



July 1, 2022

BY ELECTRONIC FILING

Marlene H. Dortch
Secretary
Federal Communications Commission
45 L Street, N.E.
Washington, DC 20554

Re: *SpaceX Semi-Annual Report*

Dear Ms. Dortch:

Pursuant to paragraph 97u of the modification order issued on April 27, 2021,¹ Space Exploration Holdings, LLC provides the attached semi-annual constellation status report covering the period from December 1, 2021 to May 31, 2022.

If you have any questions, please do not hesitate to direct them to me.

Sincerely,

/s/ David Goldman

David Goldman
Senior Director of Satellite Policy

SPACE EXPLORATION TECHNOLOGIES CORP.
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Attachment

cc: Karl Kensinger

¹ See *Space Exploration Holdings, LLC*, FCC 21-48, ¶ 97u (rel. Apr. 27, 2021).

SPACE X CONSTELLATION STATUS REPORT

December 1, 2021 – May 31, 2022

SpaceX appreciates this opportunity to update the Commission and the public about the reliability and safety of its satellite constellation. As this report details, SpaceX uses extremely conservative assumptions that minimize risk and exceed industry standards and approaches by a massive margin. In its previous report, SpaceX detailed how its maneuver threshold is a full order of magnitude more sensitive than the industry standard. To minimize non-maneuverable debris, SpaceX satellites are screened at low altitude shortly after deployment to ensure functionality. SpaceX also takes an extremely conservative approach when it chooses to de-orbit satellites and ensures all satellites are fully demisable, exceeding industry standards and causing no calculable risk to life on the ground. SpaceX's tightly integrated approach allows it to quickly identify ways in which it can improve the service, the performance, and the reliability of its satellites. Accordingly, SpaceX has a bias towards de-orbiting and replacing satellites whenever doing so will improve service for consumers on the ground or enhance the sustainability of space. Because of the low altitudes at which these satellites operate, they can be de-orbited quickly.

This conservative approach requires a significant investment in sustainability and performance. Not only must SpaceX invest in satellites that are more capable and perform more maneuvers that carry considerable cost to SpaceX, but unlike other operators with less emphasis on sustainability, SpaceX is willing to deorbit satellites at the first sign of trouble, rather than waiting for larger issues to develop. SpaceX takes this most costly approach out of an abundance of caution to best preserve and protect low Earth orbit.

SpaceX volunteered to report on the health of its system because it believes transparency is critical to sustainable space operations. So far this year, SpaceX has published public updates on starlink.com/resources specific to "SpaceX's Approach to Space Sustainability and Safety" as well as "Starlink Conjunction Avoidance with Crewed Space Stations" which detail our commitment to keeping space safe for other satellite operators as well as human spaceflight programs. But SpaceX reiterates that it cannot maintain a sustainable orbital environment unilaterally and without non-U.S.- firms participating; no operator, and indeed no country, can do so. SpaceX therefore pleads once again for other operators—including those that have chosen to license their satellites outside the U.S. and claim not to be bound by U.S. rules, yet want to offer services here—to provide similar public disclosures about the performance of their satellites. Only with all operators working together can we truly maintain the space environment for future operations and human space flight.

Since our last report, SpaceX has conducted 16 launches deploying an additional 764 satellites to its constellation.

RESPONSES TO COMMISSION REQUESTS

1. *“Number of conjunction events identified for Starlink satellites during the reporting period, and the number of events that resulted in an action (maneuver or coordination with another operator), as well as any difficulties encountered in connection with the collision avoidance process and any measures taken to address those difficulties.”*

Events/Maneuvers—SpaceX uses a conservative maneuver threshold an order of magnitude more sensitive than the industry standard. Specifically, SpaceX satellites will maneuver if the probability of collision is greater than 1e-5 (1 in 100,000 chance of collision), as opposed to the industry standard of 1e-4 (1 in 10,000 chance of collision). Using this standard, SpaceX satellites performed 6,873 maneuvers over the period of this report. These maneuvers have resulted in no collisions, keeping space free of debris.

For other events, other operators asked SpaceX not to perform a maneuver because those operators preferred to maneuver their satellites; this circumstance occurred approximately ten times over this period.

Other Issues—“difficulties encountered in the collision avoidance process and the steps taken to resolve those difficulties.”

Thirty-Eight SpaceX Satellites Reentered from the Launch on February 3, 2022—On February 3, 2022, SpaceX launched 49 satellites into an orbit with a perigee of approximately 210 km. Every satellite achieved controlled flight, but due to a geomagnetic storm, the satellites experienced an increased atmospheric drag approximately 50% higher than all previous launches. As a result, while SpaceX was able to command 11 of the satellites to a drag-stable attitude sufficient to ride out the storm, the other 38 satellites reentered the Earth’s atmosphere and demised.¹ Since this event, SpaceX has updated the flight software of our satellites to accommodate similar space weather events in the future and is working toward a solution whereby satellites will include an independent position “beacon” to improve ground antenna pointing.

