HUMAN EXPLORATION OF THE SOLAR SYSTEM SYMPOSIUM (A5)
Human Exploration of Mars (2)

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TORPOR INDUCING TRANSFER HABITAT FOR HUMAN STASIS TO MARS

Abstract

The idea of suspended animation for interstellar human spaceflight has often been posited as a promising far-term solution for long-duration spaceflight. A means for full cryo-preservation and restoration remains a long way off still. However, recent medical progress is quickly advancing our ability to induce deep sleep states (i.e. torpor) with significantly reduced metabolic rates for humans over extended periods of time. In July 2013, the NASA Innovative Advanced Concepts (NIAC) Program awarded SpaceWorks Engineering with a Phase I study to investigate the feasibility and systems-level impact of applying this medical technology to human spaceflight, specifically for human missions to Mars. This paper summarizes the results of this nine month NIAC Phase I study.

To investigate the feasibility of applying torpor to human spaceflight, the authors performed a thorough literature review of the two required medical procedures for inducing long-duration torpor. The first procedure, Therapeutic Hypothermia (TH) is a medical treatment that lowers a patient's body temperature and induces sleep. The second procedure, Total Parenteral Nutrition (TPN), is the feeding of a person intravenously by nutritional fluids delivered via a catheter. Both procedures are well-proven, inexpensive to implement, and supported by standard protocols. Details of these medical procedures and their history are discussed at length.

The authors created several designs for human stasis Mars transfer habitats. These habitats are small, pressurized modules that are docked around a central node/airlock permitting direct access to the Mars excursion vehicle and Earth return capsule by the crew. Some of the designs considered are capable of inducing artificial gravity by rotating the crew module. For the baseline habitat design, total crew habitat mass is reduced by a factor of 2, and pressurized volume is reduced by a factor of 4, compared to NASA's current Mars mission Design Reference Architecture (DRA 5.0) habitats. Detailed engineering diagrams and mass breakdown statements for these habitat designs are provided.

End-to-end Mars mission architectures were evaluated using the new habitat designs to fully characterize the impact of this technology to Mars exploration. Both conjunction-class and opposition-class missions were considered. For the baseline conjunction-class missions and baseline human stasis habitat design, the human stasis option shows a 30