

Return to the Moon (02)
Concepts for Robotic and Human Missions to the Moon (3)

Author: Mr. Benjamin Donahue
The Boeing Company, United States

Mr. John Connolly
United States

REUSABLE LUNAR LANDER BASED AT AN EARTH MOON LAGRANGE POINT

Abstract

A Lunar exploration campaign is described that features a reusable lander based at one of the Earth-moon Libration points (L1 or L2). The lander provides crew sorties between the L-point station and the Lunar surface utilizing fuel transferred to the L-point station (from Earth) and a disposable drop stage. Elements are boosted directly to the L Point station by the Space Launch System (SLS), or are boosted to LEO and then transferred to the L-point via in-space transfer stages. Later, the crew is boosted directly to the L-point station by the SLS. A Lander staging approach was selected that uses a dedicated upper stage to perform lunar orbit capture and the majority of the Lunar descent burn before being jettisoned. This staging approach was first used by the Surveyor series of landers in the mid 1960's, and later by the Soviet Luna landers. Staging and dropping the large propulsive stage 5km above the surface allows for a significantly smaller lander than the Constellation program's Altair lunar lander. Once the L-point station and the reusable Lander are in place, only one SLS launch is required to bring up the crew and payloads necessary to complete one Lunar sortie mission, enabling a "single launch sortie" architecture. The use of a single lander for multiple sorties would reduce the recurring costs for exploration and would provide operational experience with the highly reliable systems that are needed for future Human Mars exploration. This paper will include illustrations of lander propulsion systems and SLS manifests, as well as discussions on the benefits, design and operational considerations of a reusable lander. Additionally, the paper will address how the lander's propulsion stage could serve as a pathfinder for a future Mars ascent stage. An L point station emplacement might be a suitable "first beyond LEO mission" for the SLS, and follow-on crewed Lunar missions could form the basis for a series of SLS flights into the mid-2020s. The elements and their masses necessary to perform this scenario will tightly match the launch capabilities of the SLS. Methodologies for a highly reliable lander stage will be identified. The L-point Station is discussed as a staging base and a review of its advantages as compared to lander missions staged from LEO is given. The Lunar mission is placed in the context of a exploration campaign that includes Lunar precursors, including teleoperation of lunar assets from the L Point station.