Paper ID: 12441
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From Earth Missions to Deep Space Exploration (05)
Habitation for Exploration Missions (3)

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A DEEP SPACE HABITAT FOR EXPLORATION

Abstract

The paper describes a habitable module to be used for long duration space exploration missions. The Deep Space Habitat (DSH) is conceived as a cis-lunar orbital infrastructure and a space-ship for deep space exploration missions. It will represent the first outpost beyond LEO, being deployed at the first Earth-Moon Lagrangian point (EML1), and is envisaged as a human-tended infrastructure with crew visits periodically foreseen. The DSH has to be firstly used as a platform for research and to demonstrate a set of critical technologies and associated operations required to perform a deep space human exploration mission (e.g. to a NEO). In this regard, placing the module at EML1 allows reproducing conditions that would be encountered during a travel to an asteroid (or to Mars), thus guaranteeing the possibility to test specific technologies in a more significant environment with respect to what possible on ground or in LEO (e.g. effects of radiations on human body outside the protection of the Van Allen belts and radiation protection system test). Besides being a technology test bed, the DSH will support lunar human exploration missions, providing a staging post and a safe haven for crew working on the Moon surface. The overall architecture of the DSH has derived from a set of system trade-off performed accordingly to the objectives to be accomplished: the most important features are described within the paper. The DSH deployed at EML1 can be seen as a first unit to be utilized as a precursor for a habitation module to be actually adopted for hosting the crew during a deep space mission (to a NEO or to Mars). Indeed, a second unit is envisaged, which exploits the experience gained through its precursor, having a common core with it and implementing technologies previously tested on it. Only minor changes shall be envisioned due to the peculiarities of the mission for which it is used. In particular, the description of the second unit presented in the paper refers to a specific reference mission to a NEO lasting one year. The first part of the paper focuses on the main performed trade-offs, as well as the obtained results, in terms of both system architecture and operations, highlighting the major differences between the two envisioned units. The second part is devoted to the critical and enabling technologies, with particular attention to advanced regenerative ECLSS, rapid prototyping and radiation protection system.