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THERMAL CONTROL SUBSYSTEM FOR A LUNAR ROVER

Abstract

The vision for global cooperation on the lunar surface proposed by ESA's general director with the 'Moon Village' is setting up the next milestone of the human exploration of space. This call made for a sustained robotic and human presence on the moon forces all nations, institutions and industries involved with the realisation of such ambition to re-think their approach to operations in the harshest environment of all. All aspects involved in the survival of the missions constituting the moon village will have to be looked at with a fresh eye. The solutions designed to turn the moon village from a concept to a reality will have to be integrated and interdependent; adaptable; sustainable and will have to be fully dependable. The purpose of this Master's thesis is to focus on the thermal control subsystem which will be necessary to sustain a multi-function mobile platform on the moon surface. The foreseen area of operation is Marius Hills, located in Oceanus Procellarum, an environment where the temperature ranges from -150C (123K) to +120C (393K). In addition to surviving these extreme conditions; a lunar rover mission includes challenges related to propulsion; power; habitat; instrumentation... All areas deriving very stringent requirements for the thermal subsystem which will support them. The ambition of the work is to adopt the standard thermal analysis methodology by which the lunar environment and the operating conditions of the rover will be modelled. This analysis will be done in adherence with the mission specific design drivers identified for the mobile platform which will be captured as variables embedded in the model. This will be followed by a review of the potential implementation for the thermal control subsystems, potentially relying on traditional solutions (discrete devices like heaters; MLI; heat pipes; radiative coatings; etc.) but also favouring the promotion of new technologies adopted in the area of thermal control (two phase fluid loops; capillary pumped loops; loop heat pipes; etc.). The assessment of the viability of the implementation proposed will constitute an essential part of the master's thesis. Considerations such as the maturity of the technology, the industrialisation constraints, cost and funding will be presented. The paper will conclude with a recommendation of a thermal control subsystem solution for the SpaceTech 2016 Moon Village Mobile Platform.