NASA SBIR 2017 Phase I Solicitation

Z10.02 Methane In-Space Propulsion

Lead Center: GRC

Participating Center(s): JSC, MSFC

Technology Area: TA2 In-Space Propulsion Technologies

NASA is developing high thrust in-space chemical propulsion capabilities to enable human and robotic missions into the proving ground (Mars and beyond). Successful proposals are sought for focused investments on key technologies and design concepts that may transform the path for future exploration of Mars or beyond, while providing component and system-level cost and mass savings. In-space propulsion is defined as the development and demonstration of technologies for ascent, orbit transfer, pulsing attitude/reaction control (RCS), and descent engines.

Technologies of interest for operation with liquid oxygen and liquid methane specifically are sought:

- Components for integrated RCS (~100-lb class) and Main Propulsion System (MPS) (25,000-lb class) feed systems (utilizing common propulsion tanks), including:
    - Lower power (~100 - 30 W) electric-pump systems (28-100 Vdc) at desired flowrates (~8-10 lbm/s max).
    - Vacuum capable (<10 torr) compact exciters with high spark rates (>200 sps) and 30-50 mJ minimum delivered spark energy.
    - Improved materials/manufacturing capabilities for high temperature (>800 K), high pressure (>1000 psia) applications.
- Technologies to improve throttling in pressure-fed engines (5000-lb class), to minimize performance losses, such as:
    - Improved injector concepts that provide at least 98% c* (c-star) efficiency at full throttle conditions and maintain stability at 20% throttle ratios.
    - Fast-acting (<80 ms response time), low-leakage (<3 SCCS to 0.1 SCCS gaseous propellants) throttle valves, which meet the following performance considerations: maintain consistent mixture ratio (MR) over the throttle range, 50% (minimum) force margin, cold and warm operations, easily chilled in.

Proposers MUST clearly articulate the metrics of their technology, and must show a clear understanding of the current state of the art (SOA), and explicitly describe how their technology advances the state of the art. A clearly defined description of the following, at a minimum, is desired:

- Assessment of SOA with the key performance parameters (KPP) of their choosing (such as performance, mass, response time, etc.), including specifics which may be referenced in backup material - provide SOA for each major technology element in the proposal.

- Address the outstanding technology performance being promised and the degree to which the concept is new, different, and important. Particularly, explicitly define how the technology and/or fabrication technique proposed saves cost, schedule and/or mass. If a new manufacturing technique is proposed, clearly define how the technique provides a unique technology not feasible through other manufacturing methods.
- Provide quantitative rather than qualitative assertions (e.g., x% improvement of y, z kg of mass savings, xx% in cost savings, etc.) to the advancement over the SOA.
- Identify specific deliverables being offered. Clearly and explicitly specify what items are being delivered as part of contract performance, and clearly identify if hardware is being offered. Explicitly identify if any commitment has been made for post-development testing.

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.

Note: Technologies for cryogenic applications must be demonstrated in relevant environment by end of Phase II. Water demonstration is not sufficient for demonstrating TRL 5 capability.