NASA SBIR 2006 Phase I Solicitation

X8.02 Space Based Nuclear Fission Power Technologies

Lead Center: GRC

NASA is interested in the development of highly advanced systems, subsystems and components for use with fission power systems for future Lunar and Mars robotic and manned missions. Anticipated power levels range from 10's of kilowatts to 100's of kilowatts. Proposals are sought for critical technologies for fission power systems to meet the following anticipated missions and applications.

The current Vision for Exploration identifies the first human lunar landing in 2018 with subsequent long duration lunar stays of approximately 6 months in 2022. Fission-based systems are anticipated to enable the long duration stay over the lunar night. Initial planetary base power levels are anticipated to be between 30 - 50 kWe.

Planetary surface human base applications may include: habitats, resource processing and propellant production/liquefaction/maintenance, surface mobility for both robotic and piloted rovers, excavating and mining equipment and science stations. Human Mars mission activities could require power in the 100 kWe range.

Potentially, robotic outpost as a precursor to human Mars exploration with 50 - 500 day stays could be the proving ground for smaller fission systems. A 20 - 30 kWe system could support science applications such as: deep drilling, resource production demos, rovers, weather stations, etc.

Specific technology topics of interest are:

- Advanced, high efficiency, high temperature power conversion > 20%, 25 kWe to 100 kWe unit size;
- Electrical power management, control and distribution. 1000 - 5000 V;
- High temperature, low mass thermal management/heat rejection 2;
- Deployment systems/mechanisms for large radiators, surface mobility systems for remote emplacement of power systems, innovative methodology for use of indigenous shielding materials;
• High temperature materials or coatings compatibility with local soil and atmospheric environments;

• Systems/technologies to mitigate planetary surface environments. Dust accumulation, wind, planetary atmospheres (CO₂, corrosive soils, etc.);

• Power system design considerations for long life (> 5 years), autonomous control and operation, including sensor technologies;

• Radiation tolerant systems and materials (including lunar, Mars and in-space environments) for robust, long life operation;

• Innovative methodologies and approaches to accelerated life testing.

In addition to reducing overall system mass, volume and cost, increased safety and reliability are of extreme importance. It is envisioned that these technologies would be used on robotic and human missions and it is to NASA’s advantage to develop those technologies that transcend robotic to human mission requirements with a minimum of redesign. Technologies that easily and efficiently scale in power output and can be used in a host of applications (high commonality) are desired.