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July 24, 2017

BY ELECTRONIC FILING

Jose P. Albuquerque
Chief, Satellite Division
International Bureau
Federal Communications Commission
445 Twelfth Street, S.W.
Washington, DC 20554

Re: *Space Exploration Holdings, LLC, IBFS File No. SAT-LOA-20170301-00027*

Dear Mr. Albuquerque:

On behalf of Space Exploration Holdings, LLC ("SpaceX"), we hereby respond to your letter dated June 22, 2017, in which you have requested additional information with respect to the above referenced application for authority to deploy and operate a non-geostationary orbit ("NGSO") satellite system.[1] As described in that application, SpaceX proposes to operate a system composed of two sub-constellations of space stations: (1) the LEO Constellation, composed of 4,425 satellites operating at altitudes ranging from 1,110 km to 1,325 km; and (2) the VLEO Constellation, composed of 7,518 satellites operating at altitudes ranging from approximately 336 km to 346 km. Each question and the relevant response are set forth below.

1. ***A statement from SpaceX disclosing the accuracy with which the parameters of satellite orbits will be maintained, including apogee, perigee, inclination, and the right ascension of the ascending node(s). Although SpaceX states that it will maintain the accuracy of its orbital parameters at a level that will allow operations with sufficient spacing to minimize the risk of conjunction with adjacent satellites in the constellation and other constellations, SpaceX's statement does not disclose the information specified above concerning the accuracy of the orbital parameters of its satellite system.***

Apogee and perigee will be maintained to within 30 km for the LEO Constellation, and to within 5 km for the VLEO Constellation. For both systems, inclination will be maintained to less than 0.5 degree of the respective target values. The right ascension of the ascending nodes

[1] Letter from Jose P. Albuquerque to William M. Wiltshire and Paul Caritj, IBFS File No. SAT-LOA-20170301-00027 (June 22, 2017).

("RAANs") will precess and span the full range of 0-360 degrees. As the design matures and approaches flight, these values will be refined further.

In addition, SpaceX has designed orbits such that LEO Constellation satellites need only maintain a position with a tolerance no larger than 60 km along-track in the worst case, or even greater distances at earlier stages of the roll-out. It is unlikely this full along-track margin will ever be used, but these highly conservative tolerances further improve the robustness of the SpaceX system. For the VLEO Constellation, under nominal conditions the satellites are separated by at least 55 km in-track, and by 5 km in altitude. In addition, SpaceX will maintain extremely accurate information about the location of each satellite, and make this information available to other operators through its shared ephemeris data.

2. ***Please provide an analysis of collision risk for satellites during the passive disposal phase, (i.e., after all propellant is consumed) for a 7,518 satellite deployment, assuming 100% reliability; and using representative scenarios for altitude at the end of the active phase. As part of that analysis, please provide an assessment of how many conjunctions and/or collision avoidance maneuvers might be required of the International Space Station (ISS), assuming it is in operation throughout the period in which SpaceX satellites would transit the ISS orbit.***

Due to their very low operational altitudes, satellites in the VLEO Constellation will reenter the atmosphere within approximately one month after completion of their mission. In fact, these satellites operate at such low altitudes that separate disposal orbits are not necessary. While in service, these satellites require frequent thrust to counteract atmospheric drag and maintain operational altitude. Soon after the thrusters are disabled, VLEO satellites will naturally re-enter the Earth's atmosphere due to atmospheric drag. Because these satellites operate at a lower altitude than the ISS, there is no possibility that they will intersect the orbit of the ISS during this deorbit process.

SpaceX will continue to monitor the orbital environment, spacecraft design, and orbital characteristics of its disposal procedures to ensure that these are performed responsibly, and incorporate any improvements should the need become apparent.

3. ***Please provide an analysis of collision risk, assuming rates of satellite failure resulting in the inability to perform collision avoidance procedures of 10, 5 and 1 percent. This analysis should include a study performed assuming all failures occur at the mission altitude, but may also include additional studies specifying alternative assumptions concerning the orbital locations (such as injection altitude) at which failures might occur.***

SpaceX's current and planned space-based activities underscore its unparalleled commitment to safe space. Indeed, much of the motivation for SpaceX's innovative VLEO Constellation was the desire to address precisely the challenge of reducing orbital debris in the presence of large satellite constellations. The orbital altitudes of SpaceX's VLEO Constellation solve this problem by guaranteeing that a disabled spacecraft, or any debris, will swiftly re-enter the atmosphere, as the VLEO satellites require frequent thrust to maintain altitude. The consequent collision risk due to satellite failure is near zero because each spacecraft will quickly drop below the operational orbit and be rendered kinematically unable to intersect the orbits of its still-flying cohort.

