



NASA SBIR 2009 Phase I Solicitation

S3.03 Power Generation and Conversion

Lead Center: GRC

Participating Center(s): GSFC, JPL, JSC, MSFC

Future NASA science missions will employ Earth orbiting spacecraft, planetary spacecraft, balloons, aircraft, surface assets, and marine craft as observation platforms. Proposals are solicited to develop advanced power generation and conversion technologies to enable or enhance the capabilities of future science missions. Requirements for these missions are varied and include long life, high reliability, significantly lower mass and volume, higher mass specific power, and improved efficiency over the state of practice for components and systems. Other desired capabilities are high radiation tolerance and the ability to operate in extreme environments (high and low temperatures and over wide temperature ranges).

While power generation technology affects a wide range of NASA missions and operational environments, technologies that provide substantial benefits for key mission applications/capabilities are being sought in the following areas:

Radioisotope Power Conversion

Improvements are solicited in component and systems technology relevant to Sterling and thermophotovoltaic power conversion. For Stirling conversion, advances sought, but not limited to, include:

- Novel methods or approaches for radiation-tolerant, sensorless, autonomous control of Stirling converters with very low vibration and having low mass, size, and electromagnetic interference (EMI);
- High-temperature, high-performance regenerators and linear alternators;
- Advances applicable to Venus surface missions including high-temperature heater heads ($> 850^{\circ}\text{C}$), joining techniques and regenerators ($\sim 1200^{\circ}\text{C}$), and combined electrical power generation and cooling systems applicable to Venus surface missions ($\sim 1200^{\circ}\text{C}$);
- Concepts for Stirling engine power from cold energy lunar regolith down to 2-3 meters below the surface, including Stirling Engines that will provide up to 100 watts with a mass less than 50kg for the surface lunar

environment with the hot side operating at about 256 K and a cold side at about 100 degrees lower.

Thermophotovoltaic conversion is currently focused on follow-on technology for the International Lunar Network (ILN) and for the outer planets mission. Advances sought, but not limited to, include:

- Low-bandgap cells having high efficiency and high reliability;
- High temperature selective emitters;
- Low absorptance optical band-pass filters;
- Efficient multi-foil insulation.

Photovoltaic Energy Conversion

Photovoltaic cell, blanket, and array technologies that lead to significant improvements in overall solar array performance (i.e. conversion efficiency >30%, array mass specific power >300watts/kilogram, decreased stowed volume, reduced initial and recurring cost, long-term operation in high radiation environments, high power arrays, and a wide range of space environmental operating conditions) are solicited. Technologies specifically addressing the following mission needs are highly sought:

- Photovoltaic cell and blanket technologies capable of low intensity, low-temperature operation applicable to outer planetary (low solar intensity) missions;
- Photovoltaic cell, blanket and array technologies capable of enhancing solar array operation in a high intensity, high-temperature environment (i.e. inner planetary and solar probe-type missions);
- Lightweight solar array technologies applicable to solar electric propulsion missions. Current missions being studied require solar arrays that provide 1 to 20 kilowatts of power at 1 AU, are greater than 300 watts/kilogram specific power, can operate in the range of 0.7 to 3 AU, provide operational array voltages up to 150 volts and have a low stowed volume.

Proposals should show an understanding of one or more relevant science needs, and present a feasible plan to fully develop a technology and infuse it into a NASA program.