Attachment D - Space Debris Mitigation Plan

EUTELSAT 139WA Space Debris Mitigation Plan
(prepared for the Federal Communications Commission)

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1. Introduction

This document describes the space debris mitigation plan that Eutelsat Communications S.A ("Eutelsat") shall apply to the EUTELSAT 139WA satellite at the 139.2° West Longitude (W.L.) orbital location.

Eutelsat 139WA is based on the Astrium Eurostar 3000 bus and it was manufactured according to European standards and specifications. The satellite is 3-axis stabilised and uses bi-propellant chemical propulsion for attitude and on-station control.

Eutelsat 139WA was launched on the 15th of March 2004 and the end of its operational life is not expected to be before Mid-2025.

2. Related documents

2.1. Applicable Documents

1. EUTELSAT Space Debris Mitigation Plan. Issue 2.0. EUT_CTL_SAT_QMS_PLN_00021, 25 April 2017.
2. FCC. Orbital Debris Mitigation Standard Practices. FCC 04-130. June 21, 2004

2.2. Reference Documents

1. European Code of Conduct for Space Debris Mitigation. Issue 1.0. 28 June 2004.
2. IADC Space Debris Mitigation Guidelines. IADC-02-01. Revision 1. September 2007.
3. Space Product Assurance. Safety. ECSS-Q-40A. 19 April 1996.
4. Orbital Debris Mitigation Standard Practices. FCC 04-130. 21 June 2004.
5. NASA Safety Standard. Guidelines and Assessment Procedures for limiting Orbital Debris. NSS 1740.14. Aug 1995.
6. ITU Environment Protection of the Geostationary Orbit. S.1003. 1993.
7. UNCOPUOS. Technical Report on Space Debris. 1999.

3. EUTELSAT 139WA Operations

Eutelsat operates the satellite to control and limit the amount of debris released in a planned manner during normal operations, and assesses and limits 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.

Eutelsat has assessed the amount of debris released in a planned manner and no intentional debris will be released during normal operations of the EUTELSAT 139WA spacecraft. A safe operational configuration of the satellite system is ensured thanks to the hardware design and operational procedures

Eutelsat minimizes the probability of the satellite becoming a source of debris by collisions with large debris or other operational satellites. Eutelsat assessed and determined that there are no other satellites located at or sufficiently near EUTELSAT 139WA's planned orbital location that might result in overlap of satellite orbit control windows.

EUTELSAT 139WA will be controlled within its orbit control window (139.2° W.L. +/- 0.1°) by standard routine periodic orbit correction manoeuvres. In case of anticipated violation of the window, correction manoeuvres would be implemented to avoid such violation.

Eutelsat has assessed the probability of accidental explosions during and after completion of mission operations. Thanks to design safety margins, the probability of occurrence of accidental explosion of the EUTELSAT 139WA satellite is negligible.

Satellite design is such that high levels of thruster activity and orbit perturbation do not result when foreseeable on-board events occur

4. EUTELSAT 139WA End of life disposal

The post-mission disposal activities have been planned as follows:

1. The orbit of the satellite will be raised by 300 km in order to ensure that the spacecraft will not re-enter into the GEO protected region (GEO height +/- 200 km) in the long term. A mass of 10.7 kg of propellant has been allocated and reserved with a confidence level of 99% to carry out the post-mission disposal manoeuvres. The FCC will be informed of any material change to the above quantity of propellant.

   The minimum perigee height to avoid re-entering into the GEO protected region can be computed using the IADC formula applied to this satellite:

   $$\Delta H\ (km) = 235 + 1000 \cdot (A/m) \cdot eff = 262\ km$$

   where the final term is the effective area/mass ratio of the satellite. Therefore, the planned 300 km above GEO height is sufficient to satisfy the 262 km requirement.

   Eutelsat will monitor the remaining propellant to ensure that sufficient fuel remains in the tanks to reach the 300 km minimum perigee.

2. The satellite tracking, telemetry and control operations are planned to avoid interference and coordinated with potentially affected satellite networks.

3. As part of the end of life activities, EUTELSAT 139WA energy sources will be rendered inactive such that debris generation will not result from the conversion or dissipation of energy sources on-board the satellite. For EUTELSAT 139WA, this involves the following:

   - Discharge the batteries during end of life operations and isolate them from the solar arrays to prevent further electrical energy storage.

   - Switch off the momentum wheels.

- Deplete and eventually vent the propellant tanks, which allows depressurizing during passivation operations and results in only negligible residuals remaining in the helium tank that cannot be vented. The helium tank is isolated just after the completion of Launch and Early Operations Phase (LEOP) operations and therefore cannot be fully vented as part of the end of life (EOL) operations. The following table summarises information regarding the residual helium in the tank:

Volume [L]	Pressure [bar]	Temp. [°C]	He Mass [kg]
178	53.0	46.6	1.5

In addition, the tank has been designed, manufactured, and validated according to the MIL-STD-1522 standard and it is "leak before burst" designed. Therefore, the risk of break-up is negligible.

- All pyrotechnic systems are fired at initial stage of satellite operations. Those systems do not generate any debris.

5. Notifications

Eutelsat undertakes to provide the relevant bodies as required (UNCOPUOS, FCC, ITU, French ANFR, etc.) with all appropriate notifications as required by law or regulations for Eutelsat satellites including but not limited to those concerning initial entry of service, location, relocations, inclined orbit operations and de-orbiting operations.