IAF HUMAN SPACEFLIGHT SYMPOSIUM (B3)
Utilization & Exploitation of Human Spaceflight Systems (3)

Author: Dr. Julie A. Robinson
National Aeronautics and Space Administration (NASA), United States

Mr. Michael C. Waid
National Aeronautics and Space Administration (NASA), Johnson Space Center, United States
Mr. David Korth
NASA, United States
Ms. Michelle Rucker
NASA, United States
Mr. Royce Renfrew
National Aeronautics and Space Administration (NASA), United States

INNOVATIVE APPROACHES TO USING THE INTERNATIONAL SPACE STATION AS A MARS TRANSIT HABITAT ANALOG

Abstract

From the beginning of human spaceflight, scientists and engineers have sought appropriate analogs to extreme missions in order to improve engineering design, medical requirements and countermeasures, and ultimately ensure safety and mission success. The International Space Station (ISS) from its inception has served as a key place for doing research on the effects of microgravity on human physiology. Typically Earth-based analogs have been used to model isolation, confinement and remote conditions of exploration mission scenarios in simulated Mars missions conducted in the U.S. HERA (Human Exploration Research Analog) and Russian NEK (Nazemnyy eksperimental'nyy kompleks) facilities.

Recently, NASA completed a cross-disciplinary assessment of whether modifications could be made to operations or facilities so that ISS could be used more effectively as an analog to simulate long-duration crew missions beyond low earth orbit. Three use cases where ISS could provide valuable high-fidelity experience were identified. (1) Testing of operations procedures and medical care could be enhanced by demonstrating crew handling a simulated medical event in microgravity autonomously, and with significant communications delay. (2) Isolation and confinement effects of deep space transit could be studied on ISS to validate current habitable volume requirements for Mars transit as well as provide context for evaluating the results of the extensive ground-based simulations in HERA and NEK. A trade study of possible operational and hardware changes that would make ISS applicable to these use cases was completed. (3) Surface operations after the physiological deconditioning of a long transit could be conducted to validate crew ability to perform critical ground tasks after 6-month Mars transit and aid in conceptual design of Mars surface element architectures.

Each of the case studies includes a trade space between operational impacts on nominal ISS activities and degree of fidelity. A phased approach to implementation means that several "quick start" activities can be done in 2019 at the same time as planning continues for more complex options beginning as early as 2022. The team determined that many of these quick start tasks could be done with available assets, entirely independent of other exploration system development timelines (such as Orion or the Space Launch System). The consideration of the full suite of human spaceflight capabilities in the lunar vicinity can also be included as each step in human exploration serves as a simulation opportunity for some aspect of subsequent missions and could provide significant inputs to future mission architectures.