

Attachment D - Space Debris Mitigation Plan



**EUTELSAT 8WB Space
Debris Mitigation Plan**

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EUTELSAT 8WB Space Debris Mitigation Plan (prepared for the Federal Communications Commission)

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<i>Prepared by:</i>	<i>Position</i>	<i>Signature</i>	<i>Date</i>
D. Zamora	Head of Flight Dynamics		17/07/2019

<i>Approved by:</i>	<i>Position</i>	<i>Signature</i>	<i>Date</i>
L.R. Pattinson	Director of Satellite Operations		17/7/19.

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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 8WB satellite at the 8.0° West Longitude (W.L.) orbital location.

Eutelsat 8WB is based on the Thales Alenia Space Spacebus 4000-C4 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 8WB was launched on the 20th of August 2015 and the end of its operational life is not expected to be before September 2033.

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. NASA Safety Standard, Guidelines and Assessment Procedures for limiting Orbital Debris, NSS 1740.14 (August 1995)
5. ITU-R Recommendation S.1003-2, Environment Protection of the Geostationary Orbit (2010).
6. UNCOPUOS, Technical Report on Space Debris (1999)

3. EUTELSAT 8WB 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 8WB 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

8WB's planned orbital location that might result in overlap of satellite orbit control windows.

EUTELSAT 8WB will be controlled within its orbit control window (8.0° 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 8WB satellite is negligible.

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

4. EUTELSAT 8WB 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 14.1 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:

$$\Delta H \text{ (km)} = 235 + 1000 \cdot (A/m) \cdot \text{eff} = 259 \text{ km}$$

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 259 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 8WB 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 8WB, 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 tanks that cannot be vented. The helium tanks are 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 tanks:

Tank	Volume [L]	Pressure [bar]	Temp. [°C]	He Mass [kg]
He1	89.5	70.7	35.9	1
He2	89.5	70.7	35.9	1

In addition, the tanks have been designed, manufactured, and validated according to the MIL-STD-1522 standard and they are “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.