



NASA SBIR 2011 Phase I Solicitation

X2.02 High Thrust In-Space Propulsion

Lead Center: GRC

Participating Center(s): JSC, MSFC

This solicitation intends to examine a range of key technology options associated with cryogenic, non-toxic storable, and solid core nuclear thermal propulsion (NTP) systems for use in future exploration missions. Non-toxic engine technology, including new mono and bi-propellants, is desired for use in lieu of the currently operational NTO/MMH engine technology. Handling and safety concerns with toxic chemical propellants can lead to more costly propulsion systems. For future short round trip missions to Mars, NTP systems using nuclear fission reactors may be enabling by helping to reduce launch mass to reasonable values and by also increasing the payload delivered for Mars exploration missions. Non-toxic and cryogenic engine technologies could range from pump fed or pressure fed reaction control engines of 25-1000 lbf up to 60,000 lbf primary propulsion engines. Pump fed NTP engines in the 15,000-25,000 lbf class, used individually or in clusters, would be used for primary propulsion.

Specific technologies of interest to meet proposed engine requirements include:

- Non-toxic bipropellant or monopropellants that meet performance targets (as indicated by high specific impulse and high specific impulse density) while improving safety and reducing handling operations as compared to current state-of-the-art storable propellants.
- High temperature, low burn-up carbide- and ceramic-metallic (cermet)-based nuclear fuels with improved coatings and /or claddings to maximize hydrogen propellant heating and to reduce fission product gas release into the engine's hydrogen exhaust stream.
- Low-mass propellant injectors that provide stable, uniform combustion over a wide range of propellant inlet temperature and pressure conditions.
- High temperature materials, coatings and/or ablatives or injectors, combustion chambers, nozzles, and nozzle extensions.
- High temperature and cryogenic radiation tolerant instrumentation and avionics for engine health monitoring. Non-invasive designs for measuring neutron flux (outside of reactor), chamber temperature, operating pressure, and liquid hydrogen propellant flow rates over wide range of temperatures are desired. Sensors need to operate for months/years instead of hours.

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- Combustion chamber thermal control technologies such as regenerative, transpiration, swirl or other cooling methods, which offer improved performance and adequate chamber life.
 - Long life, lightweight, reliable turbopump designs and technologies include seals, bearing and fluid system components. Hydrogen technologies are of particular interest.
 - Highly-reliable, long-life, fast-acting propellant valves that tolerate long duration space mission environments with reduced volume, mass, and power requirements is also desirable.
 - Radiation tolerant materials compatible with above engine subsystem applications and operating environments.

Note to Proposer: Subtopic S3.04 under the Science Mission Directorate also addresses in-space propulsion. Proposals more aligned with science mission requirements should be proposed in S3.04.