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UPDATE ON RISK REDUCTION ACTIVITIES FOR A LIQUID ADVANCED BOOSTER FOR NASA'S SPACE LAUNCH SYSTEM

Abstract

The stated goals of NASA's Research Announcement for the Space Launch System (SLS) Advanced Booster Engineering Demonstration and/or Risk Reduction (ABEDRR) are to reduce risks leading to an affordable Advanced Booster that meets the evolved capabilities of SLS; and enable competition by mitigating targeted Advanced Booster risks to enhance SLS affordability. Dynetics, Inc. and Aerojet Rocketdyne (AR) formed a team to offer a wide-ranging set of risk reduction activities and full-scale, system-level demonstrations that support NASA's ABEDRR goals.

Dynetics and AR offered a series of full-scale risk mitigation hardware demonstrations for an affordable booster approach that meets the evolved capabilities of the SLS. To establish a basis for the risk reduction activities, the Dynetics Team developed a booster design that takes advantage of the flight-proven Apollo-Saturn F-1 to deliver 150 mT (331 klbm) payload to LEO, which enables a low-cost, robust approach to structural design.

During the ABEDRR effort, the Dynetics Team has modified proven components and subsystems to improve affordability and reliability. The team has built hardware to validate production costs and tests to demonstrate it can meet performance requirements. State-of-the-art manufacturing and processing techniques have been applied to the heritage F-1, resulting in a low recurring cost engine while retaining the benefits of Apollo-era experience. NASA test facilities have been used to perform low-cost risk-reduction engine testing.

Dynetics has also designed, developed, and built innovative tank and structure assemblies using friction stir welding to leverage recent NASA investments in manufacturing tools, facilities, and processes, significantly reducing development and recurring costs. A full-scale cryotank assembly was used to verify the structural design and prove affordable processes. Dynetics performed proof and cryothermal cycle tests on the assembly to verify it met performance requirements.

During the contract, NASA and the Dynetics Team agreed to move work focused on an Oxidizer-Rich Staged Combustion (ORSC) cycle rocket engine under Dynetics' ABEDRR prime contract. The purpose of this risk reduction activity is to demonstrate combustion stability and measure performance of a 500,000 lbf thrust class main injector. To meet these objectives, the effort is focused on the design, analysis, fabrication, and test of a full scale ORSC main injector, Thrust Chamber Assembly (TCA), and supporting hardware.

This paper will discuss the ABEDRR engine task and structures task achievements to date and the remaining effort through the end of the contract.