# Lunar Night Survivability Achieved by Radioisotope and Fission Power System Technology

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The Moon's surface environment offers a significant challenge for most space systems and, particularly, for power technologies. A complete lunar day cycle is 354 hours of sunlight and 354 hours of darkness. Equatorial diurnal surface temperatures range from about 400K at lunar noon to 100K during the night. Surviving the long lunar night poses a significant challenge for photovoltaic arrays and energy storage systems. Providing the required energy for both nominal operations and for electric heaters to maintain keep-alive temperatures for electronics and other vital systems would necessitate a massive photovoltaic power supply and storage system, thereby reducing the amount of landed payload available for exploration and science investigations. Radioisotope power systems (RPS) produce power by converting the heat produced by natural isotopic decay into electricity. For example, the 110 We multi-mission radioisotope thermoelectric generator (MMRTG) has been powering the Mars Curiosity rover and is also planned for the Mars 2020 mission rover. RPS is ideally suited for lunar surface applications eliminating the need for large batteries, thus saving 100's kg of mass even for modest science missions while providing waste heat to maintain components and systems in required temperature ranges. The US uses plutonium-238 as the fuel source and it offers a high energy density along with an 88-year half-life. Eventual human habitats, crewed rovers, in-situ resource production demonstration, etc., will require significantly greater levels of power not practical for a RPS system or photovoltaic systems. For these higher power needs, nuclear fission systems would be a viable solution. Recent developments in smaller scale reactor systems called Kilopower are envisioned as an initial step in powering near term human lunar surface systems. Options for advanced RPS and Kilopower systems will be discussed and compared to alternate power system solutions.