



PUBLIC NOTICE

Federal Communications Commission
445 12th St., S.W.
Washington, D.C. 20554

News Media Information 202 / 418-0500
Internet: <http://www.fcc.gov>
TTY: 1-888-835-5322

DA 05-2698

Report No. SPB – 112

October 13, 2005

International Bureau Satellite Division Information

DISCLOSURE OF ORBITAL DEBRIS MITIGATION PLANS, INCLUDING AMENDMENT OF PENDING APPLICATIONS

On June 21, 2004, the Commission released a Second Report and Order in IB Docket No. 02-54 “Mitigation of Orbital Debris.”¹ The Second Report and Order amends the Commission’s rules by requiring a narrative description of a space station operator’s plans to mitigate orbital debris as part of the documentation that the Commission requires under Parts 5, 25 and 97 of the Commission’s rules.² The Second Report and Order also requires that all requests for Commission authorization that entail submission of technical information pursuant to Section 25.114 that are pending at the time of the effective date of the rules be amended within 30 days of the effective date of the rules to include disclosure of the system’s orbital debris mitigation plans.³ Under Section 25.137,⁴ this requirement is also applicable to pending requests to access a non-U.S. licensed space station, if access to that space station has not previously been the subject of a regular approval (*i.e.*, listing on the space station permitted list, grant of a spectrum reservation pursuant to a letter of intent ruling, or authorization of the satellite as a point of communication in a regular earth station authorization).

The orbital debris mitigation disclosure rules become effective on October 19, 2005.⁵ Accordingly, all applications that are pending as of October 19, 2005, that entail submission of technical information pursuant to Section 25.114 of the Commission’s rules, must be amended by November 18, 2005, to include disclosure of the system’s orbital debris mitigation plans, as set forth by Section

¹ Mitigation of Orbital Debris, *Second Report and Order*, 19 FCC Rcd 11567 (2004) (“*Second Report and Order*”).

² See 47 C.F.R. § 25.114(d)(14). An applicant for an experimental license under Part 5 and a license grantee of an amateur space station under Part 97 must disclose orbital debris mitigation plans for the space station as part of the requirements of Sections 5.63(e) and 97.207(g) that were adopted by the Commission in the *Second Report and Order*. See 47 C.F.R. §§ 5.63(3) and 97.207(g).

³ See *Second Report and Order*, 19 FCC Rcd at 11577 (para. 20); see also Erratum, DA 04-2613 (rel. Aug. 24, 2004). The Commission’s rules do not require amendment of pending filings for space stations in the experimental or amateur services. The Commission may, however, request the orbital debris mitigation plans for any experimental or amateur space stations on a case-by-case basis to ensure that such proposed operations serve the public interest pursuant to Titles I and III of the Communications Act.

⁴ 47 C.F.R. § 25.137.

⁵ See 70 Fed. Reg. 59,276 (October 12, 2005).

25.114(d) of the Commission's rules. Failure to file an amendment within this time period will result in the pending application being dismissed as incomplete. All applications filed after October 19, 2005, that require submission of Section 25.114 information must include an orbital mitigation disclosure as part of the application or will be dismissed as incomplete. Applications that do not require submission of information under Section 25.114, such as applications for transfer of control or assignment of licenses, do not require an orbital debris mitigation disclosure. Disclosures are not required for already authorized space station and earth station operations. If existing operators seek authority for additional or modified authorizations, and information under Section 25.114 is required by our rules in connection with requests for such authorizations, disclosure of orbital debris mitigation plans is required as part of the request for additional authority.

No fee is required for amendments filed for the sole purpose of amending a pending application for authorization in order to comply with the new orbital debris mitigation requirements of the Commission's rules.⁶ However, amendments that include changes in requested frequencies or orbital locations must include a fee payment.⁷ The Satellite Division will issue a public notice for informational purposes listing amendments received for Part 25 applications.

This Public Notice also reminds applicants of the information that they must disclose as part of their orbital debris mitigation plans. Pursuant to the Commission's orbital debris rules,⁸ an orbital debris mitigation plan must include a narrative statement that addresses four elements of orbital debris mitigation: (1) spacecraft hardware design; (2) minimizing accidental explosions; (3) safe flight profiles; and (4) post-mission disposal. The statement must identify particular methods by which a satellite system will mitigate orbital debris, rather than presenting a generalized commitment to address orbital debris mitigation at a future date or a catalogue of potential options. If an applicant's orbital debris mitigation plans change after authorization, the changes must be submitted to the Commission by means of a request to modify the authorization.

