellites,"[31] and
- Assert "[b]y continuing testing *even after the satellites have reached their intended orbits*, SpaceX will ensure ongoing capabilities . . . ."[32]

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[27] *See Update to Parts 2 and 25 Concerning Non-Geostationary, Fixed-Satellite Service Systems and Related Matters*, Report and Order and Further Notice of Proposed Rulemaking, 32 FCC Rcd 7809 (2017), at ¶ 41 ("[W]e are adopting the EPFD limits contained in Article 22 of the ITU Radio Regulations, and applicants must use the ITU-approved validation software to assess compliance with these limits ….").

[28] *SpaceX Response,* at 5.

[29] *STA Request,* at 1.

[30] *SpaceX Response*, at 3.

[31] *STA Request,* at 1 (emphasis supplied).

[32] *Id.* at 2 (emphasis supplied).

If STA is needed only during orbit raising, and not to test the communications payload during "early operations" (a period that SpaceX does not specify), SpaceX should reflect that change as well.

Moreover, SpaceX seeks such communications payload test authority at "approximately 280 km"—an altitude that is about 2x as close to the Earth's surface as its authorized operating orbit of 550 km, about 4x as close as its 1,110 km authorized operating orbit, and about 5x as close as its 1,325 km authorized operating orbit. At a 280 km altitude, free space propagation loss is approximately 6 dB, 12 dB, and 14 dB less than at SpaceX's authorized orbits, respectively.[33] Thus, unless SpaceX reduces its power levels during payload "test" operations at 280 km to account for this factor, SpaceX risks exceeding the EPFD limits in its current authorization[34] that are designed to ensure that SpaceX does not cause harmful interference to GSO FSS networks. Notably, these are the EPFD limits with which SpaceX's current license requires it to comply *all of the time*,[35] but that the STA request indicates SpaceX intends to honor only "*during almost all operations*."[36]

In fact, SpaceX *entirely ignores* the part of Viasat's STA Petition that addresses EPFD concerns separately from the proposed power increase.[37] Apart from addressing when it intends to conduct high-power TT&C operations, SpaceX does not address the scope of other anticipated

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[33] $FSPL = 20log_{10}(f) + 20log_{10}(d) + 20log_{10}\left(\frac{4\pi}{c}\right)$.

[34] *See Space Exploration Holdings, LLC, Request for Modification of the Authorization for the SpaceX NGSO Satellite System*, Order and Authorization, 34 FCC Rcd 12307 (IB 2019), at ¶ 19(d), (e) ("*SpaceX Second Modification*").

[35] *See SpaceX Initial Authorization*, at ¶ 40.

[36] *STA Request*, at 2 (emphasis supplied)

[37] *See Viasat STA Petition,* at 5-6. Thus, SpaceX misstates when it claims: "Viasat's objection focuses on a single aspect of the Extension Request – the new proposal to transmit telemetry, tracking, and command ('TT&C') signals in the 12.15-12.25 GHz band at a higher power level in a very small number of cases for very short duration to the extent necessary to aid in establishing contact with SpaceX satellites soon after orbital insertion." *SpaceX Response,* at 1.

EPFD exceedances,[38] and it still fails to provide an EPFD analysis for transmissions from the communications payloads on its satellites under the proposed STA when operating at injection orbit or during orbit raising. Such an analysis should be conducted and consider the impact on third-party Ku-band and Ka-band satellite user terminals and gateways.

Again, Viasat provides extremely critical applications to certain customers for whom even "occasional" randomly occurring interference could be very damaging. SpaceX does not contest that it bears the burden of providing the necessary technical analysis to substantiate its proposal to operate on a non-interference basis.[39] SpaceX still fails to meet that burden. The Commission cannot consider processing this STA until SpaceX has provided the requisite analysis and the public has an opportunity to comment on that analysis.

4. Core Satellite Reliability Issues Remain Unaddressed

Viasat's STA Petition explains that recently-reported failures of SpaceX satellites bear on the STA request because neither the Commission nor interested parties are able to discern (i) the full nature of these failures, (ii) the root causes of the failures, or (iii) *whether these failures have any impact on SpaceX's ability to control the communications payload on its spacecraft during the time periods in which operations would occur under this requested STA*.[40] That is, neither the Commission nor interested parties know what happens when SpaceX loses control of a satellite and whether the payload could *continue* transmitting on its own, and, if so, at what levels and in what directions.[41]

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[38] As Viasat's STA Petition explains: "Thus, the STA request is entirely unclear (i) at what times and under what conditions SpaceX does not intend to comply with these limits, (ii) the extent of the exceedances (in terms of power levels), and (iii) the temporal duration of the exceedances." *Viasat STA Petition*, at 5.

[39] *See Viasat STA Petition,* at 4.

[40] *Id.* at 6.

[41] *Id.* at 6-7.

Far from being a "non sequitur," as SpaceX claims,[42] this "zombie" satellite issue is directly related to the unreliability/failure issue that is the stated basis for the STA request—both in the application and in the SpaceX response.[43] SpaceX deflects the issue by saying its satellites will not transmit until they are contacted by an earth station. That simply is not responsive. The issue is what happens to the payload once the satellite is activated and control is then lost, or the satellite otherwise fails. Does an automatic initiation of disposal occur when communications with a satellite that have been initiated otherwise cease or become limited? Is there a possible failure mode under which the Starlink satellites continue to transmit after a critical failure, and, if not, what makes that occurrence impossible?

In addition, this concern with zombie satellites is not limited to initial phases of operation since the SpaceX STA request ostensibly extends to some level of "on-orbit" operations.[44] Under these circumstances the zombie satellite concern applies to all stages of operations under the STA, even the payload testing "after the satellites have reached their intended orbits."[45] Therefore, SpaceX must provide more information about what measures it has taken to prevent unintended transmissions from satellites that fail after they have been initiated.

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SpaceX fails to address many issues raised in Viasat's STA Petition, and incompletely addresses the issues it does discuss. At bottom, SpaceX's response leaves the record insufficient to allow the Commission to proceed further on SpaceX's STA request. Among other things,

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42 *SpaceX Response*, at 5.

43 *See STA Request* at 1 ("SpaceX has recently begun inserting satellites at a very low orbital altitude – approximately 280 km. At that altitude, even in the unlikely event of an immediate satellite failure, spacecraft can be expected to demise in the atmosphere within a matter of weeks and thereby quickly remove any danger they could pose as orbital debris."); *SpaceX Response,* at 2 ("As the Commission well knows, the atmospheric drag at lower altitudes ensures that any orbital debris will quickly re-enter and demise in the atmosphere.").

44 *STA Request,* at 1.

45 *Id.* at 2.

SpaceX has not provided EPFD analyses for interference from its communications payload in injection orbit or during orbit rising into third party Ku-band or Ka-band satellite user terminals or gateways. And the full scope of potential EPFD exceedances remains unclear. Moreover, many of the responses that SpaceX does provide raise new questions. The Commission must deny or defer SpaceX's STA request until it provides the information necessary to fully evaluate these matters.

In any event, the "orbital debris" issue that is touted as a purported public interest benefit of granting the STA is in reality a satellite unreliability issue of SpaceX's own making that (i) unduly increases risk to safe space, and (ii) cannot in any manner constitute a basis for granting the requested STA.

Respectfully submitted,

/s/

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CERTIFICATE OF SERVICE

I, Kayla Ernst, hereby certify that on this 28th day of August, 2020, I caused to be served a true copy of the foregoing Reply of Viasat, Inc. via first-class mail upon the following:

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