NASA STTR 2018 Phase I Solicitation

T9.01 Lander Systems Technology

Lead Center: MSFC

Participating Center(s): GRC, JSC, LaRC

Technology Area: TA9 Entry, Descent and Landing Systems

Lander Components and Affordable/Sustainable Development

Lander systems require many components that will need to advance beyond their current capability to meet the needs of lander missions.Â A lander is essentially a system of components and each must be developed to enable mission success.Â Several components for lander systems have been identified as weak points or long lead development and/or qualification concerns that necessitate advancement.Â These include the following:Â

- Additive manufacturing for LOX/Methane and other propulsion components.Â Additional development in the area of additive manufacturing for propulsion components will continue to open up the trade space for lander systems.
- Testbed and hardware-in-the-loop testing systems that allow rapid hardware development and permit parallel design and test efforts.
- Less expensive methods for qualifying Commercial Off the Shelf (COTS) components as well as flight developed components.
- Developments to improve mission design and simulation tools.Â With advancing Technology Readiness Level (TRL) components, better mission design and simulation tools will be needed to capture and model the changing lander systems in order to leverage improvements.
- Avionics and flight software development is needed for proper lander systems control, navigation, propulsion operation.
- Lander systems scalability studies to facilitate larger payloads.
- Deep Space Engine capability; particularly in Monomethylhydrazine (MMH) and Mixed Oxides of Nitrogen (MON-25) development which allow lower propellant temperatures.Â

LOX/Methane Propulsion Technology (see also Z10.02)

LOX/Methane propulsion remains attractive to lander systems and will require further advancements to leverage its full potential.Â LOX/Methane Propulsion Technology is focused on propulsion systems and engine components development that increase durability, reliability, and capability, while reducing the mass of the component or the overall system.Â These technologies include the following:Â

- Integrated propulsions systems that reduce duplication of systems to support main engines and Reaction Control Systems (RCS).

- 25lbf to 100 lbf thrust Reaction Control Systems (RCS) to enable higher payloads and manned missions.
- Engine components designed for 1000 lbf to 4000 lbf thrust LOX/Methane systems.
- Low leakage valves that minimize propellant loss over long duration missions.Â With missions to Mars taking years, low leakage valves are essential to conserve propellant that will be needed for ascent and maneuvers.
- Reliable, low actuator load valves designed to operate and be compatible with cryogenic propellants (such as Methane).Â Low actuator loads keep power and mass requirements to a minimum which is of particular importance for long duration lander missions.
- LOX/Methane Engine components compatible with In-Situ Resource Utilization capabilities that reduce launch mass.
- Design and test demonstration of Integrated Main Propulsion System (MPS) Reaction Control with LOX/Methane.
- Large scale nozzle and nozzle extension technology (> 40â€ dia) using novel processing techniques that reduce fabrication costs and schedule.
- High temperature (>2600Â° F) nozzle material development to support in-space, ultra-light weight applications in a methane environment.Â This includes but is not limited to Carbon-Carbon (C-C) and refractory metal nozzles that are regeneratively or radiatively-cooled.Â

In-Situ Resource Utilization (ISRU) Compatible Propulsion

ISRU compatible propulsions systems will be essential to make long-term manned missions possible with landers.Â ISRU compatible propulsion technologies include the following:Â

- Liquefaction system design and testing.
- Liquefaction subsystem development that demonstrates the performance required for a Mars ISRU plant.
- Integrated liquefaction and propulsion system concepts.
- Tanking and Cryogenic Fluid Management (CFM) capabilities for ISRU applications.
- Insulation systems for ISRU propulsion.Â

Lander Systems of Interest

Additional lander systems are needed to develop capabilities and open trade spaces for further concepts.Â Other lander systems of interest include the following:

- Reduced toxicity hypergolic thrusters and components.
- Multi-engine architecture with distributed avionics.
- Long duration wetted seals for MON-25 propulsion.
- Engine cooling technologies.
- Variable Conductance Heat Pipes (active and/or passive).
- Alternate Reaction Control System (RCS) pressurization capability.
- Valve drivers for high speed valves.
- Guidance, Navigation, and Control senor studies and development.
- Propellant vapor pressure studies.
- Tank slosh management.
- Flight computers and flight software development.