Human-rated energy storage devices are required to enable future robotic and human exploration missions. Advanced battery, fuel cell and regenerative fuel cell systems are sought for use in a wide range of Exploration mission applications including portable power for landers, rovers, and astronaut equipment, and stationary energy storage applications such as base power, and storage systems for crew exploration vehicles and spacecraft. Technology advances that will reduce the weight and volume, improve the efficiency, life, safety, system simplicity and reliability of electrochemical systems, specifically rechargeable batteries and fuel cell systems are desired. The specific advancements of interest are outlined below.

**Advanced Secondary Battery Systems**

Areas of emphasis for advanced battery systems include technology advancements that contribute to the following cell-level performance goals: specific energy > 180 Wh/kg, calendar life >15 years, and operating temperature range -60°C to 60°C and cycle life at 100% DOD > 2000 cycles. Systems that combine all of the above characteristics and demonstrate a high degree of safety are desired.

Specific technology areas sought are improved component materials that include non-toxic cathodes with specific capacities in excess of 250 mAh/g at the C rate and 25°C, and electrolytes that provide safe, non-flammable, non-hazardous operation. Cells that exhibit tolerance to mild abuse such as overcharge and over temperature are desirable. Chemistries and/or cell design capable of rapid recharge (Innovative concepts for the design and management of packaged battery modules with specific energy >140 Wh/kg and energy density > 300 Wh/l are of keen interest.

Proposals addressing micro-batteries, structural batteries, and/or integrated power generation and are sought.

**Fuel Cell Systems**

Fuel cell (FC) systems with power capabilities in the range of 100-1000 watts and 1-10 kW are of interest, as are...
regenerative fuel cell (RFC) energy storage systems in the 10 - 25 kW power range.

Specifically, technological advances are sought for FC/RFC based systems that contribute to system simplicity and improved reliability through (1) innovative, integrated system-level design concepts, and (2) passive ancillary components. An example of these advances at the system level is primary and/or regenerative fuel cell systems that minimize or eliminate reactant re-circulation external to the stacks themselves. Examples at the component level include replacement of pumps and other active, motorized mechanical ancillary components with passive devices that perform the functions of both reactant management and thermal control.

Advanced FC/RFC development at both the system and component levels should focus exclusively on proton-exchange-membrane PEM technology utilizing pure hydrogen, oxygen, and water as reactants.