Maneuvers to Reduce Ariane 5 Upper Stage Lifetime Duration in Orbit

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ABSTRACT

The ESCA Upper stage on Ariane 5 uses the HM7B engine which is a heritage of the Ariane 1 upper stage engine. This induces that ESC stage is not re-ignitable in orbit, as such a feature can be avoided for GTO launches from French Guiana. As a result, it is not possible to perform a controlled reentry of the upper composite once the launcher’s main mission is completed. As Ariane 5 was designed well before 2008, it has to justify of its best effort in the aim at respecting the so called “25 years rule” relative to the maximum life duration on orbit (Article 55 of the Technical Rules of the French Space Operations Act).

The upcoming Ariane 6 launcher is fully compliant since upper stage will be re-ignitable and deorbited with a controlled atmospheric reentry.

In order to do our best effort and minimize the A5 upper composite life duration on orbit, ARIANEGROUP, ARIANESPACE, ESA and CNES, have joined efforts to implement, recurrently, maneuvers to reduce lifetime by using remaining onboard energy to decrease altitude of the upper composite GTO orbit after payloads’ injection. The technical approach is to use residuals propellants, after commercial phase, to create, by cold liquid / gas ejection, a delta velocity in an optimized direction, without introducing any hardware change to the current launcher system definition. LH2/GH2 are ejected through the HM7B nozzle, without re-ignition, which allows to reach a certain level of thrust enabling to reduce both perigee and apogee altitudes and therefore the upper composite’s life duration.

After some experimental flights, maneuvers for Upper stage perigee/apogee decrease are now implemented as the reference for the ESC end of flight before final passivation.

This article will expose maneuvers applied at the end of Upper stage flight and gains expected in term of life duration minimization. Durations will be compared with Upper composite previous situation without maneuvers.