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LUX-THERMAL: A POWER GENERATION SYSTEM FOR LUNAR NIGHT SURVIVAL

Abstract

Surviving the lunar night is one of the most demanding environmental challenges that future Moon expeditions will face; however, it is essential for maintaining a long-term human presence. Motivated from developing thermal and electrical solutions for lunar night survival, LUX-Thermal is an autonomous self-contained energy generation technology that provides thermal and electrical energy on demand. Unique to this system, a combination of innovation, safety, high energy density and paired electrical/thermal power satisfaction for multiple assets are merits embedded in the development process of the presented system. Depending on the customer's energy and power needs, the modularity of LUX-Thermal permits it to be developed as a stand-alone system on the lunar surface, integrated on top of a lander or viewed as a payload within a rover or satellite envelope.

As a first step, the system collects thermal energy from a heat source such as the sun, lander, rover, or other source of power. A reservoir will contain the storage material which will be used to satisfy the "Power as a Service" market either through direct thermal power transfer or following its conversion to electricity in a different module. Candidate storage options include phase changing materials, brought from Earth, or regolith collected in-situ leading to the reduction of overall launch mass. Throughout the system and at the customer interface points, an Active Thermal Switch (ATS), a Lunar Outpost EU developed product, will be actively connecting, or disconnecting thermal links through conduction on-demand.

As part of LuxIMPULSE, LOTESS-E (Lunar Outpost Thermal Energy Storage System – Earth), a scaled-down version of LUX-Thermal acting as a ground prototype, is currently undergoing assembly and testing. It is comprised of a solar collector, light pipes, latent heat storage system and ATS with the goal of maturing a scaled prototype of LUX-Thermal to TRL 4 in 2024. The rapid prototyping mindset established in Lunar Outpost EU, combined with the existing expertise in thermal management systems are believed to be capable of accelerating the realization of a system capable of overcoming the main challenge posed by the lunar surface on space exploration and extending the survival of assets over multiple diurnal cycles in a cost-effective and sustainable manner.