HUMAN SPACEFLIGHT SYMPOSIUM (B3)
Advanced Systems, Technologies, and Innovations for Human Spaceflight (7)

Author: Mr. Mark Schaffer
SpaceWorks Enterprises, Inc., United States, mark.schaffer@sei.aero

Dr. John Bradford
SpaceWorks Enterprises, Inc. (SEI), United States, john.bradford@sei.aero
Dr. Douglas Talk
SpaceWorks Enterprises, Inc., United States, douglas.w.talk@gmail.com

# A FEASIBLE, NEAR-TERM APPROACH TO HUMAN STASIS FOR LONG-DURATION DEEP SPACE MISSIONS

**Abstract**

The idea of suspended animation for interstellar human spaceflight has often been posited as a promising far-term solution for long-duration voyages. A means of full cryo-preservation and restoration remains a long way off still. However, recent medical progress is quickly advancing our ability to induce torpor, a deep sleep hibernation-like state, in humans for extended periods of time. The authors propose that torpor can be used as a means of achieving human stasis for long-duration deep space by combining two existing, common, and well-understood medical procedures: Therapeutic Hypothermia (TH) and Total Parenteral Nutrition (TPN).

Therapeutic Hypothermia (TH) is a medical treatment in which a patient's body temperature is lowered to 32C to 34C (89F to 93F) in order to slow the body's metabolism. TH is being used routinely in hospitals around the world with broad application to reduce the impact of traumatic body injuries. Total Parenteral Nutrition (TPN) is a medical process in which patients are fed intravenously by nutritional fluids delivered via a central venous catheter. Long-term TPN is often used to treat patients suffering the extended consequences of an accident, surgery, or digestive disorder.

The authors began investigating the use of torpor for human stasis in 2013 through a study funded by the NASA Innovated Advanced Concepts (NIAC) program. In papers presented at IAC 2014 and IAC 2015, the authors presented the results of initial feasibility and systems-level impact studies of applying this medical technology to near-term exploration class missions to Mars (IAC-14-A5.2.8), and to far-term settlement-class missions to Mars (IAC-15-A5.2.12).

This paper focuses on the medical perspective of applying TH and TPN to long-duration deep space missions. The authors have assembled a team of medical experts in multiple medical specialties to access the feasibility of long-term use of both TH and TPN, overcoming the long-term medical complications that may occur, and advantages of placing the crew in hibernation. Detailed descriptions of the current state-of-the-art for each process, recommendations from the medical team, and discussions of medical advantages and potential medical challenges are presented. Designs for crew support systems enabling the application of TH and TPN in deep space habitats are also discussed.