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DEEP SPACE HABITATION SYSTEMS - A TECHNOLOGICAL REVIEW

Abstract

According to the AIAA Space Architecture Technical Committee, Space Architecture "encompasses architectural design of living and working environments in space related facilities, habitats, and vehicles". To sustain future deep space missions, an understanding of the requirements for habitation systems both during long-duration space travel and upon landing on different celestial bodies is of utmost importance in order to develop effective solutions. Reducing dependencies on Earth for supplies will be crucial as we venture farther within our solar system. This is essential in maximising efficiency and supporting mission objectives. Additionally, it is important to recognise the significance of robust monitoring and communication systems within the facility in increasing safety and performance of astronauts. As we venture further from low Earth Orbit (LEO), a foundational understanding of the human requirements for future deep space and planetary exploration is necessary. Never before did humans have the need for Environmental Control and Life Support Systems (ECLSS) to operate independently from Earth for long

periods and under different gravitational gradients. For this reason, it is vital for ECLSS to have self-reliant oxygen, water, food and waste management systems. This study will review current advancements in physicochemical and bioregenerative technologies, and critically assess which open questions are most important to deal with. This study will also examine results from recent ground analog missions, while taking into consideration all possible environmental variables at play. Finally, human-system integration is expected to increase safety, efficiency and performance of astronauts; for this reason, by reviewing state-of-the-art monitoring and communications systems for space stations, habitats, and EVA systems, this research can determine where to best allocate resources to tackle the most pressing of issues. The outcome of this study is to define research questions in each of these areas, in order to effectively develop solutions for future deep space and planetary exploration missions. This study is performed by the Deep Space Initiative (DSI). DSI is a non-profit entity that aims to increase accessibility and opportunity for space research, and its main focus is to help enable deep space exploration for the benefit of all Humankind.