NASA SBIR 2012 Phase I Solicitation

**H2.01 Cryogenic Fluid Management Technologies**

Lead Center: GRC

Participating Center(s): ARC, GSFC, JSC, KSC

This subtopic solicits technologies related to cryogenic propellant storage, transfer, and instrumentation to support NASA's exploration goals. Proposed technologies should feature enhanced safety, reliability, long-term space use, economic efficiency over current state-of-the-art, or enabling technologies to allow NASA to meet future space exploration goals. This includes a wide range of applications, scales, and environments consistent with future NASA missions. Specifically:

- Innovative concepts for cryogenic fluid instrumentation are solicited to enable accurate measurement of propellant mass in low-gravity storage tanks, sensors to detect in-space and on-pad leaks from the storage system, and minimally invasive cryogenic liquid mass flow measurement sensors, including cryogenic two-phase flow.
- Passive thermal control for Zero Boil-Off (ZBO) storage of cryogens for both long term (>200 days) and short term (~14 days) in all mission environments. Insulation systems that can also serve as Micrometeoroid/orbital debris (MMOD) protection and are self-healing are also desired.
- Cryogenic storage technologies for alternate propellants such as xenon.
- Active thermal control for long term ZBO storage for space applications. Technologies include 20K cryocoolers and integration techniques, heat exchangers, distributed cooling, and circulators.
- Zero gravity cryogenic control devices including thermodynamic vent systems, spray bars, mixers, and liquid acquisition devices.
- Advanced spacecraft valve actuators using piezoelectric ceramics. Actuator should reduce the size and power while minimizing heat leak and increasing reliability.
- Propellant conditioning and densification technologies for propellant storage and transfer. Specific component technologies include compact, efficient and economical cryogenic compressors, pumps, Joule-Thompson orifices and heat exchangers. Also, subcooling of propellants for ground processing and long-term in-space cryogen storage and transfer.
- Liquefaction of oxygen for in space applications. This includes passive cooling with radiators, cryocooler liquefaction, or open cycle systems that work with high-pressure electrolysis.
- Efficient small to medium scale hydrogen liquefaction technologies (1-10k gal/day) including domestically produced wet cryogenic turboexpanders.

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.

Potential NASA Customers include:

- Cryogenic Propulsion Storage and Transfer Technology Demonstration Mission.
- Office of Chief Technologist - Game Changing Development Cryogenic Propulsion Stage Program.