Technology Demonstration of Extended Operations for Volatile Prospecting and Processing in Lunar Permanently Shadowed Regions Enabled by Advanced Radioisotope Power

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The adoption of in-situ resource utilization (ISRU) for exploration missions requires robust and long-lived hardware. The Lunar Crater Observation and Sensing Satellite (LCROSS) and Lunar Reconnaissance Orbiter (LRO) missions proved the existence of water in the moon's polar regions. The absence of sunlight in these regions poses a significant challenge for solar/battery systems to perform extensive exploration, prospecting and collection of subsurface water/volatiles and deliver to an ISRU plant. Demonstrating long-term durability of the required systems in a relevant environment on Earth would be a major undertaking. The application of a radioisotope power system (RPS) would enable the demonstration of these technologies in a lunar crater environment. This proposed technology demonstration would include an advanced RPS capable of producing higher electrical power levels than current state-of-the-art and additionally provide heat required for ISRU prospecting and collection processes and also help maintain thermal management for rover/lander systems in the harsh crater environment. A framework for a combined RPS and ISRU technology demonstration will be developed based on the predicted power and energy requirements for volatile extraction while situated within a lunar polar region. The ratio of heat to electricity requirements would be determined to optimize the entire system. A concept of operations analysis will determine the feasibility of such a technology demonstration.