NASA SBIR 2011 Phase I Solicitation

S3.03 Power Generation and Conversion

Lead Center: GRC

Participating Center(s): ARC, 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

Radioisotope technology enables a wide range of mission opportunities, both near and far from the Sun and hostile planetary environments including high energy radiation, both high and low temperature and diverse atmospheric chemistries. Technology innovations capable of advancing lifetimes, improving efficiency, highly tolerant to hostile environments are desired for all thermal to electric conversion technologies considered here. Specific systems of interest for this solicitation are listed below.

Stirling Power Conversion: advances in, but not limited to, the following

- System specific mass greater than 10 We/kg.
- Highly reliable autonomous control.
- Low EMI.

- High temperature, high performance materials, 850-1200 C.
- Radiation tolerant sensors, materials and electronics.

Thermoelectric Power Conversion: advances in, but not limited to, the following

- High temperature, high efficiency conversion greater than 10%.
- Long life, minimal degradation.
- Higher power density.

Photovoltaic Energy Conversion

Photovoltaic cell, blanket, and array technologies that lead to significant improvements in overall solar array performance (i.e., conversion efficiency >33%, 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 300 volts and have a low stowed volume.

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.

Note to Proposer: Topic X8 under the Exploration Mission Directorate also addresses power technologies (X8.03 Space Nuclear Power Systems, and X8.04 Advanced Photovoltaic Systems). Proposals more aligned with exploration mission requirements should be proposed in X8.