Russian Anti-Satellite Weapon Activity Precipitated Many Events—The November 2021 Russian anti-satellite weapon test released thousands of pieces of debris into space, spread over the orbits of many operational satellites. The SpaceX collision avoidance system was deftly able to adjust to and accommodate this significant influx of debris, but SpaceX is now maneuvering more for COSMOS 1408 debris than for any other objects in space. In fact, over the reporting period, SpaceX satellites maneuvered over 1,700 times for COSMOS 1408 debris.

Operator Contact Information on Space-Track.org—Only a subset of spacecraft on Space-Track.org have contact information populated by their operator, while many still do not. Coordination is more challenging when operators fail to provide contact information. To improve sustainability, all operators should populate their contact information.

¹ Because these 38 satellites reentered at the time of deployment and were never operational, we have excluded them from Table 2, but included them in Table 3 for completeness.

2. *“Satellites that, for purposes of disposal, were removed from operation or screened from further deployment at any time following initial deployment, and identifying whether this occurred less than five years after the satellite began regular operations or were available for use as an on-orbit replacement satellite.”*

Satellites that started Deorbit	Can the satellite still maneuver for collision avoidance?	Removed <5 years after beginning operation?
STARLINK-1050	Yes	Yes
STARLINK-1125	No	Yes
STARLINK-1135	Yes	Yes
STARLINK-1192	No	Yes
STARLINK-1232	Yes	Yes
STARLINK-1241	No	Yes
STARLINK-1472	Yes	Yes
STARLINK-1483	Yes	Yes
STARLINK-1499	Yes	Yes
STARLINK-1613	No	Yes
STARLINK-1902	Yes	Yes
STARLINK-1946	Yes	Yes
STARLINK-1988	Yes	Yes
STARLINK-2060	No	Yes
STARLINK-2148	Yes	Yes
STARLINK-2216	Yes	Yes
STARLINK-2328	Yes	Yes
STARLINK-2352	Yes	Yes
STARLINK-3123	Yes	Yes
STARLINK-3280	Yes	Yes
STARLINK-3307	Yes	Yes
STARLINK-3367	Yes	Yes
STARLINK-3376	Yes	Yes
STARLINK-3377	Yes	Yes
STARLINK-3384	Yes	Yes
STARLINK-3402	Yes	Yes
STARLINK-3403	Yes	Yes
STARLINK-3404	Yes	Yes
STARLINK-3405	Yes	Yes
STARLINK-3406	Yes	Yes
STARLINK-3407	Yes	Yes
STARLINK-3408	Yes	Yes
STARLINK-3409	Yes	Yes
STARLINK-3410	Yes	Yes

STARLINK-3411	Yes	Yes
STARLINK-3412	Yes	Yes
STARLINK-3413	Yes	Yes
STARLINK-3414	Yes	Yes
STARLINK-3416	Yes	Yes
STARLINK-3417	Yes	Yes
STARLINK-3418	Yes	Yes
STARLINK-3420	Yes	Yes
STARLINK-3422	Yes	Yes
STARLINK-3423	Yes	Yes
STARLINK-3426	Yes	Yes
STARLINK-3427	Yes	Yes
STARLINK-3662	Yes	Yes
STARLINK-3676	Yes	Yes
STARLINK-3693	Yes	Yes
STARLINK-3710	Yes	Yes
STARLINK-3719	Yes	Yes
STARLINK-3731	Yes	Yes

3. “Satellites that re-entered the atmosphere.”

Satellite Number	Date of Re-entry	Re-entered <5 years after beginning operation?
STARLINK-1285	2022-05-09	Yes
STARLINK-80	2022-05-04	Yes
STARLINK-1753	2022-04-30	Yes
STARLINK-1947	2022-04-30	Yes
STARLINK-2172	2022-04-30	Yes
STARLINK-2183	2022-04-30	Yes
STARLINK-1870	2022-04-24	Yes
STARLINK-2176	2022-04-23	Yes
STARLINK-2246	2022-04-23	Yes
STARLINK-1951	2022-04-22	Yes
STARLINK-3676	2022-04-18	Yes
STARLINK-3693	2022-04-18	Yes
STARLINK-1754	2022-04-17	Yes
STARLINK-3662	2022-04-17	Yes
STARLINK-3710	2022-04-17	Yes
STARLINK-3719	2022-04-16	Yes
STARLINK-1743	2022-04-10	Yes
STARLINK-1889	2022-04-09	Yes
STARLINK-1919	2022-04-08	Yes
STARLINK-1182	2022-04-08	Yes
STARLINK-1859	2022-04-03	Yes
STARLINK-1831	2022-04-02	Yes
STARLINK-3731	2022-04-01	Yes
STARLINK-1050	2022-03-27	Yes
STARLINK-1684	2022-03-27	Yes
STARLINK-1439	2022-03-13	Yes
STARLINK-2177	2022-03-13	Yes
STARLINK-1406	2022-03-07	Yes
STARLINK-1985	2022-03-07	Yes
STARLINK-2313	2022-03-02	Yes
STARLINK-1379	2022-02-16	Yes
STARLINK-1064	2022-02-11	Yes
STARLINK-1668	2022-02-10	Yes
STARLINK-3152	2022-02-10	Yes
STARLINK-3163	2022-02-10	Yes
STARLINK-3164	2022-02-10	Yes
STARLINK-3169	2022-02-10	Yes

