NASA SBIR 2008 Phase I Solicitation

S3.03 Power Generation and Storage

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.

(http://nasascience.nasa.gov/search?SearchableText=missions+under+development, http://www.nap.edu/catalog.php?record_id=10432)

Proposals are solicited to develop advanced power conversion, energy storage, and power electronics to enable or enhance the capabilities of future science missions. The requirements for the power systems for these missions are varied and include long life capability, high reliability, significantly lower mass and volume, higher mass specific power, and improved efficiency over the state of practice (SOP) components/systems. Other desired capabilities are high radiation tolerance, and ability to operate in extreme environments (high and low temperatures and over wide temperature ranges).

Advanced Photovoltaic Energy Conversion

Photovoltaic cell, blanket, and array technologies that lead to significant improvements in overall solar array performance (i.e. efficiency (>30%), mass specific power (>300W/kg), 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):

- Photovoltaic cell and blanket technologies capable of low intensity, low-temperature (LILT) operation applicable to the Outer Planets Mission;
- Photovoltaic cell, blanket and array technologies for high intensity high-temperature operation applicable to the Solar Probe mission;
- Thermophotovoltaic technologies applicable to the Outer Planets Mission;
- Component technologies of interest include advanced solar cell designs, space-durable coatings, designs capable of high voltage operation within the space environment, and technologies that reduce fabrication/testing costs while maintaining high reliability;
- Array technologies of interest include concentrators, large reliably-deployable arrays, ultra-lightweight arrays for use with flexible, lightweight cells. Of particular interest are lightweight array technologies that are electrostatically-clean and can operate at voltages up to 1000 volts, enabling direct drive electric propulsion for deep space missions.

Stirling Power Conversion

Novel methods or approaches for radiation-tolerant, sensorless, autonomous control of the Stirling converters with very low vibration and having low mass, size, and electromagnetic interference (EMI). Other technologies of interest include:

- High-temperature, high-performance regenerators;
- High-temperature, lightweight, high-efficiency, low EMI, linear alternators;
- High-temperature heater heads (> 850Â°C) and joining techniques and regenerators applicable to Venus surface missions (~1200Â°C);
- Combined electrical power generation and cooling systems applicable to Venus surface missions (~1200Â°C).

Energy Storage

Future science missions will require lithium-based or other advanced rechargeable electrochemical battery systems that offer greater than 40,000 charge/discharge cycles (7 year operating life) for low-Earth-orbiting (LEO) spacecraft, 20 year life for geosynchronous (GEO) spacecraft, and as low as -80Â°C storage and operation temperatures for planetary missions. Energy storage technologies that enable one or more of the above requirements combined with very high specific energy and energy density are of interest.

Power Management and Distribution

Advanced electrical power technologies are required for the electrical components and systems on future platforms to address the size, mass, efficiency, capacity, durability, and reliability requirements. In addition to the above requirements, proposals must address the expected improvements in energy density, speed, efficiency, or wide-temperature operation (-125Â°C to 200Â°C) with a high number of thermal cycles. Advancements are sought in power electronic devices, components, and packaging. Technologies of interest include:

- Power electronic components and subsystems;
- Power distribution;
- Fault protection;
- Advanced electronic packaging for thermal control and electromagnetic shielding.

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.Â