SPACE TRANSPORTATION SOLUTIONS AND INNOVATIONS SYMPOSIUM (D2)
Heavy Lift Launchers Capabilities and New Missions (8)

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THE SPACE LAUNCH SYSTEM CAPABILITIES FOR ENABLING LUNAR, NEAR EARTH ASTERIOD AND MARS EXPLORATION MISSIONS

Abstract

The Boeing Company has identified three robust space exploration architectures that are enabled by the new Space Launch System (SLS) family of Launch Vehicles. This paper centers on the capabilities provided by, and benefits derived from, utilizing the SLS to provide insertion into beyond Earth transfer orbits. This paper addresses configuration, staging, engine selection, propellant loading, ascent flight, and upper stage sizing options. Specifically, performance and vehicle characteristics of Core Stages with 4 and 5 engines, large upper stages with 1 and 2 J2-X engines, and smaller 45mt mass upper stages with RL-10 engines are presented. Included is a comparison of Solid (SRB) and a Liquid Rocket Booster (LRB) options for the Evolved SLS. This paper includes descriptions of the beyond Earth elements necessary for exploration transfer (in-space) stages boosted by the SLS. Descriptions are given for three beyond Earth missions, with the SLS upper stages providing Trans-Lunar Injection, injection into Near Earth Asteroid (NEA) trajectories and Trans-Mars Injection. The SLS is an asset with performance capabilities enabling a promising set of exploration missions in the 2020-2040 time frame. Summary findings include:

• Mid 2020's: The interim SLS can provide initial Crewed Lunar capabilities; while validating systems and technologies necessary to longer duration NEA and Mars missions. • Mid-late 2020's: The interim SLS can provide high injection velocity for outer planet and sample return missions • Late 2020's: The Evolved SLS can provide "Reusable lander" EML2 based crew Lunar sorties via a single launch; later, multiple launch architectures facilitate Crew NEA missions using chemical or Solar Electric Propulsion (SEP) transfer stages. • Early 2030's: Multiple launches of the Evolved SLS can provide for 3 year crewed Mars missions using SEP stages and inflatable habitats.

These missions, enabled by the SLS, will be presented in the context of a linked set of exploration objectives, via a series of crewed missions that progress further out into the Solar system. As upper stage, transfer stage and crew habitation technologies are qualified in near Earth space, evolutions to these elements will be used for longer duration missions. Those missions, with destinations at Lunar Libration points, NEA and Mars, will require the large payload volume and heavy lift capabilities that only the SLS can provide.