Spacecraft Hardware Design. Debris mitigation plans must include a statement that the space station operator has assessed and limited the amount of debris released in a planned manner during normal operations, and has assessed and limited the probability of the space station becoming a source of debris by collisions with small debris or meteoroids that could cause loss of control and prevent post-mission disposal. As part of this statement, applicants must confirm whether any debris is planned to be released during the course of normal operations and to describe any such planned release with particularity. Applicants must also confirm whether they have assessed the probability of collisions with debris or meteoroids smaller than one centimeter in diameter and state what steps have been taken to limit the effects of such collisions, for example, through the use of shielding, the placement of components, or the use of redundant systems. If the space station design involves use of a sub-system or set of sub-systems, distinct from systems used in connection with the primary communications mission, in order to accomplish end-of-life disposal, the disclosure should address in greater detail the measures taken specifically to analyze the susceptibility of that sub-system to collisions with small debris.

Minimizing Accidental Explosions. Debris mitigation plans must state whether the space station operator has assessed and limited the probability of accidental explosions during and after completion of mission operations. This statement must demonstrate that debris will not be generated

⁶ 47 C.F.R. § 1.1114(a).

⁷ *Id.*

⁸ 47 C.F.R. §§ 5.63(e), 25.114(d), 97.207(g).

from the conversion of energy sources on board the spacecraft into energy that fragments the spacecraft. Energy sources include chemical, pressure, and kinetic energy. The debris plan must also address whether stored energy will be removed at the spacecraft's end of life, by depleting residual fuel and leaving all fuel line valves open, venting any pressurized system, leaving all batteries in a permanent discharge state, and removing any remaining source of stored energy, or through other equivalent procedures specifically disclosed in the application. The Satellite Division generally will consider as sufficient a statement that the operator has assessed and limited the probability of accidental explosions during mission operations by means of a failure mode verification analysis or similar process, and that the operator will remove all stored energy at the end of the spacecraft's mission operations. Although operators need not routinely submit failure mode verification analyses in support of their statements, the Commission retains the discretion to seek this additional information in the event that a showing suggests that further review may be warranted.

Safe Flight Profiles. Debris mitigation plans must state whether the space station operator has assessed and limited the probability of the space station becoming a source of debris by collisions with large debris or other operational space stations.

For space stations that are to operate in non-geostationary orbit (NGSO), this statement must identify whether the intended orbit is identical or very similar to an orbit used by other space stations. If so, it must include an analysis of the potential risk of collision and a description of what measures the space station operator plans to take to avoid in-orbit collisions. If the space station operator is relying on coordination with another system, the statement must indicate what steps have been taken to contact the other system and to ascertain the likelihood of successful coordination of physical operations between the systems. The statement must also disclose the accuracy – if any – with which orbital parameters of non-geostationary satellite orbit space stations will be maintained, including apogee, perigee, inclination, and the right ascension of the ascending node(s). In the event that a system is not able to maintain orbital tolerances (*e.g.*, it lacks a propulsion system for orbital maintenance), the debris mitigation plan should include that fact. Such systems must also indicate the anticipated evolution over time of the orbit of the proposed satellite or satellites. In addition, for entities seeking approval for operations in low-Earth orbit, the statement should address the risk posed to inhabitable orbiting objects, such as manned spacecraft, and should disclose what measures, such as maintaining a minimum distance separation and coordination, will be undertaken to address such risks to inhabitable orbiting objects.

For space stations that are to operate in geostationary-Earth orbit (GEO), the statement must assess whether there are any known satellites located at, or reasonably expected to be located at, the requested orbital location, or assigned in the vicinity of that location, such that the station-keeping volumes of the respective satellites might overlap. If so, the statement must include a statement as to the identities of those parties and the measures that will be taken to prevent collisions. The statement should address any licensed FCC systems, or any systems applied for and under consideration. The statement need not address every filing with the International Telecommunication Union (ITU) that meets these criteria. The operator should, however, assess and address any systems reflected in ITU filings that are in operation or that it believes may be progressing toward launch, for example, by the appearance of the system on a launch vehicle manifest. Where coordination is identified as an avoidance measure, the statement must disclose the technical means (*e.g.*, eccentricity offset) by which that coordination will be effected.

In addition, any entity requesting Commission authorization for spacecraft maneuvers, particularly those involving relocation of space stations at very slow drift rates, should disclose whether it has undertaken coordination with other space station operators through whose station keeping volume the maneuvering space station will pass.

Post-Mission Disposal. Debris mitigation plans must include a statement detailing the post-mission disposal plans for the space station at end of life.

For geostationary-Earth orbit space stations launched after March 18, 2002, the statement must disclose the minimum altitude above the geostationary-Earth orbit selected for a post-mission disposal orbit and the calculations that are used in deriving the minimum disposal altitude. The statement must disclose the values used in application of the Inter-Agency Space Debris Coordination Committee (IADC) formula.⁹ In particular, statements must disclose the values used for the solar radiation pressure coefficient (C_R) and the Area-to-mass ratio (A/m).¹⁰ Statements may make simplifying assumptions when calculating values under the IADC formula, provided that such assumptions bear in mind the objective of ensuring that objects placed into a storage orbit do not re-enter the geostationary protected region. Thus, any assumptions should lead to a disposal orbit altitude in excess of one calculated using higher fidelity methods, to the extent the two differ. Statements must also disclose the amount of fuel, in kilograms, that is intended to be reserved to accomplish post-mission disposal, as well as the methodology used to derive that quantity, including the methods used to determine and address fuel gauging uncertainty. With regard to methods to determine and address fuel gauging uncertainty, the Satellite Division will consider as sufficient a statement that the operator has assessed fuel gauging uncertainty and has provided an adequate margin of fuel reserve to address the assessed uncertainty.

