NASA SBIR 2019 Phase I Solicitation

S3.03 Power Electronics and Management, and Energy Storage

Lead Center: GRC

Participating Center(s): GRC, GSFC, JPL

Technology Area: TA3 Space Power and Energy Storage

Power Electronics and Management

NASA's Planetary Science Division is working to implement a balanced portfolio within the available budget and based on a decadal survey that will continue to make exciting scientific discoveries about our solar system. This balanced suite of missions shows the need for low mass/volume power electronics and management systems and components that can operate in extreme environment for future NASA Science Missions.

Advances in electrical power technologies are required for the electrical components and systems of these future spacecraft/platforms to address program size, mass, efficiency, capacity, durability, and reliability requirements. Radioisotope power systems (RPS), Advanced Modular Power Systems (AMPS) and In-Space Electric Propulsion (ISP) are several programs of interest which would directly benefit from advancements in this technology area. These types of programs, including Mars Sample Return using Hall thrusters and power processing units, require advancements in components and control systems beyond the state-of-the-art. Of importance are expected improvements in system robustness, energy density, speed, efficiency, or wide-temperature operation (-125° C to over 450° C) with a number of thermal cycles. Science Mission Directorate (SMD) has a need for intelligent, fault-tolerant Power Management and Distribution (PMAD) technologies to efficiently manage the system power for deep space missions.

Overall technologies of interest include:

- High power density/high efficiency modular power electronics and associated drivers for switching elements.
- Non-traditional approaches to switching devices, such as addition of graphene and carbon nanotubes to material.
- Materials for lightweight, flexible, low voltage (less than 5 volts) power transmission.
- Intelligent power management and fault-tolerant electrical components and PMAD systems.
- Advanced electronic packaging for thermal control and electromagnetic shielding.

The possible programs that could benefit from this technology include AMPS, Solar Electric Propulsion, RPS, and CubeSat/NanoSat Programs.

The expected TRL for this project is 3 to 5.

Energy Storage

Future science missions will require advanced primary and secondary battery systems capable of operating at temperature extremes from -100° C for Titan missions to 400 to 500° C for Venus missions, and a span of -230° C to +120° C for Lunar Quest. Advancements to battery energy storage capabilities that address operation at extreme temperatures combined with high specific energy and energy density (>200 Wh/kg and >200 Wh/l) are of interest in this solicitation.

In addition to batteries, other advanced energy storage/load leveling technologies designed to the above mission requirements, such as mechanical or magnetic energy storage devices, are of interest. These technologies have the potential to minimize the size and mass of future power systems.

Research should be conducted to demonstrate technical feasibility during Phase I and show a path toward a Phase II, and when possible, deliver a demonstration unit for NASA testing at the completion of the Phase II contract. Phase II emphasis should be placed on developing and demonstrating the technology under relevant test conditions. Additionally, a path should be outlined that shows how the technology could be commercialized or further developed into science-worthy systems.

The possible programs that could benefit from this technology include Solar Electric Propulsion, AMPS, RPS, and CubeSat/NanoSat Programs.

The expected TRL for this project is 3 to 5.

References:

Power Electronics and Management

- https://www.nasa.gov/smallsat-institute/smd
- https://science.nasa.gov/
- https://www1.grc.nasa.gov/space/sep/

Energy Storage

- https://www.nasa.gov/smallsat-institute/smd
- https://science.nasa.gov/
- https://www1.grc.nasa.gov/space/sep/

NASA has plans to purchase services for delivery of payloads to the Moon through the Commercial Lunar Payload Services (CLPS) contract. Under this subtopic, proposals may include efforts to develop payloads for flight demonstration of relevant technologies in the lunar environment. The CLPS payload accommodations are yet to be precisely defined, however at least for early missions, proposed payloads should not exceed 15 kilograms in mass and not require more than 8 watts of continuous power. Smaller, simpler, and more self-sufficient payloads are more likely to be accommodated. Commercial payload delivery services may begin as early as 2020 and flight opportunities are expected to continue well into the future. In future years it is expected that payloads of higher mass and with higher power requirements might be accommodated. Selection for award under this solicitation will not guarantee selection for a lunar flight opportunity.