NASA SBIR 2008 Phase I Solicitation

X1.04 Integrated System Health Management for Ground Operations

Lead Center: ARC

Participating Center(s): JPL, KSC, MSFC, SSC

Innovative health management technologies are needed throughout NASAâ€™s Constellation architecture in order to increase the safety and mission-effectiveness of future spacecraft and launch vehicles. In human space flight, a significant concern for NASA is the safety of ground and flight crews under off-nominal or failure conditions. The stringent launch availability requirements of the Constellation Program challenge traditional vehicle processing and launch operations. Some of the challenges for the new architecture include optimization of sensors (placement, physical and functional redundancy, weight and cost), validation of inherently unreliable sensors, increasing the effective capability for state determination using innovative analysis algorithms, and integration of sensor information distributed across ground support equipment and the vehicles in multiple processing locations and phases. Diagnostic and prognostic analyses which provide an accurate assessment of system and component health will ensure the completion of complex launch processing flows on schedule. Projects may focus on one or more relevant subsystems such as solid rocket motors, liquid propulsion systems, structures and mechanisms, thermal protection systems, power, avionics, life support, and communications. Proposals that involve the use of existing testbeds or facilities at one of the participating NASA centers (ARC, MSFC, KSC, or JPL) for technology validation and maturation are strongly encouraged. Specific technical areas of interest related to integrated systems health management include the following:

- Innovative methods for sensor validation and robust state estimation in the presence of inherently unreliable sensors. Proposals should focus on data analysis and interpretation during pre-flight checkout using legacy sensors rather than development of new sensors or sensor systems.
- Model-based methods for fault detection and isolation in rocket propulsion systems based on existing sensor suites during pre-launch propellant loading and during mission operations.
- Concepts for advanced built-in-tests for spacecraft avionics that reduce or eliminate the need for extensive functional verification and to predict remaining life of avionics systems based on usage history.
- Prognostic techniques able to anticipate system degradation and enable further improvements in mission success probability, operational effectiveness, and automated recovery of function. Proposals in this area should focus on systems and components commonly found in spacecraft.
- Innovative human-system integration methods that can convey a wealth of health and status information to pre-flight check-out crews, ground operations and mission support staff quickly and effectively, especially under off-nominal and emergency conditions.
- Innovative approaches to effective utilization of health information from NASA spacecraft and launch vehicles with seamless integration to ground based systems using commercial health information from programmable logic controller systems and commercial Reliability, Availability and Serviceability (RAS) systems.

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[back to top]

[back to Solicitation] [back to Chapter 9.1.2][back to Chapter 9][back to table of contents]