For geostationary-Earth orbit space stations launched on or before March 18, 2002, the orbital debris mitigation statement must disclose the intended disposal altitude that will be used at end of life for the space station, but the disposal altitude will not be evaluated based on the IADC formula, although applicants are encouraged to consider the IADC formula and related ITU Recommendations in connection with end-of-life disposal. Statements must, however, disclose the amount of fuel, in kilograms, that is intended to be reserved to accomplish post-mission disposal, as well as the methodology used to derive that quantity, including the methods used to determine and address fuel gauging uncertainty. With regard to methods to determine and address fuel gauging uncertainty, the Satellite Division will consider as sufficient a statement that the operator has assessed fuel gauging uncertainty and has provided an adequate margin of fuel reserve to address the assessed uncertainty.

For non-geostationary satellite orbit space stations, the statement must disclose the post-mission disposal plans for all NGSO space stations in a system at the end of life. If post-mission disposal will be

⁹ The IADC formula is:

$$36,021 \text{ km} + (1000 \cdot C_R \cdot A/m)$$

where C_R is the solar radiation pressure coefficient of the spacecraft, and A/m is the Area to mass ratio, in square meters per kilogram, of the spacecraft. This formula is based on a geostationary-Earth orbit altitude of 35,786 kilometers and establishes a “protected region” of 200 kilometers around the geostationary-Earth orbit, plus 35 kilometers to account for the maximum descent of a re-orbited spacecraft due to lunar, solar, and geopotential perturbations. The formula then provides an additional term to take into account the solar radiation pressure on a particular spacecraft.

¹⁰ The area of the satellite should be calculated using a method that reflects its deployed and on-station configuration. To the extent that antenna and solar panels remain deployed upon disposal, calculations under the IADC formula should account for this fact. The area to be calculated is the average aspect area. Although the Second Report and Order does not specify a detailed methodology for calculating average aspect area, National Aeronautics and Space Administration (NASA) Safety Standard NSS 1740.14 may prove instructive in making this calculation. NSS 1740.14 may be found on-line at: http://orbitaldebris.jsc.nasa.gov/library/NSS1740_14/nss1740_14-1995.pdf.

effectuated through the use of disposal orbits, the statement must disclose the altitudes and orbital parameters of such disposal orbits. If disposal orbits are contemplated for post-mission disposal of space stations in orbits that do not pass through LEO or GEO, such as highly-elliptical or medium-Earth orbits, the statement must indicate with specificity what orbit will be used for disposal and whether that orbit has been analyzed to determine its long-term stability (*e.g.*, over a 100-year period). The post-mission disposal statement of all NGSO space stations must also include the amount of fuel, in kilograms, that is intended to be reserved to accomplish post-mission disposal, as well as the methodology used to derive that quantity, including the methods used to determine and address fuel gauging uncertainty. With regard to methods to determine and address fuel gauging uncertainty, the Satellite Division will consider as sufficient a statement that the operator has assessed fuel gauging uncertainty and has provided an adequate margin of fuel reserve to address the assessed uncertainty. If post-mission disposal will be effectuated through atmospheric re-entry, the statement must disclose the anticipated mission lifetime of each NGSO space station and the corresponding overall orbital lifetime of each NGSO space station prior to re-entry. If atmospheric re-entry will not utilize on-board propulsion systems, the statement must disclose this fact and must disclose the timeframe for removal of the object from orbit after the completion of its mission.

The orbital debris mitigation statement must also include a casualty risk assessment if planned post-mission disposal involves atmospheric re-entry of the space station. In general, an assessment should include an estimate as to whether portions of the spacecraft will survive re-entry and reach the surface of the Earth, as well as an estimate of the resulting probability of human casualty. The Satellite Division has previously released a Public Notice clarifying the minimum information that must be submitted to the Commission to constitute a sufficient casualty risk assessment.¹¹

For further information contact Stephen Duall, Satellite Division, International Bureau, at (202) 418-1103 (e-mail: Stephen.Duall@fcc.gov), or Sankar Persaud, Satellite Division, International Bureau, at (202) 418-2441 (e-mail: Sankar.Persaud@fcc.gov).

¹¹ Public Notice, International Bureau Satellite Division Information, SPB-208, DA 04-1724 (rel. June 16, 2004).