SpaceX has also taken, and continues to take, steps to ensure the reliability of its spacecraft. SpaceX has had extensive experience in safe-flight design and operation through many missions to the ISS by both the Falcon 9 launch vehicle and the Dragon spacecraft. The company is highly experienced with cutting-edge debris mitigation practices and has deep ties with the domestic and international institutions tasked with ensuring the continued safety of space operations.

Accordingly, SpaceX is committed to maintaining a debris-free environment in space. For example, SpaceX has designed a rigorous maneuver response procedure to react to Joint Space Operations Center ("JSpOC") conjunction warning messages, including future enhancements afforded by the Space Fence, in order to tightly control overall constellation risk to a safe value. Its satellites are designed with propulsion systems capable of performing frequent maneuvers to avoid any trackable orbital debris, and will include redundancy for critical components, as well as other attributes that enhance reliability and survivability. SpaceX will also aggressively monitor the health of each satellite (including specialized on-board instrumentation) so that it can quickly detect any potential problems, and will have recovery protocols in place should such a problem arise. Each of these capabilities and features, developed for our LEO constellations, will be carried over to the VLEO spacecraft as well.

Having taken such steps to reduce the risk of collision or malfunction, SpaceX views satellite failure to deorbit rates of 10 or 5 percent as unacceptable, and even a rate of 1 percent is unlikely. As noted above, even these unacceptably high failure rates would not elevate the risk of collision for satellites in SpaceX's VLEO Constellation, which will rapidly re-enter the Earth's atmosphere due to atmospheric friction in the event of any loss of control.

Moreover, for the LEO Constellation, several aspects of the company's operations and business practices combine to effectively eliminate the chance that failure rates of 10 or 5 percent will ever occur. First, de-orbit will be the highest reliability system on the spacecraft. SpaceX will construct its spacecraft to specifications and tolerances designed to ensure that failure rates are nowhere near the levels postulated in this question. Specifically, SpaceX is designing the constellation to exceed NASA's debris mitigation guidelines, which require a post-mission disposal success rate of 90 percent,[2] by targeting a less than 1 percent rate of failure to deorbit from all causes. This is not only a sound practice to secure safety of space generally, but also a business imperative for a company like SpaceX that depends upon regular access to and use of space.

Furthermore, unlike operators with a small number of large satellites, SpaceX's incentives to maintain the overall health of its constellation align well with SpaceX's and the Commission's goals of ensuring the continued safety of space. Because each satellite will constitute only a small portion of the overall system investment, SpaceX will have little incentive to keep an unhealthy satellite in orbit and a far stronger incentive to maintain overall constellation health and an operating environment free of debris. Therefore, SpaceX intends to use information from its aggressive monitoring program to quickly detect any potential problems and deorbit affected satellites at a more conservative threshold of spacecraft health.

Second, SpaceX will deploy its spacecraft incrementally over a long period of time. Launching thousands of satellites will take years to complete, enabling SpaceX to monitor and react to developments with its constellation along the way. Thus, even in the unlikely event that an unforeseen circumstance arises, SpaceX would be able to defer further deployment until the problem has been identified and corrected before resuming launch of subsequent spacecraft.

Third, SpaceX does not intend to freeze the design process for its spacecraft at the first launch. Rather, it will continue to explore new technologies and implement upgrades in an iterative process to ensure that its satellites are highly reliable – a necessity not only for maintaining

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[2] *Process for Limiting Orbital Debris*, NASA Technical Standard, NASA-STD-8719.14A, § 4.6.2.4(a) ("NASA Standard 8719.14A"), *available at* http://everyspec.com/NASA/NASA-NASA-STD/NASA-STD-8719--14A_CHG-1_46754/.

the continued safety of space, but also for delivering a high-quality service. SpaceX already has substantial experience engaging in such a process of continued improvement with its Dragon capsule, and this ongoing review would likely expose and correct any latent defect in system design. This would enable SpaceX not only to avoid launching any more problematic spacecraft, but also to deorbit any spacecraft already in orbit identified as at risk for similar issues.

