

Hypothermia CLIFF Peer Review

This CLIFF characterizes hypothermia that might occur during spaceflight. There is a spectrum of hypothermia from mild to severe. The consequences of hypothermia can range from mild shivering to loss of consciousness and neurologic and cardiorespiratory failure. Hypothermia may occur terrestrially in cold environments where there is inadequate protection from low temperatures, or where there is dysregulation of body function responsible for thermal regulation. During spaceflight, however, a low temperature environment should only occur in the event of vehicle system failures. Space vehicles are designed to maintain a comfortable cabin or EVA suit temperature. Cold injuries can only occur when these systems fail either when a drastic power down is required (such as on Apollo 13) or when there is a failure of the thermal control systems. EVA suit failures have been considered elsewhere and are thought to be an extremely unlikely possibility given the redundancy built into the suit. Hypothermia due to body dysregulation during conditions such as sepsis are covered separately. Thus, only vehicle system failures were considered.

After having a series of meetings on this condition with engineers and PRA analysts, it was decided to defer inclusion of this CLIFF as well as a second CLIFF dealing with cold injuries. CST subject matter experts, reviewers, and ExMC management unanimously agreed to do so. The rationale is that: 1) there is not enough data available about failure modes leading to cold ambient temperatures to make a well-informed incidence calculation. 2) The risk of becoming hypothermic or having cold injury is very much dependent on the mission phase and the dynamics of the thermal environment that might be encountered. This is not yet well-characterized for all mission segments. 3) There are operational workarounds available for possible failure modes (e.g., if Gateway loses temperature control, the crew can use Orion as a lifeboat). 4) A scenario (such as multiple electrical bus failures or total failure of the electrical system) that could lead to these conditions would probably result in the loss of the crew. 5) The loss of thermal control systems or atmospheric revitalization equipment is more likely to lead to elevated cabin temperatures rather than low temperatures.

Of note, the scenario that led to the Apollo 13 power down and low environmental conditions is not felt to be applicable to Orion because there are no fuel cells with O₂/H₂ supply tanks that could leak..

Reviewed by:

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