Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554

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

RESPONSE OF SPACE EXPLORATION HOLDINGS, LLC

In this proceeding, Space Exploration Holdings, LLC ("SpaceX") requests an extension of its existing Special Temporary Authorization ("STA") so that satellites launched and to be launched into its non-geostationary orbit ("NGSO") Starlink constellation can continue to communicate with earth stations operated by its sister company, SpaceX Services, Inc. ("SpaceX Services"), during the orbit-raising and de-orbit phases and early operations of its satellites.[1] SpaceX has conducted such operations for over a year under a series of STAs without complaint from any licensed user of the relevant spectrum.

Only one party – Viasat, Inc. ("Viasat") – filed in response, asking that the Commission deny or defer consideration of SpaceX's request.[2] 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

[1] *See* Request for Extension of Special Temporary Authority, IBFS File No. SAT-STA-20200610-00071 (June 10, 2020) ("Extension Request").

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

satellites soon after orbital insertion. Although Viasat's concerns are overblown and SpaceX's proposed operations can continue to be conducted on a non-harmful interference basis, SpaceX will revise its request to lower the level of higher power TT&C transmissions by 2 dB in order to ensure that all such operations will comply with applicable equivalent power flux-density ("EPFD") limits designed to protect geostationary satellite operations. This adjustment should fairly and fully satisfy any legitimate concerns. Accordingly, the Commission should deny Viasat's Petition and grant extension of the SpaceX STA on these revised terms.

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. The lower the altitude, the more pronounced this effect will be. SpaceX has decided to launch its satellites to an injection altitude of approximately 280 km – much lower than other operators do. At this altitude, a satellite would de-orbit in a matter of days unless it engages propulsion to offset the effects of drag and gravity. As a result, while this low injection altitude enhances space safety in general, it also creates a very short window during which SpaceX must establish contact with its satellites before they demise in the atmosphere.

In most cases, SpaceX has little difficulty establishing contact with its satellites after launch. But in a small number of cases, it has nearly lost a satellite before it could do so. Earth station pointing is a bit of an approximation due to the inexact information on satellite location prior to establishing contact, and the gain of the omnidirectional TT&C antenna on the satellites varies substantially with azimuth and elevation so that the EIRP transmitted toward the earth station can be 5-6 dB lower than the stated maximum. Because all SpaceX satellites are programmed not to transmit until they have been contacted by an earth station, the failure to make

and sustain a connection would result in the loss of a satellite that may be in perfectly good health. Thus, SpaceX has proposed a mechanism to enhance its ability to establish initial contact with those few satellites that might otherwise be difficult to reach.

As discussed in the Extension Request,[3] under the expiring STA, SpaceX satellites are authorized to transmit TT&C signals at 14 dBm upon orbital insertion. Under SpaceX's proposal, nothing would change for the first 24 hours after insertion – a period during which SpaceX has been able to establish contact with almost all of its satellites to date. To the extent a satellite had not yet established a link within that timeframe, it would be programmed to respond at a higher power level if contacted within the next 48 hours. SpaceX estimates that in the large majority of cases transmitting for approximately five seconds at the higher power level should be sufficient to downlink trajectory information so that SpaceX's TT&C ground station can track the spacecraft and maintain contact. In a small number of cases, it is possible that the satellite may be unable to close the link for the full five-second period, and thus will continue to transmit bursts of trajectory information over several minutes until it is either successful or passes out of the TT&C earth station's view. At the end of this 72-hour cycle, the satellite would reboot and repeat the 24/48-hour power cycle. At any point in this process after the satellite establishes contact with SpaceX's TT&C earth station, it will quickly revert to the currently authorized (lower) power level.

Notwithstanding the fact that all of this was laid out in the STA request, Viasat intentionally misconstrues the nature of SpaceX's request, asserting that SpaceX proposes to operate at higher power "during launch, deorbit and early operations"[4] when clearly the request is far more limited. Perhaps this is why Viasat wonders what problem the higher-power proposal is designed to solve

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3 *See* Extension Request at 1-2.

