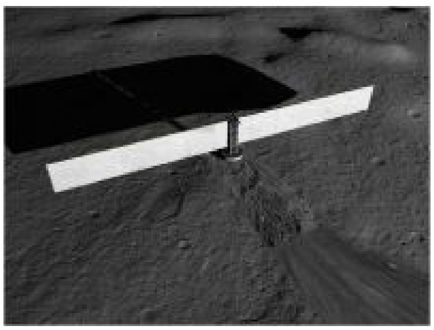
NASA Developing Fission Surface Power Technology

September 11 2008



An artist’s concept of a fission surface power system on the surface of the moon. The nuclear reactor has been buried below the lunar surface to make use of lunar soil as additional radiation shielding. The engines that convert heat energy to electricity are in the tower above the reactor, and radiators extend out from the tower to radiate into space any leftover heat energy that has not been converted to electricity. The power system would transmit a steady 40 kW of electric power, enough for about eight houses on Earth, to the lunar outpost. Credit: Courtesy NASA

(PhysOrg.com) -- NASA astronauts will need power sources when they return to the moon and establish a lunar outpost. NASA engineers are exploring the possibility of nuclear fission to provide the necessary power and taking initial steps toward a non-nuclear technology demonstration of this type of system.

A fission surface power system on the moon has the potential to generate a steady 40 kilowatts of electric power, enough for about eight houses on Earth. It works by splitting uranium atoms in a reactor to generate heat that then is converted into electric power.

The fission surface power system can produce large amounts of power in harsh environments, like those on the surface of the moon and Mars, because it does not rely on sunlight. The primary components of fission surface power systems are a heat source, power conversion, heat rejection and power conditioning and distribution.

"Our goal is to build a technology demonstration unit with all the major components of a fission surface power system and conduct non-nuclear, integrated system testing in a ground-based space simulation facility," said Lee Mason, principal investigator for the test at NASA's Glenn Center in Cleveland. "Our long-term goal is to demonstrate technical readiness early in the next decade, when NASA is expected to decide on the type of power system to be used on the lunar surface."

Glenn recently contracted for the design and analysis of two different types of advanced power conversion units as an early step in the development of a full system-level technology demonstration. These power conversion units are necessary to process the heat produced by the nuclear reactor and efficiently convert it to electrical power.

The first design concept by Sunpower Inc., of Athens, Ohio, uses two opposed piston engines coupled to alternators that produce 6 kilowatts each, or a total of 12 kilowatts of power. The second contract with Barber Nichols Inc. of Arvada, Colo., is for development of a closed Brayton cycle engine that uses a high speed turbine and compressor coupled to a rotary alternator that also generates 12 kilowatts of power.

"Development and testing of the power conversion unit will be a key factor in demonstrating the readiness of fission surface power technology and provide NASA with viable and cost-effective options for nuclear power on the moon and Mars," said Don Palac, manager for Glenn's Fission Surface Power Project.

After a one year design and analysis phase, a single contractor will be selected to build and test a prototype power conversion unit. When complete, the power conversion unit will be integrated with the other technology demonstration unit's major components. Glenn will develop the heat rejection system and provide the space simulation facility. Glenn will also work in conjunction with the Department of Energy and NASA's Marshall Space Flight Center in Huntsville, Ala. Marshall will develop and provide a non-nuclear reactor simulator with liquid metal coolant as the heat source unit for this technology demonstration.

A nuclear reactor used in space is much different than Earth-based systems. There are no large concrete cooling towers, and the reactor is about the size of an office trash can. The energy produced from a space reactor is also much smaller but more than adequate for the projected power needs of a lunar outpost.

Testing of the non-nuclear system is expected to take place at Glenn in 2012 or 2013. These tests will help verify system performance projections, develop safe and reliable control methods, gain valuable operating experience, and reduce technology and programmatic risks. This technology demonstration is being conducted as part of NASA's Exploration Technology Development Program.

Provided by NASA

Citation: NASA Developing Fission Surface Power Technology (2008, September 11) retrieved 17 April 2024 from https://phys.org/news/2008-09-nasa-fission-surface-power-technology.html