

Eutelsat W3A/Eutelsat 7A Space Debris Mitigation Plan (prepared for the Federal Communications Commission)

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CHANGE RECORD

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21/02/2012	1/0	All	First issue.
01/03/2012	1/1	6	Section 4: Add details on non vented propellant and pressurised vessels at end of life.
08/03/2012	1/2	4	Section 1: Replace end of life date by design life.

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1. Introduction

This document describes the space debris mitigation plan that Eutelsat shall apply to the **Eutelsat W3A/7A** space station.

Eutelsat W3A/7A 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 W3A/7A was launched in 2004 with a design life of greater than 15 years.

2. Related documents

2.1. Applicable Documents

1. EUTELSAT Space Debris Mitigation Plan. Issue 1.3. EUT_CTL-SAT_QMS_PLN_00021, 26 July 2010.
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 W3A/7A operations

- Eutelsat operates in order 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 W3A/7A 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 for

Eutelsat W3A/7A whether there were any known satellite located at the requested orbital location or might overlap.

- Eutelsat W3A/7A is controlled within its ITU allocated orbit control window (7.0°E +/- 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 and enough safety barriers, the probability of occurrence of accidental explosion of the Eutelsat W3A/7A 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 W3A/7A 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 have 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 significant 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:

$$\Delta H \text{ (km)} = 235 + 1000.(A/m)_{\text{eff}} = 269 \text{ km}$$

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 269 km requirement.

During the satellite lifetime, Eutelsat determine the remaining propellant tanks.

2. As part of the end of life activities Eutelsat W3A/7A energy sources will be rendered inactive, such that debris generation will not result from the conversion of energy sources on board the spacecraft into energy that fragments the satellite. For Eutelsat W3A/7A, this involves the following:
 - depleting the chemical propulsion system, and where possible leaving open fuel lines and valves.

The following table shows the characteristics of the pressurant tank, propellant tanks and propellant lines at end of life (EOL). It shall be noted that during the passivation the four propellant tanks will be depressurised as much as possible.

Element	Total Volume (l)	Material contained at EOL	Predicted mass of material at EOL (kg)
NTO Propellant tank 1	550	NTO	8.2
		He	1.1
MMH propellant tank 2	550	MMH	1.3
		He	1.1
NTO propellant tank 3	550	NTO	8.2
		He	1.1
MMH propellant tank 4	550	MMH	1.3
		He	1.1
NTO lines	2 x 1.24	NTO	2 x 1.8
MMH lines	2 x 1.29	MMH	2 x 1.1
Pressurant tank	178	He	1.5

Other pressurised elements at end of life are the Lithium-Ion batteries and the heatpipes, which use ammonia as working fluid. Nevertheless, the operating pressure of the batteries is more than 4 times smaller than the burst pressure and the batteries are “leak before burst” designed. The operating pressure of the heatpipes is more than 6 times smaller than the burst pressure, the risk of break-up is considered negligible.

3. The satellite tracking, TM and TC usage are planned so as to avoid electrical interference to other satellites and coordinated with any potential affected satellite networks.
4. During the orbit raising manoeuvres the tracking, TM and TC frequencies will be limited to those where the satellite is authorized to operate.

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 re-orbiting operations.

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