

Return to the Moon (02)
Lunar Surface Outposts and Enabling Technologies (4)

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NITROGEN-BASED CYCLE PROCESS AS ENABLING TECHNOLOGY FOR FUTURE LUNAR
MISSIONS

Abstract

In contrast to previous short term missions, future endeavors to the lunar surface will have to face the challenge of surviving the 14 days lasting night. While current concepts foresee energy storage or RTG-based systems, this paper will present an idea for a new lunar power generation solution. Analog to Earth's geothermal power plants, a thermodynamic cycle will be applied to utilize selenothermal energy. As the lunar thermal energy is much lower compared to Earth - the surface temperature sinks down to about 113 Kelvin at night - water will be replaced as working fluid by nitrogen, which has a boiling point at 77.36 Kelvin. Discovered by Apollo 15/17 and beginning at a depth of 0.5 meters, day/night-independent temperatures of 250 Kelvin and higher could even be measured. By channeling the nitrogen into the ground, vaporization can thus be triggered without additional energy. The expanding fluid can be utilized to propel a turbine, after which it is directed back to and stored on the lunar surface to condensate, again. This cycle can be performed multiple times during a single lunar night, thereby allowing a compact power generation system. The paper presents the initial feasibility analysis as well as a first iteration of design improvements which served as basis for a patent application in cooperation with the DLR Institute of Space Systems.