NASA SBIR 2010 Phase I Solicitation

O3.04 Vehicle Integration and Ground Processing

Lead Center: KSC

Participating Center(s): MSFC, SSC

This subtopic seeks to create new and innovative technology solutions, which improve safety and lower the life cycle costs of assembly, test, integration and processing of the ground and flight assets at our nation’s spaceports and propulsion test facilities.

Current State of the Art: The propulsion testing and launch vehicle processing activities at NASA account for a large portion of the life cycle costs of today’s space programs. The technologies in use today at these facilities date back to the beginnings of manned space flight. A majority of the test infrastructure at Stennis Space Center and launch processing facilities at Kennedy Space Center indeed go back to the Apollo era and early shuttle design days of the 1960’s and early 70’s. Technology solutions typically take 3-6 years from inception in the SBIR Phase I program to having a direct impact on the processing activity. NASA needs to invest in these vehicle integration and ground-processing technology needs now to be in place for the NASA heavy launch vehicle concepts of the future.

Propellant servicing operation for both propulsion testing and launch operations are in need of technology advancement to make these operations safer and more cost efficient. The hardware and practices in use today do indeed date back to 1960’s investments. Technology solutions are needed to increase visibility into processes real-time (smart instrumentation), more efficient cryogenic propellant storage solutions, a new generation of cryogenic couplings to allow cold mate and de-mate operations without ice or frost buildup, and to reduce our usage of massive amounts of gaseous helium (a scarce, non-renewable global resource).

Changes in environmental regulations have had a tremendous negative impact on the coatings used to protect our NASA test and launch infrastructure. Many of the coatings used in the last 10 years are no longer available due to changes in the environmental law banning the use of certain chemicals. KSC and SSC are located in some of the worst corrosion environments in the country. At KSC, the addition of the acidic exhaust plumes from solid rocket motors, make these conditions even worse. New advancements in coatings and materials are needed to reduce the infrastructure maintenance costs of these facilities.

Due to the lightweight, high strength properties, composite materials are being sought more often to solve weight reduction efforts on future launch vehicles. New materials mean new problems for the ground operations team charged with insuring these vehicles are safe to fly. New inspection tools are needed to confirm structural integrity
during the processing flow after field repairs or accidental contact.

The following areas are of particular interest:

**Propellant Servicing Technologies**

Technologies for advanced, energy efficient cryogenic fluid storage, transfer and propellant servicing of launch vehicles and propulsion test facilities. These efforts include:

- Cost effective technology solutions to support helium facility supply infrastructure and helium conservation initiatives to reduce/eliminate helium usage during LH2 and LO2 system operations and recover/re-purify helium from large volume waste streams;
- Techniques and technologies to reduce parasitic heat loads in large cryogenic storage tank structural design to enable more economical zero boil-off storage concepts;
- Advances in smart instrumentation for in-situ fluid flow analysis and process control, surviving and operating under cryogenic and launch conditions to enable real-time monitoring of propellant servicing processes and high efficiency purging operations of cryogenic systems; and
- Non-frosting/icing quick-disconnect development to support cryogenic propellant servicing operations.

**Control of Material Degradation**

Technologies are needed for the prediction, prevention, detection and mitigation of corrosion/erosion in spaceport and propulsion test facility infrastructure and ground support equipment including steel refractory concrete. Material solutions must meet current and emerging environmental restrictions and endure today’s corrosive and highly acidic launch environments. These needs include:

- Methodology to predict long-term corrosion protection performance of coatings for steel operating in a marine environment;
- Damage responsive coatings with corrosion inhibitors;
- Replacement options for poor-performing refractory concrete exhibiting low temperature cure characteristics or means of providing large area coverage with modular units that can be cured off site;
- Protective coatings for non-painted surfaces;
- Innovations in thermal spray metallic coatings equipment and alloys;
- Non-chrome protective coatings/sealants for aluminum alloys; and
- New environmentally friendly protective coating options to replace products lost due to EPA regulation changes.

**Spaceport Processing Evaluation/Inspection Tools**

Technologies in support of defect detection in composite materials; methods for determining structural integrity of composite materials and bonded assemblies; and non-intrusive inspection of Composite Overwrapped Pressure Vessels (COPV), Orion heat shield and other composite systems. Technologies must support identifying composite material defects, evaluating material integrity, damage inspection and/or acceptance testing of composite systems. Technology solutions are also desired for in-situ evaluation of refractory concrete as installed in the flame trenches associated with propulsion test and launch pad infrastructure. Provide solutions that reduce inspection times, provide higher confidence in system reliability, increase safety and lower life cycle costs.
For all above technologies, research should be conducted to demonstrate technical feasibility during Phase I and show a path toward Phase II hardware and software demonstration and delivering a demonstration unit or software package for NASA testing at the completion of the Phase II contract.

Phase I Deliverables: Demonstration of technical feasibility (TRL 2-4).

Phase II Deliverables: Demonstration of technology (TRL 4-6)

The technology in this subtopic may also be applicable to Topic O2, Space Transportation.