**(14) A description of the design and operational strategies that will be used to mitigate orbital debris including the following information:**

**(i) 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;**

**(ii) A statement that the space station operator has assessed and limited the probability of accidental explosions during and after completion of mission operations. This statement must include a demonstration that debris generation will not result from the conversion of energy sources on board the spacecraft into energy that fragments the spacecraft. Energy sources include chemical, pressure, and kinetic energy. This demonstration should 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;**

**(iii) A statement that 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. Where a space station will be launched into a low-Earth orbit that is identical, or very similar, to an orbit used by other space stations, the statement 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, and ascertain the likelihood of successful coordination of physical operations with, the other system. The statement must 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, i.e., it lacks a propulsion system for orbital maintenance, that fact should be included in the debris mitigation disclosure. Such systems must also indicate the anticipated evolution over time of the orbit of the proposed satellite or satellites. Where a space station requests the assignment of a geostationary-Earth orbit location, it 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;**

**(iv) A statement detailing the post-mission disposal plans for the space station at end of life, including the quantity of fuel--if any--that will be reserved for post-mission disposal maneuvers. For geostationary-Earth orbit space stations, the statement must disclose the altitude selected for a post-mission disposal orbit and the calculations that are used in deriving the disposal altitude. The 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.**

(14) Orbital Debris Mitigation Plan

**HISPAMAR SATELITES S.A.** (hereinafter **HISPAMAR SATELITES**) is proactive in ensuring safe operation and disposal of this and all spacecrafts under its control. The four elements of debris mitigation are addressed below:

(i) Spacecraft Hardware Design

The spacecraft is designed such that no debris will be released during normal operations. **HISPAMAR SATELITES** has assessed the probability of collision with meteoroids and other small debris (<1 cm diameter) and has taken the following steps to limit the effects of such collisions: (1) critical spacecraft components are located inside the protective body of the spacecraft and properly shielded; and (2) all spacecraft subsystems have redundant components to ensure no single-point failures. The spacecraft does not use any subsystems for end-of-life disposal that are not used for normal operations.

(ii) Minimizing Accidental Explosions

**HISPAMAR SATELITES** has assessed the probability of accidental explosions during and after completion of mission operations. The spacecraft is designed in manner to minimize the potential for such explosions. Propellant tanks and thrusters are isolated using redundant valves and electrical power systems are shielded in accordance with standard industry practices. At the completion of the mission, upon disposal of the spacecraft andaccording to the manufacturer, EADS Astrium, the E3000 design allows removing the chemical stored energy by depleting the chemical propulsion tanks. Albeit the E3000 design does not allow to completely depressurize the pressurant tank, however, the remaining pressure (30 bars) is far below the burst pressure (625 bars); in addition, the pressurant tank is located inside the central cylinder, well protected from external impact. Further, the E3000 design allows removal of the electrical stored energy by discharging the batteries and actuating the batteries bypasses. EADS concludes that with such conditions the FCC concerns and objectives are met.

The mass of any sealed pressurant that will be left in the Amazonas-2 at the end of life and the volume in which that mass is contained will be

| Mass in Pressurant Tank (kg) | Volume (m^3) |
|---|---|
| 1.258 | 0.18 |

(iii) Safe Flight Profiles

**HISPAMAR SATELITES** has assessed and limited the probability of the space station becoming a source of debris as a result of collisions with large debris or other operational space stations.

The proposed orbital location for **AMAZONAS 2** is 61° W.L. same as AMAZONAS 1. **AMAZONAS 2** will be maintained on the geostationary orbit within a window of less than 0.1° in North South and East West. It will be co-located with AMAZONAS 1, also owned by **HISPAMAR SATELITES**. The co-location strategy will be based on separation in eccentricity and inclination in such a way than when separation in inclination is minimum, eccentricity is maximum and vice versa.

**HISPAMAR SATELITES** is not aware of any other FCC licensed system, or any other system applied for and under consideration by the FCC, having an overlapping station keeping volume with **AMAZONAS-2. HISPAMAR SATELITES** is also not aware of any system with an overlapping station keeping volume with **AMAZONAS-2** that is the subject of an ITU filing and that is either in orbit or progressing towards launch.

(iv) Post Mission Disposal

At the end of the mission, **HISPAMAR SATELITES** will dispose of the spacecraft by moving it to a minimum altitude of 415 kilometers above the geostationary arc. This exceeds the minimum altitude established by the IADC formula.

**HISPAMAR SATELITES** has reserved 16.5 kilograms of fuel for this purpose. There served fuel figure was determined by the spacecraft manufacturer and provided for in the propellant budget. To calculate this figure, the "rocket equation" was used, taking into account the expected mass of the satellite at the end of life and the required delta-velocity to achieve the desired orbit. The fuel gauging uncertainty has been taken into account in these calculations.

In calculating the disposal orbit, **HISPAMAR SATELITES** has used simplifying assumptions as permitted under the Commission's Orbital Debris Report and Order. For reference, the effective area to mass ratio (Cr*A/M) of the **AMAZONAS-2** spacecraft is 0.0404 $m_2$/kg, resulting in a minimum perigee disposal altitude under the IADC formula of at most 275.4 kilometers above the geostationary arc, which is lower than the 415 kilometers above geostationary disposal altitude specified by **HISPAMAR SATELITES** in this filing.

Accordingly, the **AMAZONAS-2** planned disposal orbit complies with the FCC's rules.