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SPACE TRANSPORTATION SOLUTIONS AND INNOVATIONS SYMPOSIUM (D2)
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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.

For NASA's SLS ABEDRR procurement, Dynetics and AR formed a team to offer 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. Using NASA's vehicle assumptions for the SLS Block 2, a two-engine, F-1-based booster design delivers 150 mT (331 klbm) payload to LEO, 20 mT (44 klbm) above NASA's requirements. This enables a low-cost, robust approach to structural design.

During the ABEDRR effort, the Dynetics Team has modified proven Apollo-Saturn components and subsystems to improve affordability and reliability (e.g., reduce parts counts, touch labor, or use lower cost manufacturing processes and materials). 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. The full-scale cryotank assembly was used to verify the structural design and prove affordable processes. Dynetics will also perform proof and cryo thermal cycle tests on the assembly to verify the assembly meets performance requirements. Dynetics is partnered with NASA through Space Act Agreements to maximize the expertise and capabilities applied to ABEDRR.

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