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PLANETARY SURFACE OPERATIONS AND UTILIZATION: HOW ISS AND ARTEMIS MISSIONS CAN BE USED TO MODEL HUMAN EXPLORATION OF MARS

Abstract

A major benefit of NASA's return to the moon is to demonstrate and evaluate living and working on the lunar surface as a way to improve systems and planning for the first human missions to Mars. Systems from EVA suits to rovers that are built for Artemis will also serve as testbeds for future Mars operations. Experience gained in working to protect crew health and performance during challenging lunar missions will also be important in defining plans for human missions to Mars.

Experience from ISS crew time planning and EVA activities and other Mars surface concepts were used as inputs into a derived reference for the surface exploration portion of a human Mars mission architecture, as documented in a recently released surface operations timeline model (NASA document HEOMD-415). We documented constraints and considerations in planning daily activity timelines for crewed exploration on Mars. A major focus was estimating how much time during each Martian sol might be available for exploration activities, especially utilization and conducting science activities, after accounting for time needed for crew and equipment care. A focus was on a short (30 sol) surface stay, in order to reduce overall risks on a first human mission to Mars. By using the model to summarize crew time in relevant mission planning categories a basis of estimate for planning early mission science objectives in a future NASA Science-sponsored workshop was constructed.

Although no decisions have been made by NASA regarding human Mars mission objectives, durations, or architectures, this operations model aids in trade studies and can be used to evaluate alternative mission approaches and objectives. In addition, it enables assessment of human systems risks across different mission phases. The model is also being compared with models of Artemis surface activities for surface missions of similar durations. Assumptions will be evolved and validated with lessons learned from Artemis surface missions as they progress to a similar 30-day duration over time. Generally, architecture trades have focused on capabilities such as propulsion and landers. This broader interdisciplinary approach that includes operational assumptions and assessments of crew risk will help us make more informed decisions about Mars architectures and make it easier to apply lessons learned from Artemis to Mars planning. Emphasizing utilization and especially science activities on the surface helps to focus current discussions led by NASA's Mars Program so that we can work together to make more informed studies of architecture trades.