NASA SBIR 2007 Phase I Solicitation

**X8.01 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 regenerative fuel cell (RFC) energy storage systems are sought for use in a wide range of Exploration mission applications including portable power for landers and rovers, and stationary power for surface bases. Technology advances that will reduce the weight and volume, improve the efficiency, life, safety, system simplicity and reliability of RFC systems are desired. The specific advancements of interest are outlined below.

Regenerative Fuel Cell (RFC) Systems: Primary fuel cells and water electrolyzers are the two major constituent subsystems of RFC systems. Of these two subsystems, water electrolyzers are at a lower level of technology readiness than primary fuel cells.

Specifically, technological advances are sought in the area of highly efficient, high-pressure proton-exchange-membrane (PEM) water electrolyzers. Highly efficient operation reduces the total quantity of reactants required, thereby minimizing weight. The efficiency of electrolysis stacks increases by operating at lower current densities. High-pressure electrolysis eliminates or reduces the need for external gas compression prior to reactant storage. The draw-back of high-pressure operation, however, is the increased diffusion of reactants across the proton exchange membrane of the cell, which effectively decreases the efficiency. This efficiency loss is magnified at lower current densities. The challenge, therefore, is to minimize this diffusion at higher operating pressures and low current densities, making efficient electrolysis operation possible.

High-pressure electrolysis systems capable of oxygen and hydrogen gas production at pressures less than 2000 psi are of special interest.

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.