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CREWED CERES MISSION USING HUMAN MARS TRANSPORT

Abstract

While Mars has been NASA's horizon destination for human exploration, there are also destinations of interest further out in our solar system. Ceres – a dwarf planet that resides in the asteroid belt – is a location that has drawn significant scientific interest in recent decades due to the presence of a significant amount of water. Given the current scientific interest, this study looks into the feasibility of using the Human Mars Transportation System, a hybrid chemical and electric propulsion system most recently defined in current NASA Mars mission studies, for a crewed mission to Ceres in the late 2030s, early 2040s timeframe. Various mission profiles are explored, ranging from a flyby to a rendezvous with various ensuing stay times. After investigating and selecting viable transfer trajectories, this study then examines the necessary modifications on the Human Mars Transportation System in order to accommodate the crew for various mission durations. This includes the required provisions for the trip, the equipment needed to perform the desired science, and potential changes to the propulsion or power systems to provide the needed performance. Analysis was performed using NASA's Copernicus and Beyond LEO Architecture Sizing Tool (BLAST) software packages to generate viable trajectories along with spacecraft designs. For mission profiles that rendezvous with Ceres, the study also examines the impacts associated with several potential sample collection techniques as the low gravitational parameter of Ceres enables descent to and ascent from the surface for minimal additional performance cost. These techniques range from human EVAs to robotic sample collection and return. The goal of this study was not to suggest that the Human Mars Transportation System should go to Ceres instead of Mars, but to examine the feasibility of utilizing the same infrastructure to do so with little new investment. One such example might be that the transport has been built up first and all of the Mars infrastructure will not be ready for another five or more years. The result of this study is the comparison of various Ceres mission profiles and the potential necessary modifications, if any, on the Human Mars Transportation System to meet the mission constraints.