



October 9, 2023

The Honorable Polly Trottenberg
Deputy Secretary
U.S. Department of Transportation
800 Independence Ave., S.W.
Washington, DC 20591

VIA ELECTRONIC MAIL

Dear Secretary Trottenberg:

Space Exploration Technologies Corp. (SpaceX) writes to correct the record and address inaccurate assessments regarding Starlink, SpaceX's global low Earth orbit (LEO) satellite broadband system, included in the September 22, 2023 Federal Aviation Administration (FAA) *Report to Congress on the Risk Associated with Reentry Disposal of Satellites from Proposed Large Constellations in Low Earth Orbit*. This report sought to articulate how FAA licensing processes can address potential risk with the reentry disposal of satellites from large constellations in LEO. Instead, it relied in error on a deeply flawed analysis that falsely characterizes reentry disposal risks associated with Starlink, while failing to evaluate reentry disposal from any other large constellation operator, whether U.S. or foreign. By this letter, SpaceX aims to identify and correct these errors. By extension, SpaceX respectfully requests that FAA correct its report to Congress.

To be clear, SpaceX's satellites are designed and built to fully demise during atmospheric reentry during disposal at end of life, and they do so. Extensive engineering analysis and real-world operational experience verify this basic fact. SpaceX has taken extraordinary measures to design, build, and operate its constellation in a safe and sustainable manner, both in relation to low Earth orbit but most importantly to people and property on the ground. With more than 5,000 Starlink satellites on orbit, SpaceX's approach to safety has been demonstrated in actual fact. Indeed, while FAA bases its conclusions on a claim that the space industry has not met the 90 percent success rate for post-mission disposal, SpaceX's post-mission disposal success rate *is greater than 99 percent*. This critical and clearly pertinent fact is somehow omitted from both FAA's report and the Aerospace Corporation analysis upon which it relies.

FAA's report relies exclusively on a technical evaluation conducted in 2021 by the Aerospace Corporation, a federally funded research and development corporation (FFRDC) that has no special knowledge or insight regarding Starlink. Due to this lack of knowledge, a flawed methodology that omits critically important factors, and an over-reliance on an inapt and outdated NASA study, Aerospace has provided FAA with a distorted analysis that makes preposterous, unjustified, and inaccurate claims regarding Starlink disposal risk to people on the ground and to aviation. These errors may have been avoided if Aerospace had simply made basic inquiries with SpaceX, but it elected not to do so. In fact, Aerospace did not even seek to review the Starlink demisability analysis, which should have been a fundamental part of its analysis.

Instead, Aerospace chose to base its evaluation on assumptions, guesswork, and outdated studies relating to satellite constellations developed decades ago. As it relates to Starlink, Aerospace took no effort to evaluate the materials, components, construction, or computer aided design (CAD) model of SpaceX's satellites. Furthermore, neither the FAA nor Aerospace, reviewed Starlink's most recent FCC filings with respect to total constellation size. Having chosen not to communicate with SpaceX in the course of conducting its assessment, Aerospace simply failed to ensure that its approach used factually

accurate and current information about Starlink satellites and their operation. As a result of this haphazard approach, Aerospace's analysis reflects nothing more than the culmination of several egregious errors, omissions, and incorrect assumptions—and it should be dismissed.

For example, Aerospace based its analysis on a generalization from a 23-year-old NASA study that specifically warns against using it in that way. Here, the NASA study from 2000 found that roughly one piece of debris survives reentry for every 100 kg on *Iridium* satellites. This analysis is inapplicable to SpaceX satellites because—among other things—Iridium satellites were not even built to be fully demisable. The Iridium satellites analyzed in the NASA study a generation ago are not similar in material, construction, design, orbit, and operation from SpaceX or any other modern satellite in LEO. Furthermore, NASA specifically states: "NASA does not warrant the information contained herein or its suitability for any particular use. Any distribution of this assessment or information contained herein must be appropriately marked with a notice regarding the absence of any such warranty."¹ Contrary to NASA's warning, Aerospace inaccurately oversimplifies the analysis to assume SpaceX's satellites—which are designed to fully demise—are the same as the satellites NASA analyzed 23 years ago and that were not designed to fully demise. Aerospace then leaps from this false assumption to an indefensible conclusion that three objects from every SpaceX satellite will survive reentry. Aerospace provides no rational basis for basing its analysis on such an inexplicable assumption.

In relying on the Aerospace report, which was completed in 2021, FAA apparently took no steps to update the information presented. For example, the FAA report relies on outdated data and fails to consider publicly available information that is readily available two years after the Aerospace report was completed. Here, the Aerospace report assumes 54,902 satellites are in space across 12 filings from nine operators that will have satellites deorbit at the end of their design life. At this point, this information is plainly incorrect. Neither FAA nor Aerospace took any steps to update the outdated Aerospace findings to reflect updated FCC filings that actually reduced the number by 7,518 satellites prior to submitting this report to Congress.

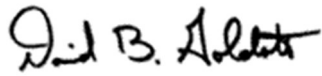
Even accepting Aerospace's use of an outdated NASA model never intended to be generically applied, Aerospace's math on risk does not add up because it got basic facts wrong regarding the actual number of proposed satellites in licenses filed before the FCC. Even more problematically, Aerospace and the FAA focus *only* on Starlink, disregarding other satellite systems like Amazon's Project Kuiper, OneWeb, or any of the LEO systems being developed and deployed by China. As a result of these errors, Aerospace erroneously concludes, and FAA repeats, that Starlink represents "over 85 percent of the expected 2035 risk to people on the ground and aviation." This claim has no basis in reality and, moreover, it is mathematically impossible.

FAA notes in its report that "[i]f SpaceX is correct in reporting zero surviving debris and a fully demisable spacecraft, the rise in reentry risk is minimal over the current risk." This is a key statement. SpaceX satellites fully demise. Indeed, SpaceX has already deorbited 325 of its satellites since February 2020 with zero pieces of debris found. SpaceX engineers conducted extensive analysis that confirms that the satellites fully demise. Aerospace's extrapolation from an inapt and outdated technical study that three components survive is based on guesswork and assumptions rather than data, and is false as it relates to Starlink. Unfortunately, FAA appears to have accepted the Aerospace report without any scrutiny or diligence, and then distributed this incorrect information to Congress. The fact that FAA simply accepted the Aerospace report without question or scrutiny raises concerns regarding FAA's technical competence to responsibly assess and regulate in this area.

¹ Exhibit E: Orbital Debris Mitigation and Casualty Risk Assessment," FCC Form 312, Schedule A, https://transition.fcc.gov/transaction/iridium-motorola/iridiumconstel_exhe.pdf.

SpaceX respectfully requests that FAA correct its report to Congress to, at a minimum, reflect these facts. The Aerospace Corporation should rescind its technical evaluation because it is inaccurate and misleading.

Sincerely,

A handwritten signature in black ink, appearing to read "David B. Goldstein". The signature is fluid and cursive, with the first name "David" being the most prominent.

David B. Goldstein, PhD
Principal Engineer

CC: The Honorable Patty Murray, Chair, Committee on Appropriations, U.S. Senate
 The Honorable Susan Collins, Ranking Member, Committee on Appropriations, U.S. Senate
 The Honorable Kay Granger, Chair, Committee on Appropriations, U.S. House of Representatives
 The Honorable Rosa Delauro, Ranking Member, Committee on Appropriations, U.S. House of
 Representatives
 Kelvin Coleman, Associate Administrator, Commercial Space Transportation, FAA
 Steve Isakowitz, President & CEO, The Aerospace Corporation