SPACE DEBRIS SYMPOSIUM (A6)
Space Debris Removal Issues (5)

Author: Dr. Franklin Chang Diaz
Ad Astra Rocket Company, United States, franklin@adastrarocket.com

Dr. Mark Carter
Ad Astra Rocket Company, United States, mark.carter@adastrarocket.com
Dr. Andrew Ilin
Ad Astra Rocket Company, United States, andrew.ilin@adastrarocket.com
Dr. Tim Glover
Ad Astra Rocket Company, United States, tim.glover@adastrarocket.com
Dr. Jared Squire
Ad Astra Rocket Company, United States, jared.squire@adastrarocket.com

AD ASTRA'S VASIMR SPACE TUG LOW EARTH ORBIT SPACE CLEANER

Abstract

The work presents the advantages of VASIMR electric propulsion technology to remove orbital debris from Low Earth Orbit (LEO) by means of a high power, solar electric propulsion space tug. Examined were the capture and controlled deorbit of 19 known large pieces of orbital debris, drifting at 800 km altitude. The chosen objects are mainly spent Zenit rocket upper stages 4 m diameter by 10 m long, weighing approximately 8 t.

This mission concept utilizes the company's multipurpose, 200 kW VASIMR solar electric space tug to lower the orbital altitude of the Zenit targets for a controlled chemical deorbit over the Pacific Ocean. To accomplish this, the reusable tug is fitted with a specialized service module consisting of a solid rocket motor (SRM) tray, loaded with 20 SRM units (19 plus a spare) and a detachable, short-range, "chemical robotic pod" (CRP) for proximity operations near the target body. For each of the 19 targets, the tug first climbs to the orbit of the drifting Zenit where the CRP is released to capture, stabilize, and bring the target back to a hard docking with the tug. At capture, the CRP also robotically installs a fresh SRM unit onto the Zenit rocket nozzle. With the Zenit attached, the tug brings it down to approximately 400 km for release at a point where the newly fitted SRM ignites, bringing the Zenit to a controlled atmospheric re-entry. The VASIMR tug then climbs back, making a plane change, as required, to capture the next target and repeat the process.

The mission involves a sequence of 19 altitude change maneuvers, in multiple orbital planes optimized for minimum fuel use and minimum time for a given power and specific impulse (Isp). The mission study shows an absolute minimum time at an Isp of 4500-5000 seconds, well suited for a VASIMR propulsion system operating with low-cost argon propellant. VASIMR's measured high power performance for this application is both faster and cheaper than other EP technologies. Going to even higher Isp may also be attractive, as it further reduces the initial launch cost to LEO with only a modest increase in mission time.