SpaceX will work to ensure that the odds of satellite failure to deorbit are driven as far towards zero as possible – both to ensure the continued safety of space and to ensure the continued health of its constellation. To the extent any spacecraft become incapacitated on-station without the ability to maneuver, they would not materially increase the risk of collision with other SpaceX spacecraft; in the unlikely event of a failed LEO satellite, that satellite would merely become another piece of debris and be treated no differently for collision-avoidance screening and risk assessment than any other piece of trackable debris.

The probability of a collision between a failed SpaceX satellite and another piece of debris is also extremely remote. Debris at VLEO altitudes suffers the same quick demise as unpowered spacecraft, and consequently this region of space is, and will remain, over 100 times cleaner than the orbits planned for the operations of most LEO systems. Debris collision is not a meaningful probability for the VLEO Constellation, but nonetheless SpaceX will perform the same conjunction avoidance analysis using JSpOC data as it does for the LEO Constellation. Moreover, SpaceX has an ongoing simulation corroborating probabilities between JSpOC information and the predictions of NASA's Orbital Debris Engineering Model, which is used to analyze collision risks under different maneuver protocols. Assuming a satellite failure rate of 1 percent at mission altitude and no maneuver events for these incapacitated vehicles, there is approximately a 1 percent chance *per decade* that *any* failed LEO Constellation satellite would collide with a piece of tracked debris. The probability is far smaller for the VLEO Constellation, given the effects of atmospheric drag at its low operating altitude. While the question suggests consideration of higher failure rates, these scenarios would be highly unlikely for the reasons discussed above. In case of such an extreme failure rate, however, the consequences can be approximately linearly extrapolated.

SpaceX commends the Commission for raising this issue, as the elimination of orbital debris is critical for all users of space. This would be an appropriate topic for inquiry of all NGSO applicants – especially those that operate above 400 km, where atmospheric drag will not guarantee prompt re-entry of any disabled satellite or orbital debris – to ensure *all* systems that serve the U.S. meet the same high standard. While the Commission applies its own orbital debris mitigation analysis to those seeking a U.S. license, it cannot simply assume that non-U.S. licensed systems that seek access to the U.S. market have been held to the same standard. The Commission may choose to defer to other licensing administrations on general oversight of debris mitigation efforts. But with respect to this crucial issue in particular, it must collect sufficient evidence to determine whether those administrations have imposed the requisite level of oversight. Unless the Commission receives such evidence, it should require non-U.S. licensees seeking access to the U.S. market to submit a response to this same range of questions.[3] Only in this way can the Commission have confidence that all those NGSO systems serving the United States have

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3 The Commission has, in some instances, requested further information with respect to orbital debris issues from non-U.S.-licensed NGSO systems seeking access to the U.S. market. *See, e.g.*, Letter from Jose P. Albuquerque to Elisabeth Neasmith, IBFS File No. SAT-LOI-20170301-00023, at 2-3 (June 22, 2017); Letter from Jose P. Albuquerque to Joseph C. Anders, IBFS File No. SAT-PDR-20161115-00112, at 1-2 (Mar. 15, 2017); Letter from Jose P. Albuquerque to Elisabeth Neasmith, IBFS File No. SAT-PDR-20161115-00108, at 1-3 (Mar. 15, 2017); Letter from Jose P. Albuquerque to Nicholas G. Spina, IBFS File No. SAT-PDR-20161115-00114, at 2-3 (Mar. 21, 2017).

adequately considered and planned for mitigation of orbital debris that would pose a serious danger to all other users of space.

4. ***Please state whether, during all stages of satellite operations prior to the passive disposal phase, SpaceX will perform collision avoidance procedures, including conjunction assessment, execution of avoidance maneuvers, trajectory planning and conjunction assessment for any planned alteration of satellite trajectory, and notification to other potentially affected operators of any planned alteration of a satellite's trajectory.***

SpaceX confirms that it intends to perform collision avoidance procedures, including conjunction assessment, execution of avoidance maneuvers, trajectory planning and conjunction assessment for any planned alteration of satellite trajectory, and notification to other potentially affected operators of any planned alteration of a satellite's trajectory. SpaceX will perform conjunction screening and avoidance maneuvers for all phases of operations, including any planned alteration of satellite trajectory, prior to passive disposal. All satellites will have sufficient propellant and capability to perform any avoidance maneuvers required for all phases of the satellites' mission.[4] SpaceX is already practicing this activity with JSpOC through a simulation of 100 satellites to ensure both SpaceX and JSpOC are prepared to implement conjunction avoidance strategies with a large constellation. SpaceX intends to share information on planned maneuvers with the satellite community, though it has not yet settled on the exact means through which it will

