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NUCLEAR SYSTEMS KILOPOWER PROJECT OVERVIEW

Abstract

The Nuclear Systems Kilopower Project was initiated by NASA's Space Technology Mission Directorate/Game Changing Development Program in fiscal year 2015 to demonstrate subsystem-level technology readiness of small space fission power in a relevant environment (Technology Readiness Level 5) for space science and human exploration power needs. The Nuclear Systems Kilopower Project centerpiece is the Kilopower Reactor Using Stirling Technology (KRUSTY) test, which consists of the development and testing of a fission ground technology demonstrator of a 1 kWe-class fission power system. The technologies to be developed and validated by KRUSTY are extensible to space fission power systems from 1 to 10 kWe, which can enable higher power future potential deep space science missions, as well as modular surface fission power systems for exploration. The Kilopower Project is cofounded by NASA and the Department of Energy National Nuclear Security Administration (NNSA).

KRUSTY include the reactor core, heat pipes to transfer the heat from the core to the power conversion system, and the power conversion system. Los Alamos National Laboratory leads the design of the reactor, and the Y-12 National Security Complex is fabricating it. NASA Glenn Research Center (GRC) has designed, built, and demonstrated the balance of plant heat transfer and power conversion portions of the KRUSTY experiment. NASA MSFC developed an electrical reactor simulator for non-nuclear testing, and the design of the reflector and shielding for nuclear testing. In 2016, an electrically heated non-fissionable Depleted Uranium (DU) core was tested at GRC in a configuration identical to the planned nuclear test. Once the reactor core has been fabricated and shipped to the Device Assembly Facility at the NNSA's Nevada National Security Site, the KRUSTY nuclear experiment will be assembled and tested.

Completion of the KRUSTY experiment will validate the readiness of 1 to 10 kWe space fission technology for NASA's future requirements for sunlight-independent space power. An early opportunity for demonstration of In-Situ Resource Utilization (ISRU) capability on the surface of Mars is currently being considered for 2026 launch. Since a space fission system is the leading option for power generation for the first Mars human outpost, a smaller version of a planetary surface fission power system could be built to power the ISRU demonstration and ensure its end-to-end validity. Planning is underway to start the hardware development of this subscale flight demonstrator in 2018.