Overview

For this work, frequency response tests were conducted on the Compact Integral Effects Test (CIET) facility to better understand how tests can be used to extract information from advanced reactors during operation. CIET is a scaled integral effects test for a fluoride salt-cooled high-temperature reactor (FHR). It uses Dowtherm-A as a simulant fluid for fluoride salt, matching Prandtl, Reynolds, Froude, and Grashof numbers. The electric resistance heater was perturbed using a variety of different inputs. The resulting temperature changes were measured throughout the loop, and the experimental frequency response functions were calculated. Initial efforts studied the design of frequency response tests. The results helped improve our understanding of heat transfer dynamics in the loop. Later testing altered the heater control to operate from simulated neutronic feedback. The simulated reactivity to heater power relationship was tested at several different levels of temperature feedback to demonstrate how frequency response testing could be used to determine feedback coefficients during normal operation of FHRs.

Heat Transfer Tests

Initial tests used a variety of input types to study the design and analysis of frequency response tests. From these tests, successful inputs were used to better understand the heat transfer dynamics in the loop. Test results quantified parasitic heat loss throughout the loop, allowing for the development of a more accurate TRANSFORM model of CIET.

Test results from a Twin Prime Binary Sequence (TPBS) (500 Watt, 143 bit, 10 sec/bit)

Simulated Neutronic Feedback Tests

The heater controller was updated to use point reactor kinetics to calculate power based on the reactivity from the simulated control rod, coolant temperature feedback, and fuel temperature feedback. Results demonstrated how frequency response tests might be used to quantify reactivity feedback coefficients during operation.

References
