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HUMAN EXPLORATION OF THE SOLAR SYSTEM SYMPOSIUM (A5)
Human Exploration of the Moon and Cislunar Space (1)

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ASTEROID REDIRECT MISSION: EARLY HUMAN SPACE FLIGHT IN THE PROVING GROUND

Abstract

The Proving Ground is the next phase of human exploration missions beyond low-Earth orbit to demonstrate the ability to safely live and work in cis-lunar space, and farther than humans have ever traveled before. Missions in the Proving Ground will build on the capabilities developed in low-Earth orbit and tested on the International Space Station. The Asteroid Redirect Mission (ARM) is an early Proving Ground mission that will include the first-ever robotic mission to capture a multi-ton boulder from near-Earth asteroid, then redirect it into a stable lunar distant retrograde orbit (LDRO) in cis-lunar space for visit by Orion crewed missions in the 2024-2025 timeframe.

ARM is part of NASA's plan to advance the new technologies and spaceflight experience needed for human missions to the Martian system in the 2030s, which includes capabilities to live in the space radiation environment and testing trajectory and operational techniques that allow future missions to Mars. The ARM robotic spacecraft will utilize an advanced high-power Solar Electric Propulsion (SEP) system to ferry the multi-ton boulder through a low gravity trajectory including insertion into the LDRO. This mission will inform Mars human mission planning by validating the use of SEP for pre-deployment of large cargo destination systems in Mars orbit and use of the LDRO as a staging location for build-up of the Mars transit spacecraft.

SLS and Orion are foundational building blocks for human missions to cis-lunar space and Mars and will be utilized in the ARM crewed mission which will also leverage new exploration space suits and systems for extra-vehicular activity to extract and contain asteroid samples. Direct human investigation of an asteroid mass will improve scientific knowledge of these bodies, which tie to the beginning of our solar system. The ARM crewed mission will also test many deep space techniques required for future missions to Mars including autonomous rendezvous and proximity operations in deep space, planetary gravity assist, staging orbit insertion and exit, and contingency mission plans.

This paper will provide the latest ARM formulation status, including program and mission planning, launch date flexibility, hardware development status, asteroid candidate identification, and advances in crew systems and operations development.