RS-34 Phoenix In-Space Propulsion System Applied to Active Debris Removal Mission

Abstract

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In-space propulsion is a high percentage of the cost when considering Active Debris Removal mission. For this reason it is desired to research if existing designs with slight modification would meet mission requirements to aid in reducing cost of the overall mission. Such a system capable of rendezvous, close proximity operations, and de-orbit of Envisat class resident space objects has been identified in the existing RS-34 Phoenix. RS-34 propulsion system is a remaining asset from the de-commissioned United States Air Force Peacekeeper program; specifically the pressure-fed storable bi-propellant Stage IV Post Boost Propulsion System.

The National Aeronautics and Space Administration (NASA) Marshall Space Flight Center (MSFC) gained experience with the RS-34 propulsion system on the successful Ares I-X flight test program flown in the Ares I-X Roll control system (RoCS). The heritage hardware proved extremely robust and reliable and sparked interest for further utilization on other potential in-space applications. Subsequently, MSFC has obtained permission from the USAF to obtain all the remaining RS-34 stages for re-use opportunities.

The MSFC Advanced Concepts Office (ACO) was commissioned to lead a study for evaluation of the Rocketdyne produced RS-34 propulsion system as it applies to an active debris removal design reference mission for resident space object targets including Envisat. Originally designed, the RS-34 Phoenix provided in-space six-degrees-of freedom operational maneuvering to deploy payloads at multiple orbital locations. The RS-34 Concept Study lead by sought to further understand application for a similar orbital debris design reference mission to provide propulsive capability for rendezvous, close proximity operations to support the capture phase of the mission, and de-orbit of single or multiple large class resident space objects. Multiple configurations varying the degree of modification were identified to trade for dry mass optimization and propellant load. The results of the RS-34 Phoenix Concept Study show that the system is technically sufficient to successfully support all of the missions to rendezvous, capture, and de-orbit targets including Envisat and Hubble Space Telescope.

The results and benefits of the RS-34 Orbital Debris Application Concept Study are presented in this paper.