[4] SpaceX will reserve approximately 245 m/s of delta-V – a measure of the impulse required for a given maneuver or, here, the capability to perform those maneuvers if necessary – to deliver the described de-orbit functionality for the LEO Constellation. A spacecraft's ability to perform a given maneuver is determined not just by the mass or volume of propellant available, but also factors specific to the propellant tank and propellant lines (such as propellant leakage), the exact efficiency of the propulsion system, and even the mass of the spacecraft itself, all of which the delta-V measurement takes into account. These additional factors also remain subject to additional testing and design improvements meaning that, while SpaceX's reserved delta-V value will remain constant, mass of available propellant reserves may vary as the spacecraft design is finalized.

do so. Potential options include JSpOC, the Federal Aviation Administration, and the Space Data Association, among others.

5. ***Any additional information you may wish to provide concerning human casualty risk resulting from satellite disposal, such as outcomes based on higher fidelity analysis, or any risk or loss mitigation strategies under development.***

SpaceX has assigned a high priority to minimizing the risk of terrestrial damage or injury that may be caused by the planned demise of constellation satellites. Accordingly, SpaceX has applied a design philosophy of minimizing the use of materials that stand a chance of surviving re-entry. Its design teams coordinate with all relevant subsystems to ensure vehicle-wide design for demisability. For the majority of the satellite, this involves designing components to facilitate rapid break-up upon re-entry. For a select few components made of materials with extremely high melting points, the goal is instead to design structures that resist break-up into multiple pieces so as to minimize the total quantity of high-risk objects that could reach the ground. While an overwhelming majority of each satellite can be expected to demise completely, a preliminary analysis using NASA's Debris Assessment Software ("DAS") has identified a small subset of components that pose a risk of human casualty. These components are currently limited to an iron ion thruster core and a precision silicon-carbide optical component. In both cases, the material properties of the component in question are critical to the design and function of its parent assembly, through some combination of physical, thermal, or electromagnetic traits.

As a result of careful design efforts, the NGSO system proposed by SpaceX can be expected to achieve safety levels well above U.S. and international norms. NASA Standard

8719.14A mandates that the risk of human injury[5] induced by all surviving remnants of a re-entering spacecraft shall not exceed 1-in-10,000. All SpaceX vehicles more than satisfy this performance figure, with individual vehicle risks ranging from 1:17,400 to 1:31,200. Nonetheless, SpaceX continues to explore design refinements that will result in even greater levels of demisability.

Furthermore, these figures were generated using NASA's DAS toolkit, a software suite for first order re-entry analysis that is intended to provide a conservative risk estimate. As the DAS User's Guide makes clear, "[t]his part of DAS is intended to be a 'first cut' assessment tool" that provides conservative results.[6] It does not, for example, include any consideration of the degree to which people would be located within structures that would provide shelter from potential impact. In 2013, the International Association for the Advancement of Space Safety released a publication that suggests that 19% of the population is unsheltered, 59% is in light shelter, and 22% is in heavy shelter.[7] According to NASA, even lightly-sheltered structures provide protection against falling debris with up to a few kilojoules of kinetic energy.[8] It is worth noting that this factor alone was sufficient to reduce the casualty risk of another NGSO system by nearly 80%.[9]

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5 NASA Standard 8719.14A § 4.7.1 defines "casualty" in this context as an injury that requires medical attention within 48 hours.

6 NASA Orbital Debris Program Office, *Debris Assessment Software User's Guide – Version 2.1*, at 35 (Oct. 2016), *available at* https://orbitaldebris.jsc nasa.gov/library/das2_1_1/das2.1_usersguide.pdf.

7 *See* Tommaso Sgobba, *Safety Design for Space Operations*, The International Association for the Advancement of Space Safety (2013).

8 NASA Standard 8719.14A at § 4.7.3(d).

9 *See* Letter from Scott Blake Harris to Marlene H. Dortch, IBFS File No. SAT-MOD-20131227-00148 (Apr. 28, 2016) (including consideration of sheltering in DAS analysis reduced human casualty rate from 1:4,400 to 1:20,000).

