Special issue of Nuclear Technology dedicated to KRUSTY test

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The KRUSTY test successfully demonstrated the efficiency of Kilopower fission power for lunar and planetary exploration

An entire issue of *Nuclear Technology* journal has been dedicated to the design work and results of the Kilowatt Reactor Using Sterling TechnologY (KRUSTY) test.

KRUSTY was the culmination of the National Aeronautics and Space Administration (NASA) Kilopower Project to design, build, and test a space nuclear reactor. This test was the first such test since the end of the Space Nuclear Auxiliary Power (SNAP) project at the end of the 1960s.

The Laboratory—in conjunction with NASA and DOE—conducted numerous experiments to test the Kilopower system, a fission reaction power system designed at Los Alamos in conjunction with NASA. Designed to provide between 1 and 10 kilowatts of power, Kilopower can work in harsh environments, such as space, and is efficient, reliable, safe, low cost, and compact.

The KRUSTY test successfully demonstrated the efficiency of Kilopower fission power for lunar and planetary exploration. It is anticipated this new nuclear power system could enable long-duration crewed missions to the Moon, Mars, and destinations beyond.

Los Alamos National Laboratory scientist Patrick McClure, of the Systems Design and Analysis Group (NEN-5), wrote the forward to the special issue, which has eight peer-reviewed technical articles on various aspects of the KRUSTY test, which has received many accolades.

“Kilopower was intended to serve both human exploration needs on planetary surfaces as well as science needs for deep-space exploration,” McClure said.

From reactor design to high-temp experiment

The technical articles move through the design, development, and progressive testing of KRUSTY. As a fission reactor, KRUSTY was the first nuclear-powered operation of any truly new reactor concept in the United States in more than 40 years.

Kilopower was progressively tested in space-like environments to ensure it would operate as predicted. The final test that proved KRUSTY's abilities took place in March 2018 over 28 consecutive hours. During the final test, the thermal power ranged from 1.5 to 5.0 kW (thermal), with a fuel temperature up to 880°C. Each 80-W (electric)–rated Stirling converter produced ~90 W (electric) at a component efficiency of ~35% and an overall system efficiency of ~25%. The testing showed that the system operated as expected, and KRUSTY is highly tolerant of possible failure conditions and transients.

Ready for liftoff

Kilopower is poised to power outposts on the Moon and Mars. Where more power is needed, multiple Kilopower units could be deployed.

The safety of the system is based on its innovative structure and physics. The heat-pipe design, with no moving parts in the core, and the self-regulating physics contribute to Kilopower's large safety margin. Kilopower uses less than five curies of naturally occurring radioactivity. The reactor activates once it reaches its destination (in deep space, on another planet, or in high orbit.

Funding and mission

The project was jointly funded by the Space Technology Mission Directorate at NASA and the Criticality Safety Program at the National Nuclear Security Administration (NNSA). The research supports the Laboratory's Energy Security mission area and the Complex Natural and Engineered Systems capability pillar.