INTERFERENCE PROTECTION

Geostationary Satellite Orbit Systems

The proposed operations will protect GSO systems from harmful interference by operating within the ITU EPFD limits that apply to the SpaceX user-terminal network as a whole, which the Commission has concluded "will adequately protect GSO FSS networks."[1] Here, the applicable ITU EPFD limits are provided in Article 22 and Resolution 76 of the ITU Radio Regulations, which require the assessment of a satellite system as a whole to demonstrate that the probabilities of emissions exceeding certain levels remain within specified regulatory limits.

In SpaceX's application for a blanket user-terminal authorization, which the Commission granted in March 2020, SpaceX confirmed that its user-terminal network as a whole will comply with these EPFD limits, and such compliance was a condition of the Commission's grant of that authorization.[2] The user terminals SpaceX seeks to operate in this application will be electrically identical to the 1,000,000 user terminals the Commission has already permitted in that authorization[3] and will operate within that previously authorized user-terminal network within those EPFD limits. Accordingly, the proposed operations will satisfy the GSO interference-protection requirements that the Commission has adopted for NGSO systems in this band.

SpaceX complies with these EPFD limits by enforcing a 25-degree minimum elevation limit, GSO avoidance angle of 18 degrees, and a transmit EIRP mask on all user terminals, including those described in this application. The minimum elevation angle and the GSO avoidance angle limit the interference geometry from the terminal to the GSO and prevent terminals from transmitting to NGSO satellites that are within 18 degrees of the GSO arc. In addition, when a terminal transmits to an NGSO satellite more than 18 degrees from the GSO arc, the EIRP mask limits the power spectral density of transmissions from the terminal toward GSO satellites. The

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[1] *Amendment of Parts 2 and 25 of the Commission's Rules to Permit Operation of NGSO FSS Systems Co-Frequency with GSO and Terrestrial Systems in the Ku-Band Frequency Range*, 16 FCC Rcd. 4096, ¶ 77 (2000) (concluding that implementation of EPFD limits "will adequately protect GSO FSS networks"). *See also* 47 C.F.R. § 25.289 (NGSO satellite systems that comply with EPFD limits will be deemed not to cause unacceptable interference to any GSO network).

[2] *See* Radio Station Authorization, IBFS File No. SES-LIC-20190211-00151 (granted Mar. 13, 2020) (callsign E190066).

[3] *Id*. Notably, the Commission does not require the submission of antenna patterns for blanket-licensed NGSO earth stations, as the EIRP mask is sufficient to verify compliance with EPFD limits and other interference-protection benchmarks. SpaceX's Part 25 blanket user-terminal authorization was granted on this basis. NGSO user terminals are also not required to comply with the antenna-gain limitations in Section 25.209. The Commission has granted other blanket user-terminal authorizations as well that have not included antenna patterns and which have correctly asserted that "that the Commission's antenna performance standards contained in Section 25.209 of the Commission's rules are not applicable to NGSO user terminals." *See* Radio Station Authorization, IBFS File No. SES-LIC-20190930-01217 (granted Apr. 27, 2021) (callsign E190727).

experimental earth stations in this application will comply with the same operational limits as the terminals covered under SpaceX's blanket license and therefore will not exceed the already authorized EPFD limits for the Starlink system.

In addition, the proposed operations will comply with the FCC's requirements for NGSO Earth Stations in Motion ("ESIMs") in these bands to ensure that motion of the user terminal will not cause it to inadvertently exceed interference protection limits. In particular, these earth stations will be self-monitoring and, should a condition occur that causes it to exceed EIRP, EIRP density or off-axis EIRP mask limits included in the licensing conditions for the FSS NGSO network that it is using as a point of communication in the 14-14.5 GHz band, the terminal will automatically cease transmissions within 100 milliseconds and not resume transmissions until the condition that caused the experimental terminal to exceed those limits is corrected.[4]

Fixed-Service Systems

Similar to protection for GSO systems, the Commission has concluded that compliance with the applicable ITU PFD limits is sufficient to protect terrestrial fixed-service operators from harmful interference.[5] The applicable ITU EPFD limits are provided in Article 21 of the ITU Radio Regulations and, as with the EPFD limits used to protect GSO systems, compliance with the ITU PFD limits is assessed on an aggregate basis for a total system.

Thus, as with the protection of GSO systems, SpaceX will protect terrestrial fixed-service systems by ensuring that the proposed operations do not cause the already-authorized SpaceX user-terminal network to exceed the applicable PFD limits, and by complying with the special measures required for ESIMs described above.[6]

NGSO Systems

The SpaceX NGSO FSS system, including operations under the authorization requested herein, will at all times comply with Section 25.261(c), which governs spectrum sharing between NGSO operators. Beyond the requirements of Section 25.261, the SpaceX system uses steerable and shapable beams as well as satellite diversity, which will often allow SpaceX to choose from multiple satellites capable of serving any one point on the ground. These advanced capabilities will allow SpaceX to minimize the potential for in-line events involving these or any other SpaceX earth stations.

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4 *See* 47 C.F.R. § 25.228(c).

5 *Amendment of Parts 2 and 25 of the Commission's Rules to Permit Operation of NGSO FSS Systems Co-Frequency with GSO and Terrestrial Systems in the Ku-Band Frequency Range*, 16 FCC Rcd. 4096, ¶ 42 (2000).

6 In addition to the Article 21 PFD limits that apply to the satellites, Section 25.228(i) provides another set of PFD limits that apply to aircraft earth stations in 25.228(i). These only apply when an aircraft is within line of sight of administrations that have a primary fixed-service allocation in the band. For these experimental operations, SpacceX will not operate within line of sight of any administration primary fixed-service allocation in the bands that SpaceX operates in.

TDRS and Radio Astronomy

SpaceX will comply with its obligations, pursuant to conditions placed on its blanket user-terminal authorizations, to avoid and/or coordinate with NASA TDRS and radioastronomy facilities as necessary to avoid harmful interference to these services.[7]

[7] Section 25.228(j) covers operation with TDRSS and Radio Astronomy. For these experimental operations, SpaceX will not operate within radio line of sight of the listed facilities unless SpaceX has coordinated its operations.