Applying a similar analysis, the aggregate risk anticipated for the LEO Constellation would be less than one global injury in 100 years, while that for the VLEO Constellation would be approximately one every 59 years.

To enhance its risk management efforts, SpaceX has initiated with NASA a higher fidelity re-entry analysis, employing NASA’s proprietary Object Reentry Survival Analysis Tool (“ORSAT”), a more comprehensive model that provides more accurate results and a further level of insight over the standard DAS analysis. The results of that analysis will enable SpaceX to further refine spacecraft component geometries in order to maximize the probability of atmospheric demise. SpaceX plans to collaborate with NASA and leverage the agency’s decades of re-entry experience in order to achieve a design that minimizes risk to people on the ground. SpaceX will continue performing this analysis on a periodic basis, ensuring that risk estimates remain relevant to future spacecraft revisions.

6. Any information or analysis you may wish to provide with respect to treatment of this application under the Commission's environmental processing rules.

SpaceX has not yet determined final locations or designs for its gateway earth stations and other ground facilities. At such time as it does deploy those facilities, it fully anticipates that they will be sited in compliance with the restrictions set forth in Section 1.1307(a) of the Commission’s rules, and will comply with the environmental limitations on human exposure to radiofrequency radiation under Section 1.1307(b).

SpaceX is unaware of any case in which the Commission has applied its environmental processing rules to the space stations of a GSO or NGSO satellite system.[10] There is no need to depart from that precedent here. As discussed above, SpaceX continues to refine its satellite system, with the goal of achieving a spacecraft design with even greater demisability upon atmospheric re-entry with respect to the few components that currently might survive.[11] In such circumstances, there is no reason to believe that the SpaceX system will have a significant effect on the areas and species listed in Section 1.1307, and thus the system should be categorically excluded from environmental processing.[12]

7. For optical inter-satellite links, please provide the wavelength, power, duty cycle, beam diameter at emitter, and beam divergence. In addition, please provide the power margin at the receiver at maximum operating distance.

The relevant characteristics of the current generation of optical inter-satellite links ("ISLs") that will be used by the SpaceX NGSO system have been provided to the Commission in response to a previous request for information,[13] and are incorporated herein by reference.

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[10] The case cited in your letter did not involve space stations, but rather a network of repeaters for two-way paging services mounted on free-floating balloons. Given that the applicant in that case intended to launch more than 50,000 such balloons per year, all of which would return (with repeaters) to Earth, the Wireless Telecommunications Bureau found that the environmental processing rules should apply. *See Space Data Corp.*, 16 FCC Rcd. 16421, ¶¶ 24-27 (WTB 2001).

[11] The Commission's estimate that the VLEO Constellation could cause 300,000 separate objects to strike the Earth's surface appears to significantly overestimate the amount of non-demising debris that the VLEO system will generate. According to the DAS analysis included in SpaceX's application, there are, at most, ten components in each VLEO satellite that may reach the Earth's surface. Multiplied across 7,518 satellites, this conservative model would predict 75,180 objects. Moreover, only a fraction of these objects would be expected to pose any risk of human casualty.

[12] *See* 47 C.F.R. §§ 1.1306, 1.1307(a) (describing areas categorically excluded from environmental processing).

[13] *See* Letter from William M. Wiltshire to Jose P. Albuquerque, IBFS File No. SAT-LOA-20161115-00118, Exhibit A (Apr. 20, 2017) (request for confidential treatment for proprietary information).

8. Please indicate whether optical inter-satellite links will be coordinated with other systems proposed in FCC applications and with the DoD's laser clearing house, and, if such coordination has commenced, please address the status of coordination.

