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Advanced Systems, Technologies, and Innovations for Human Spaceflight (7)

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KEYNOTE: FROM LEO TO THE MOON, MARS, AND BEYOND: SHAPING CAPABILITY DEVELOPMENT STRATEGIES FOR NASA'S HUMAN EXPLORATION CAMPAIGN

Abstract

The President of the United States, in signing Space Policy Directive-1, directed the NASA Administrator "to lead an innovative and sustainable program of exploration with commercial and international partners to enable human expansion across the solar system and to bring back to Earth new knowledge and opportunities. Beginning with missions beyond low-Earth orbit, the United States will lead the return of humans to the Moon for long-term exploration and utilization, followed by human missions to Mars and other destinations." NASA and the international spaceflight community, including multiple government agencies and industry partners, are coalescing around plans for extending human exploration to the Moon, Mars, and beyond.

Key to these plans is a continuum of activities utilizing platforms in low Earth orbit, cislunar space, and the lunar surface to demonstrate advanced technologies, advance operations concepts, and develop countermeasures to lessen the impacts of the space environment and long duration exposure on the crew working in space. NASA is using a capability-driven approach to identify critical gaps to be addressed as part of a focused program to reduce risk for future deep space exploration missions building to eventual human missions to the surface of Mars. Teams of discipline experts from across NASA identify capability gaps between the current state of the art and the needs of proposed exploration missions and develop integrated strategies and roadmaps for filling those gaps. These inputs are used to shape technology investment strategies and are incorporated along with human research to assess spaceflight risks in utilization planning for the International Space Station (ISS) and the new lunar orbiting Gateway, as well as human and robotic missions to the lunar surface and Mars vicinity.

This paper describes key human spaceflight capabilities that must be advanced to enable NASA's exploration goals. The paper addresses the importance and application of these capabilities to deep space human spaceflight. We discuss the activities required to advance critical exploration capabilities, the means of demonstrating system performance, and implementation planning, including selection of flight test location based upon the unique environments and characteristics of the ISS, Gateway, and potential lunar surface habitats. The optimal strategy will be a combination of ISS/LEO, Gateway, and lunar surface testing; however, not all capabilities require all these steps on their path to deep space exploration missions.