

Fission Surface Power Technology Development Testing at NASA's Early Flight Fission Test Facility

Fission surface power (FSP) systems could be used to provide power anytime, anywhere on the surface of the Moon or Mars. FSP systems could be used at polar locations, at locations away from the poles, or in permanently shaded regions, with excellent performance at all sites. A potential reference 40 kWe option has been devised that is cost-competitive with alternatives while providing more power for less mass anywhere on the lunar surface. The reference FSP system (FSPS) is also readily extensible for use on Mars. At Mars the system would be capable of operating through global dust storms and providing year-round power at any Martian latitude.

Under the NASA Exploration Technology Development Program (ETDP), NASA and the Department of Energy (DOE) have begun technology development on Fission Surface Power (FSP). The primary customer for this technology is the NASA Constellation Program which is responsible for the development of surface systems to support human exploration on the moon and Mars. The objectives of the FSP technology project are:

- 1) Develop FSP concepts that meet expected surface power requirements at reasonable cost with added benefits over other options.
- 2) Establish a hardware-based technical foundation for FSP design concepts and reduce overall development risk.
- 3) Reduce the cost uncertainties for FSP and establish greater credibility for flight system cost estimates.
- 4) Generate the key products to allow Agency decision-makers to consider FSP as a viable option for flight development.

To be mass efficient, FSP systems must operate at higher coolant temperatures and use different types of power conversion than typical terrestrial systems. The primary reason is the difficulty in rejecting excess heat to space. Although many options exist, NASA's current reference FSP system uses a fast spectrum, pumped-NaK cooled reactor coupled to a Stirling power conversion subsystem. The reference system uses technology with significant terrestrial heritage while still providing excellent performance on the surface of the moon or Mars.

Recent testing at NASA's Early Flight Fission Test Facility (EFF-TF) has helped assess the viability of the reference FSP system, and has helped evaluate methods for system integration. In June, 2009, a representative pumped NaK loop (provided by Marshall Space Flight Center) was coupled to a Stirling power converter (provided by Glenn Research Center) and tested at various conditions representative of those that would be seen during actual FSP system operation. In all areas, performance of the integrated system exceeded project goals. High-temperature NaK pump testing has also been performed at the EFF-TF, as has testing of methods for providing long-duration NaK purity.

A picture of an EFF-TF pumped NaK loop coupled to a Stirling power converter is shown in Figure 1. The presentation will summarize results of recent testing at the EFF-TF.

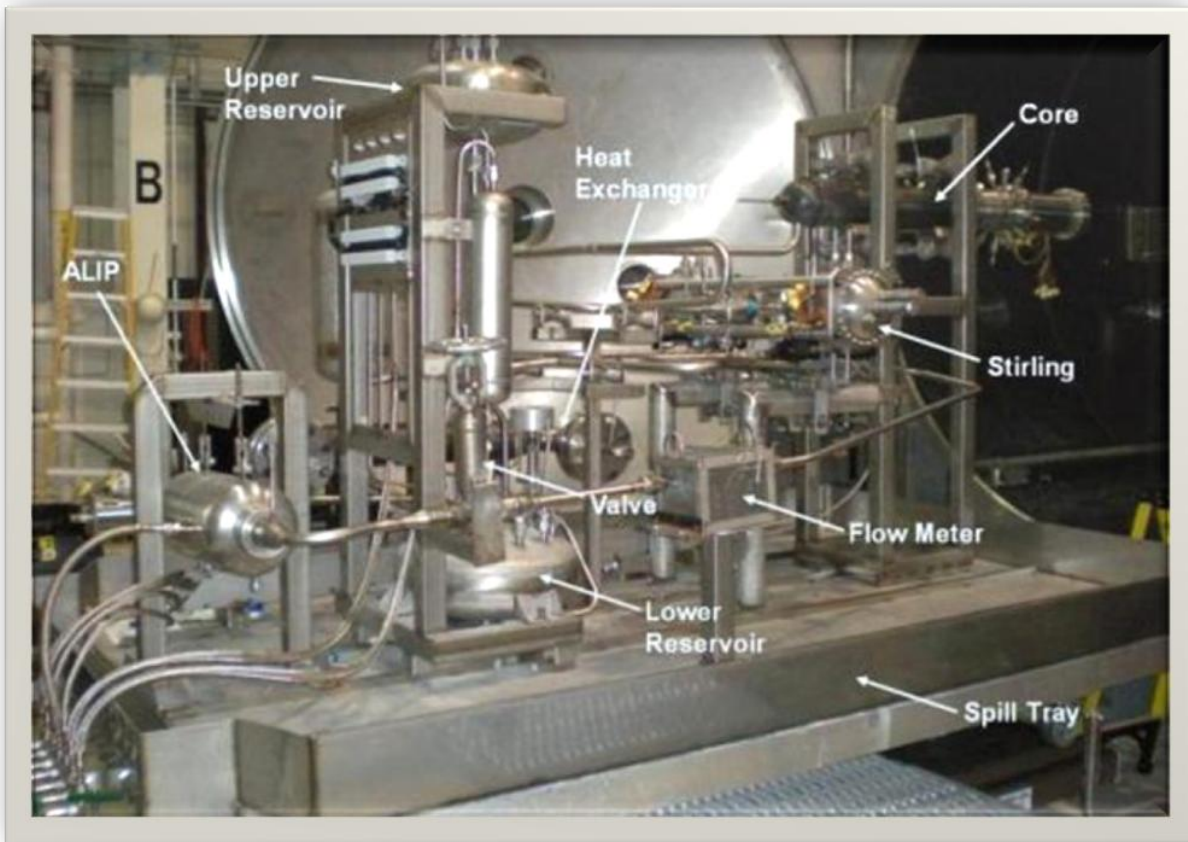


Figure 1. EFF-TF testing of pumped NaK loop coupled to Stirling power converter.