NASA SBIR 2008 Phase I Solicitation

X6.01 Fuel Cells for Surface Systems

Lead Center: GRC

Participating Center(s): JPL, JSC

Energy storage devices are required to enable future robotic and human exploration missions. Advanced primary fuel cell and regenerative fuel cell (RFC) energy storage systems are sought for Exploration mission applications, specifically descent for power for the Altair lander and stationary power for lunar surface bases. Technology advances that reduce the weight and volume, improve the efficiency, life, safety, system simplicity and reliability of fuel cell, electrolysis, and RFC systems are desired. The specific advancements of interest are outlined below:

Regenerative Fuel Cell (RFC) Systems: Primary fuel cells, water electrolyzers, and associated balance-of-plant hardware constitute a RFC system. Performance of fuel cell and electrolysis system functions through passive means and the elimination of as many ancillary components as possible have been identified as the most direct approach to achieving mission efficiency, life, and reliability goals. Specifically, technological advances are sought in the following areas:

- Static Cathode Water Vapor Feed Electrolysis Cell: Preliminary system studies have shown that static cathode feed electrolyzers have the most potential for system simplicity and the fewest number of ancillary components. Proton-exchange-membrane (PEM) electrolysis technology is sought that electrolyzes water vapor supplied to the hydrogen evolving electrode. The electrolysis cell should operate at balanced pressures up to 2000 psi and must not require circulation of hydrogen to transport the water to the electrolysis cell cathode. The exiting hydrogen and oxygen must not contain liquid water droplets, but may contain water vapor.
- Passive Fuel Cell or Electrolysis Cell Heat Removal/ Thermal Control: Passive thermal control of individual cells within a fuel cell or electrolysis stack has the potential to eliminate actively pumped liquid coolant loops. A highly thermally conductive heat pipe plate that is also electrically conductive is sought to passively remove the heat from the individual fuel cells or electrolysis cells within a cell stack. The flat plates that are sought should have a thermal conductivity exceeding 2000 W/m/K, a thickness of <= 0.050 inches, a resistivity of <= 0.2 ohm-cm, and a bulk density of <= 3 grams/cm^3.

- Fuel Cell/ Electrolysis Cell Voltage Monitor Application Specific Integrated Circuit (ASIC): A cell voltage monitoring ASIC has the potential to eliminate a number of discreet electrical components within a fuel cell, electrolysis, or RFC electrical control system. An ASIC is sought that monitors up to 48 differential cell voltages (0-2 VDC) with

Research should be conducted to demonstrate technical feasibility during Phase 1 and show a path toward a Phase 2 hardware demonstration, and when possible, deliver a demonstration unit for functional and environmental testing at the completion of the Phase 2 contract.