A Concept for a Radioisotope Powered Lunar CubeSat

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Radioisotope power systems have powered many highly successful missions to the far reaches of the solar system as well as the Moon and Mars. These systems, called Radioisotope Thermoelectric Generators (RTG) have relied on converting heat generated by the natural decay of Plutonium 238 to electric current via thermoelectric devices. The earliest unit developed supplied about 3 We and over the years developed into much higher powered units such as the ~290 We General Purpose Heat Source RTG (GPHS RTG) developed for Ulysses, Galileo and Cassini missions, and last flown on Pluto New Horizons. The RTG currently being produced is the ~110 We Multi-Mission Radioisotope Thermoelectric Generator (MMRTG) and is powering the Curiosity rover and also planned for the Mars 2020 rover mission.

While these systems are obviously too large in power and mass to be practical for a cubesat type mission however, several concepts were developed during the 1980's that utilized the radioisotope heater unit (RHU). The RHU produces ~1.0 Wth that would produce ~40 mWe coupled with thermoelectric conversion devices, named the RHURPS.

Lunar missions have been discussed that would explore the permanently shadowed regions (PSR)/craters of the moon to validate abundance and homogeneity of deposits of volatiles and/or water ice. Since solar power is not available in these regions and batteries could only support hours of operation, a conceptual assessment of how a long life RHURPS system might fit into a cubesat structure was performed. Preliminary estimates show the 40 mWe RHURPS, controller electronics and a battery could fit within 2U. This 2U cube would be combined with other cube(s) devoted to science instrumentation, communications and other devoted subsystems to complete a lunar science station. These RHURPS systems were developed with a hard landing capability in the range of 2000 g. The objective of this assessment is to see if the lunar science community can envision science missions that are enabled by lower power, long life RPS. The RHURPS is certainly not confined to a cubesat platform, but viewed as a more restrictive configuration than other small lander options.