NASA SBIR 2016 Phase I Solicitation

H8.01 Thermal Energy Conversion

Lead Center: GRC

Participating Center(s): JPL, JSC, MSFC

NASA needs innovative technologies that convert thermal energy into electricity for space power generation on orbiting platforms, extraterrestrial surfaces, and space transportation vehicles. The thermal energy could be supplied by nuclear reactors, radioisotope heat sources, solar concentrators, chemical reactions, or as waste heat from other space systems. The focus of this subtopic is the energy conversion subsystem. Proposals are requested on thermal energy conversion approaches that offer high efficiency, low mass, high reliability, long life, and low cost. Candidate technologies include thermodynamic heat engines such as Stirling, Brayton, and Rankine as well as thermoelectric and thermionic devices. Ancillary components used to deliver heat (e.g., heat transport loops, heat pipes) to the energy conversion and reject waste heat (e.g., heat pipes, radiators) are also of interest.

The primary mission pull is providing electric power for human Mars surface missions that require kilowatts for remote science stations and rovers, or 10s of kilowatts for crew habitats and in-situ resource utilization plants. A secondary mission pull is providing electric power for Mars transportation vehicles that require 10s of kilowatts for crew life support and vehicle subsystems. The Mars missions may be preceded by human precursor missions to near earth objects, cis-lunar space, and the lunar surface during which the Mars technologies could be demonstrated. The anticipated heat source temperature ranges are 800 to 1300 K for nuclear, solar, and chemical sources and less than 400 to 500 K for waste heat. The expected operating lifetime ranges from several years to greater than 10 years.

The proposals should focus on energy conversion subsystems and components with a current technology readiness level of 2 or 3. The Phase I effort should include conceptual design with analytical or experimental proof-of-concept based on the expected operating environment and system interfaces (e.g., heat source, heat rejection). The Phase II effort should include development of breadboards or prototypes that can be operated at the contractor's facility to demonstrate functionality in a laboratory environment. If the contractor testing is successful, the hardware will be considered for integration into NASA ground tests and flight experiments with representative system interfaces and relevant operating environments. Upon completion of successful integrated system tests at NASA, Phase III projects would be pursued to infuse the technologies into flight projects.