Entering into Space and New Energy and Propulsion Technology (7)
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THERMODYNAMIC PERFORMANCE OF 250KW SPACE NUCLEAR POWER SYSTEM BASED ON LIQUID METAL RANKINE CYCLE

Abstract

With the continuous development of deep space exploration, the distance of spacecraft mission is more and more farther from the Earth. Power demand for spacecraft has become increasingly a major constraint to future space exploration mission. Nuclear power system has been widely applied to the space probe power system, due to several characteristics. Liquid metal Rankine cycle with relatively mature technology and high cycle efficiency is suitable for multi-level and high-power space nuclear power system. In the current work, energy and exergy analysis approaches were used to analyze and compare the energy loss and exergy loss of the Rankine space nuclear system with the output power of 250kW. The power system consists of a lithium cooled fast reactor coupled to the advanced potassium Rankine power conversion system. The primary object is to analyze the performances of system components for quantifying the sites with largest energy and exergy dissipation. In addition, the effects of varying reference space environment state on system performance will also be investigated, and the influence of different space ambient temperature settings on the loss and efficiency of each part of the system is to be analyzed. Through establishment of physical model and mathematical model, the total energy and exergy flow rate of the status point in the system was evaluated. Results shows that energy losses mainly occurred in the condenser, and total exergy destruction was found to be maximum in the reactor. For varying space reference environment state temperature, it was found that the performance of major components undergoes drastic change.