4 Viasat Petition at 3.

and whether it is "the result of a design flaw," "a matter of convenience," or designed to achieve "cost savings."[5] The "problem" is that achieving safer space for everyone requires greater risk for SpaceX – a risk that arises by operation of physics and is actually less convenient and more expensive than using a higher injection orbit closer to its assigned operational altitude. SpaceX is willing to take on that additional risk for the good of everyone and asks only for a small operational tweak designed to help alleviate that burden.

SpaceX stated in its STA request that its proposed higher power TT&C transmissions would likely exceed the applicable EPFD limits. However, SpaceX argued that the short duration, small bandwidth, and highly intermittent nature of these transmissions made harmful interference to other licensed users of the band unlikely. Viasat asserts that 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."[6] To the contrary, SpaceX has explained that any exceedance would happen only to the extent that a satellite operates for a brief period at the higher power level during the acquisition window following orbital insertion – which itself would only happen on those very rare occasions when SpaceX was unable to establish contact during the first 24 hours after launch.

Nonetheless, SpaceX has determined that it can enhance its ability to establish initial contact with satellites after launch while also operating within the EPFD limits. SpaceX initially proposed to operate its higher power TT&C at a level of 23 dBm but is revising its request to a reduced level of 21 dBm in order to alleviate the concerns expressed by Viasat. The following analysis demonstrates that operating at that level would not exceed the EPFD limits.

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5 *Id.* at 2-3.

6 *Id.* at 5.

SpaceX has only one TT&C earth station site in the United States, located in Brewster, Washington (48.09° North Latitude). Assuming a GSO earth station collocated at that site, the worst possible case for interference occurs when the GSO earth station is pointed South at the maximum possible elevation, which at that latitude is 34.8 degrees, at the moment that a SpaceX satellite at 280 km crosses its beam while transmitting TT&C at higher power. The minimum possible distance between a SpaceX satellite at 280 km altitude and this victim earth station is 471.2 km. Using these parameters, we determine the maximum, worst case EPFD caused by higher power TT&C operations from such a satellite in Table 1 below.

Parameter	**Value**
Satellite TT&C peak gain	3 dBi
Proposed transmit power	21 dBm
Necessary bandwidth	41.5 MHz
EIRP Density	-82.2 dBW/Hz
Distance to satellite	471.2 km
Spreading loss	124.5 dB
EPFD	-160.6 dBW/m^2/40kHz

Table 1. Worst-Case EPFD Calculation

Accordingly, even in the very unlikely case described above and for the very short duration such transmissions may occur, SpaceX's proposed TT&C operations would not exceed -160 dBW/m^2/40kHz, the most stringent EPFD limit in the relevant band under Article 22 of the ITU Radio Regulations.

Lastly, in a total non sequitur, Viasat seeks to inject an irrelevant argument in which it imagines the potential for out-of-control "zombie" satellites that transmit continuously and

persistently at high power.[7] As stated above and in SpaceX's STA request, SpaceX satellites will not transmit unless they are first contacted by an earth station. Under SpaceX's proposal, only those that have not established contact within the first 24 hours would thereafter respond to contact from an earth station with a brief burst of information at higher power. If contact were lost thereafter, the transmissions would cease. Moreover, if SpaceX were not able to establish contact and initiate orbit raising maneuvers, the satellite would enter the atmosphere within less than a month. Thus, an STA that facilitates the use of a lower injection orbit would actually ameliorate Viasat's concern as it would ensure a swift demise of any such "zombie" satellite.

Thus, Viasat's purported concerns rest primarily on its willingness to ignore what SpaceX has actually proposed so that instead it can raise issues that are not actually presented. Nonetheless, SpaceX is willing to reduce its higher power operations by 2 dB in order to fully resolve any potential concerns. Accordingly, the Commission should deny Viasat's Petition.

Respectfully submitted,

SPACE EXPLORATION HOLDINGS, LLC

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[7] *See id.* at 6-7.

ENGINEERING CERTIFICATION

I hereby certify that I am the technically qualified person responsible for preparation of the engineering information contained in this filing, that I am familiar with Part 25 of the Commission's rules, that I have either prepared or reviewed the engineering information submitted in this filing, and that it is complete and accurate to the best of my knowledge and belief.

/s/ *Mihai Albulet*

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August 17, 2020
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CERTIFICATE OF SERVICE

I hereby certify that, on this 17th day of August, 2020, a copy of the foregoing pleading was served via First Class mail upon:

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