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LUNAR SOLAR-THERMAL ENERGY STORAGE: IN-SITU RESOURCE UTILIZATION FOR ENERGY STORAGE

Abstract

Prior research from NASA has shown the validity of using lunar regolith as a means of storing energy in the form of heat. The upcoming Artemis missions, that are being led by NASA and its international partners, aims to put the first women on the Moon and to eventually establish a permanent outpost at Shackleton Crater. Currently, many electrical systems rely on typical battery cells to store energy for any length of time, but batteries are extremely heavily and bulky further driving up the cost of launching material form the Earth. The goals of this project are to develop and test the use of lunar regolith as a means of energy storage. To collect the energy, a compound parabolic concentrator (CPC) was developed and tested to better understand the energy capture methods that would be suitable for the lunar south pole. Shackleton Crater is expected to get 600 hours of sunlight and with a maximum nighttime of 58 hours. This provides a great opportunity to collect a large amount of energy during the day for storage during the cold lunar nights. Prior student research at Oregon Institute of Technology has shown the efficacy of using a CPC for rural environments to improve access to electrical charging stations for electric vehicles. The remote location of Shackleton Crater is a great case study on how to improve CPC technology that could be used on the Earth. Once the solar energy is captured and transformed into usable electricity, the system then converts the electricity into thermal energy through the Peltier-Seedbeck effect. Due to the remote location of Shackleton Crater, solid-state thermoelectric devices were chosen due to their resiliency and the inability to repair any moving parts that may break during normal operating conditions. A series of thermocouples (thermopile) are used to generate power during the lunar night from the stored heat in the ground. Thermoelectric coolers are used to store energy that is captured from the CPC array on the surface of the Moon to store energy during the day. By relying on the lunar regolith as a storage medium, it would drastically reduce the need for heavy batteries and allow the SLS and other launch vehicles to prioritize their human passengers. Taking advantage of in-situ resource utilization will ensure that humanity's return to the Moon is sustainable and permanent. /enddocument