NASA SBIR 2015 Phase I Solicitation

H2.01 In-Space Chemical Propulsion

Lead Center: GRC

Participating Center(s): JSC, MSFC

The goal of this subtopic is to examine a range of key technology options associated with space engines that use methane as the propellant. Successful proposals are sought for focused investments on key technologies and design concepts that may transform the path for future exploration of Mars. In-space propulsion is defined as the development and demonstration of technologies for ascent, orbit transfer, pulsing attitude/reaction control, and descent engines. Key operational and performance parameters include:Â

- Reaction control thruster development in the 5 to 100 lbf thrust class with a target vacuum specific impulse of 325-sec. The reaction control engines would operate cryogenic liquid-liquid for applications requiring integration with main engine propellants; or would operate gas-gas or gas-liquid for small total impulse type applications. RCEs operating on liquid cryogenic propellant(s) should be able to tolerate operation for limited duty cycles with gaseous or saturated propellants of varying quality.
- Ascent/descent pressure-fed engines with 1,500 to 25,000 lbf thrust with a target vacuum specific impulse of 350 to 360-sec. The engine should be capable of throttling to 5:1 (20% power), and the chamber pressure should range from 200 to 650 psig.
- Ascent/descent pump-fed engine development is projected to range from 10,000 to 25,000 lbf thrust with a minimum vacuum specific impulse of 360-sec. The propulsion system should be capable of stable throttling to 10:1 (10% power). The engine shall achieve 90% rated thrust within 0.5 second of the issuance of the â€˜Engine ONâ€™ command.

Specific technologies of interest for operation with liquid and gaseous methane are sought. Relevance of the technology to compatibility and applicability to challenges with methane must be identified. In addition, these engines should be compatible with the future use of in situ produced propellants such as oxygen and methane. For all proposed technologies, the proposer shall show in the proposal how the component would fit in a system cycle based on thermal capabilities and pressure budgets. Propulsion technologies of interest that support the performance parameters defined above include:Â

- New additive manufacturing techniques that can be demonstrated to allow for rapid manufacturing, surface finishes, structural integrity, and significant costs savings for complex combustion devices and turbomachinery components compared to the conventional manufacturing. Manufacturing methods must scale to a final flight component.
- Low-mass propellant injectors that provide stable and uniform combustion over a wide range of propellant inlet conditions.
- Combustion chamber designs using high temperature materials, coatings, and/or ablatives for combustion chambers, nozzles, and nozzle extensions.

- Regenerative cooled combustion chamber technologies which offer improved performance and adequate chamber life.
- Turbopump technologies specific to liquid methane that are lightweight with a long shelf life that can meet deep-throttle requirements, including small durable high speed turbines, high fatigue life impellers, zero net positive suction head (NPSH) inducers, low leakage seals, and long life in situ propellant fed bearings.

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 of 4 to 5

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 of 5 to 6.Â Â