Stirling Power Conversion for Lunar Applications

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NASA is developing Stirling power convertors for use in nuclear power systems that would provide electricity to users on the lunar surface. NASA's Radioisotope Power Systems (RPS) Program is maturing advanced dynamic convertor technologies that would increase the efficiency beyond the heritage systems for missions to the Moon and other solar system bodies of interest. Development efforts have focus on Stirling and Brayton designs that meet reliability and robustness requirements for operation in the lunar environment. GRC is also maturing low power convertors in the range of 1-40 watts to power micro-spacecraft or a network of distributed probes and include basic demonstration of in-house designs for convertors and controllers. In addition to RPS applications, conceptual fission systems have been demonstrated using Stirling convertors in multiple electrically heated tests and one test heated by a nuclear reactor. The Stirling convertors used in these fission system concepts include 100 W_e convertors to enable a 1 kW_e system, 1 kW_e convertors to enable a 10 kW_e system, and 6 kW_e convertors to enable a 40 kW_e system. The maturation of Stirling power convertors for nuclear applications includes verification of performance in relevant environments and validation of the design with a focus on high reliability and robustness. Over 1 million hours of testing has been accumulated on dozens of convertors since 1999 in the Stirling Research Laboratory at the NASA Glenn Research Center located in Cleveland Ohio, where the longest running convertor is the world record holder at 137,000 hours, or 15.5 years of operation. These maturation efforts have been instrumental in increasing the technology readiness level of Stirling technologies for space applications.