STARLINK-3170	2022-02-10	Yes
STARLINK-3186	2022-02-10	Yes
STARLINK-3187	2022-02-10	Yes
STARLINK-3188	2022-02-10	Yes
STARLINK-3220	2022-02-10	Yes
STARLINK-3221	2022-02-10	Yes
STARLINK-3222	2022-02-10	Yes
STARLINK-3223	2022-02-10	Yes
STARLINK-3224	2022-02-10	Yes
STARLINK-3367	2022-02-10	Yes
STARLINK-3376	2022-02-10	Yes
STARLINK-3377	2022-02-10	Yes
STARLINK-3384	2022-02-10	Yes
STARLINK-3402	2022-02-10	Yes
STARLINK-3403	2022-02-10	Yes
STARLINK-3404	2022-02-10	Yes
STARLINK-3405	2022-02-10	Yes
STARLINK-3406	2022-02-10	Yes
STARLINK-3407	2022-02-10	Yes
STARLINK-3408	2022-02-10	Yes
STARLINK-3409	2022-02-10	Yes
STARLINK-3410	2022-02-10	Yes
STARLINK-3411	2022-02-10	Yes
STARLINK-3412	2022-02-10	Yes
STARLINK-3413	2022-02-10	Yes
STARLINK-3414	2022-02-10	Yes
STARLINK-3416	2022-02-10	Yes
STARLINK-3417	2022-02-10	Yes
STARLINK-3418	2022-02-10	Yes
STARLINK-3420	2022-02-10	Yes
STARLINK-3422	2022-02-10	Yes
STARLINK-3423	2022-02-10	Yes
STARLINK-3426	2022-02-10	Yes
STARLINK-3427	2022-02-10	Yes
STARLINK-1751	2022-02-09	Yes
STARLINK-1599	2022-02-04	Yes
STARLINK-2173	2022-02-04	Yes
STARLINK-1786	2022-01-29	Yes
STARLINK-1840	2022-01-29	Yes
STARLINK-1945	2022-01-29	Yes
STARLINK-1988	2022-01-29	Yes

STARLINK-1853	2022-01-28	Yes
STARLINK-43	2022-01-27	Yes
STARLINK-2201	2022-01-24	Yes
STARLINK-2202	2022-01-24	Yes
STARLINK-2200	2022-01-23	Yes
STARLINK-2208	2022-01-23	Yes
STARLINK-1204	2022-01-21	Yes
STARLINK-2261	2022-01-16	Yes
STARLINK-2281	2022-01-16	Yes
STARLINK-2287	2022-01-16	Yes
STARLINK-2289	2022-01-16	Yes
STARLINK-2302	2022-01-16	Yes
STARLINK-2297	2022-01-11	Yes
STARLINK-2318	2022-01-10	Yes
STARLINK-2316	2022-01-10	Yes
STARLINK-1345	2022-01-09	Yes
STARLINK-1535	2022-01-08	Yes
STARLINK-2205	2021-12-30	Yes
STARLINK-2207	2021-12-30	Yes
STARLINK-3280	2021-12-28	Yes
STARLINK-2206	2021-12-27	Yes
STARLINK-2204	2021-12-26	Yes
STARLINK-1188	2021-12-25	Yes
STARLINK-1023	2021-12-20	Yes
STARLINK-1051	2021-12-20	Yes
STARLINK-1943	2021-12-20	Yes
STARLINK-2259	2021-12-20	Yes
STARLINK-2311	2021-12-20	Yes
STARLINK-2199	2021-12-17	Yes
STARLINK-2203	2021-12-17	Yes
STARLINK-2079	2021-12-14	Yes
STARLINK-1097	2021-12-13	Yes
STARLINK-1674	2021-12-12	Yes
STARLINK-1757	2021-12-04	Yes
STARLINK-3123	2021-12-01	Yes

4. *“Satellites for which there was a disposal failure, including a discussion of any assessed cause of the failure and remedial actions.”*

Under the conditions of its license, SpaceX must provide an additional report if, during any continuous one-year period that begins after April 2, 2021, there are three or more satellite disposal failures. This section has been expanded to include such a special report.

Satellite Number	Cause	Remedial Action	Is SpaceX in contact with the satellite and does it have attitude control for collision avoidance?	Date
STARLINK-2060	Two independent failures in attitude control system	Sensitive components have been identified and removed from future designs	No	4/12/2022
STARLINK-1322	While deorbiting, fell into a non-recoverable attitude due to a failed actuator	Sensitive components have been identified and removed from future designs	No	5/20/2022
STARLINK-1339	While deorbiting, fell into a non-recoverable attitude due to a failed actuator	Sensitive components have been identified and removed from future designs	SpaceX is in contact with the satellite, but it does not have attitude control	6/22/2022