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Human Exploration of the Moon and Cislunar Space (1)

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CONCEPT STUDY OF A CIS-LUNAR OUTPOST ARCHITECTURE AND ASSOCIATED ELEMENTS THAT ENABLE A PATH TO MARS

Abstract

Since the early days of space exploration, astronauts have continued to push the bounds of both mission endurance and distance from Earth. While these achievements have contributed greatly to our ability to operate in space, what is really needed to get humans closer to achieving a Mars mission are missions that combine both duration and distance. This will allow astronauts to learn how to operate in deep space for months at a time and mitigate many of the risks associated with a deep space mission lasting over 900 days.

An outpost placed in the vicinity of the moon, called a cis-lunar outpost, is an ideal place to gain experience operating in deep space. This next generation of in-space habitation is evolvable, flexible, and modular. It allows astronauts to demonstrate they can operate for months at a time beyond LEO. A cis-lunar outpost can also be an international collaboration, with partnering nations contributing elements and major subsystems based on their national expertise.

In addition to meeting human spaceflight objectives, a cis-lunar outpost can help meet exploration science objectives. For example, astronauts in the outpost could operate a robotic rover and ascent vehicle (in near real-time) in order to collect geological samples from lunar farside and return them to the outpost. Returning samples from the SPA basin on the farside of the Moon has been identified as a priority in planetary science Decadal Surveys because it would help scientists understand the early dynamics and impact history of the solar system.

Lockheed Martin is currently studying concepts for a cis-lunar outpost architecture that evolves in capability over time. This work is being conducted both through internally funded work with partners like Thales Alenia Space Italy (TASi) and through the NASA funded NextSTEP Habitat program. The architecture includes elements such as power and propulsion modules, habitation modules, and an air-lock. The outpost's capabilities increase with each new element, incorporating lessons learned and new technologies that are needed for Mars such as closed loop life support, laser communication, advanced Extra-Vehicular Activity (EVA), In-Situ Resource Utilization (ISRU), and robotics.