SpaceX plans to operate its optical ISLs at a frequency greater than 10,000 GHz. The Commission has consistently held that these optical transmissions fall outside its jurisdiction over radio communications.[14] This conclusion is consistent with international norms as well, where the ITU Convention defines the term "radio waves" as "electromagnetic waves of frequencies arbitrarily lower than 3000 GHz, propagated in space without artificial guide."[15] Indeed, the one time that the ITU looked into the possibility of adopting procedures for free-space optical links,[16] the U.S. took the position that "interference between inter-satellite links would also be rare due to directed and narrow beamwidths, and the vast geometry of space," and that therefore "there is no evidence to suggest procedures for free space optical links are needed."[17] The ITU agreed, and the underlying resolution to look into this issue was deleted.[18] Regulation would be especially

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14 *See, e.g.*, *TRW, Inc.*, 16 FCC Rcd. 14407, ¶ 20 (IB 2001) ("Optical beam communications are not considered a type of radio communication since they operate at frequencies above 300 GHz, and they are not within the jurisdiction of the Communications Act."); *Hughes Communications, Inc.*, 16 FCC Rcd. 14310, ¶ 16 (IB 2001) (same); *Teledesic LLC*, 14 FCC Rcd. 2261, ¶ 14 (IB 1999) ("Because optical ISLs do not involve wire or radio frequency transmissions, the Commission does not have jurisdiction over the use of optical ISLs.").

15 Convention of the International Telecommunication Union, Annex, No. 1005 n.1 (2015), *available at* http://search.itu.int/history/HistoryDigitalCollectionDocLibrary/5.21.61.en.100.pdf. As part of its order implementing the results of WRC-12, the Commission recently extended the U.S. Table of Frequency Allocations to cover frequencies up to a maximum of 3,000 GHz (from 1,000 GHz). *See Amendment of Parts 2, 15, 80, 90, 97, and 101 of the Commission's Rules Regarding Implementation of the Final Acts of the World Radiocommunication Conference (Geneva, 2012) (WRC-12), Other Allocation Issues, and Related Rule Updates*, 32 FCC Rcd. 2703, ¶ 47 (2017).

16 *See* ITU Res. 955 (WRC-07).

17 *See* ITU Res. 955 (WRC-12) Agenda Item 1.6 (Resolution 955) – USA Proposals for the Work of the Conference, at 2-3, *available at* https://www fcc.gov/us-contributions-sent-citel-pccii.

18 *See* ITU, Final Acts – WRC-12, at 176 (list of resolutions approved for deletion), *available at* http://search.itu.int/history/HistoryDigitalCollectionDocLibrary/4.133.43.en.100.pdf.

unnecessary for the optical ISLs SpaceX plans to use, which operate at a very low power level – low enough to qualify as a Class 1 laser, which cannot emit laser radiation at levels that are known to cause eye or skin injury during normal operation and thus are not generally subject to regulation.[19]

These same considerations effectively obviate the need for coordination of such ISLs between satellite operators. And, unlike lower frequency emissions within the Commission's regulatory purview, beams at or near optical frequencies exhibit virtually no emissions outside of their very narrow beamwidths. In addition, because optical receivers are also highly directional, interference on an optical link would only be likely if another satellite (1) itself used optical ISLs, (2) passed through the narrow optical beam from SpaceX, and (3) did so with its ISL receiver aligned parallel to the SpaceX beam. This combination of events is extremely unlikely and makes any formal coordination unnecessary. Moreover, even if such an unlikely event were to occur, orbital dynamics ensure that the conjunction would only last fractions of a second and could only be repeated through deliberate action.

Likewise, SpaceX is aware of no general requirement for users of optical ISLs to coordinate with the Department of Defense ("DoD") Laser Clearinghouse.[20] This clearinghouse is intended for DoD users and others using lasers intentionally directed at DoD assets. SpaceX's proposed system does not meet either of these criteria. More importantly, as noted above, the very low power level and extremely narrow beam effectively mitigates any risk of harm. Notably, the DoD

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19 *See, e.g.*, American National Standard for Safe Use of Lasers, ANSI-Z136.1-2014; International Electrotechnical Commission, International Standard 60825.1: 2014 – Safety of Laser Products.

20 *See, e.g.*, U.S. Department of Defense, DoD Instruction 3100.11, *Management of Laser Illumination of Objects in Space* § 1.1 (Oct. 24, 2016) (limiting applicability to DoD owned, leased, or operated lasers and spacecraft), *available at* http://www.esd.whs.mil/Portals/54/Documents/DD/issuances/dodi/310011_dodi_2016.pdf.

Laser Clearinghouse is operated by JSpOC. As discussed in its application, SpaceX works closely with JSpOC on a range of issues, including planning for its proposed constellation. SpaceX would, of course, coordinate with other operators to the extent any such requirement is adopted or imposed.

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Should you have any questions, please do not hesitate to contact me.

Sincerely,

William M. Wiltshire

William M. Wiltshire
Counsel to SpaceX