Nuclear Systems Kilopower Project Overview

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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 of 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 consists of three elements. The primary element is the Kilopower Prototype Test. This element consists of the development and testing of a ¼ electrical power output and full thermal power ground technology demonstration of a small fission power system based on an 800 W_e reference space science power requirement. The second element, the Mars Kilopower System Concept, consists of the analysis and design of a scaled-up version of the 800 W_e reference concept to 3-10 kW_e for Mars surface power requirements. The third element is the design and development of a Kilopower high temperature water heat pipe radiator experiment prototype in preparation for a FY19 or later flight experiment development and test opportunity on the International Space Station.

The core of the Nuclear Systems Kilopower Project is the development and testing of a ¼ power electric, full thermal power ground technology demonstration of a small fission power system based on an 800 W_e space science power requirement. An 800 W_e Kilopower system will use four pairs of Stirling engines, with each pair generating 200 We. All technology objectives can be achieved with only one pair of full-scale Stirling engines. The components of the demonstration include the reactor core, heat pipes to transfer the heat from the core to the power conversion system, the power conversion system, and the radiators to reject power conversion waste heat. Los Alamos National Laboratory will lead the design of the reactor, and the Y-12 National Security Complex will fabricate it. NASA Glenn Research Center (GRC) will design, build, and demonstrate the balance of plant heat transfer, power conversion, and heat rejection portions of the Kilopower Prototype. NASA MSFC will develop an electrical reactor simulator for non-nuclear testing, and the shielding for nuclear testing. A non-nuclear electrically-heated demonstration of sodium heat pipe heat transfer, Stirling engine power conversion, and heat rejection will be assembled and tested at NASA GRC. Once the balance of plant has been tested and the reactor core has been fabricated, the balance of plant system will be reconfigured for a nuclear ground test, and the prototype will be assembled and tested at the Device Assembly Facility at the Nevada Nuclear Test Site. Figure 1 shows the evolution of Kilopower prototype development.

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