NASA SBIR 2014 Phase I Solicitation

H2.01 High Power Electric Propulsion

Lead Center: GRC

Participating Center(s): JPL, MSFC

The goal of this subtopic is to develop innovative technologies that can lead to high-power (>50 kW to MW-class) electric propulsion systems. High-power (high-thrust) electric propulsion (>50kW per thruster) may enable dramatic mass and cost savings for lunar and Mars cargo missions, including Earth escape and near-Earth space maneuvers. At very high power levels, electric propulsion may enable piloted exploration missions.

Innovations and advancements leading to improvements in the end to end performance of high power electric propulsion systems are of interest. Technologies are sought that increase system efficiency; increase system and/or component life or durability; reduce system and/or component mass, complexity, or development issues; or provide other definable benefits. In general, thruster system efficiencies exceeding 60% and providing total impulse values greater than 10^7. Desired specific impulses range from a value of 2000 s for Earth-orbit transfers to over 6000 s for planetary missions.

Specific technologies of interest in addressing these challenges include:

- Electric propulsion systems and components for alternate fuels such as the use of in-situ resources, condensable or metal propellants, and alternatives to Xenon.
- Novel methods for fabricating large refractory metal parts with complex shapes, with integrated heat pipes. Particular figures of merit include low cost, rapid turnaround, and ability to incorporate internal flow passages.
- Long life cathodes for high power electrostatic or electromagnetic thrusters capable of extended operation at required temperature and current levels for appropriate mission durations.
- Innovative plasma neutralization concepts.
- Highly accurate flow controllers and fast acting valves for pulsed thruster systems High current (MA), high repetition rate (up to 1-kHz), long life (greater than 10^9 pulses) solid state switches for high power inductive pulsed plasma thrusters.
- High-temperature permanent magnets and/or electromagnets; low-voltage, high-temperature wire for electromagnets; superconducting magnets.

Note to Proposer: Subtopic S3.02 under the Science Mission Directorate also addresses in-space propulsion. Proposals more aligned with science mission requirements should be proposed in S3.02.

For all above technologies, research should be conducted to demonstrate technical feasibility during Phase I and show a path toward Phase II demonstration, and delivering a demonstration package for NASA testing at the completion of the Phase II contract.

Phase I Deliverables - Research to identify and evaluate candidate technology applications to demonstrate the

technical feasibility and show a path towards a demonstration. Bench or lab-level demonstrations are desirable. The technology concept at the end of Phase I should be at a TRL range of 3-4.

Phase II Deliverables - Emphasis should be placed on developing and demonstrating the technology under simulated mission conditions. The proposal shall outline a path showing how the technology could be developed into mission-worthy systems. The contract should deliver a demonstration unit for functional and environmental testing at the completion of the Phase II contract. The technology concept at the end of Phase II should be at a TRL range of 4-5.