Experimental Studies of NGNP Reactor Cavity Cooling System with Water

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Abstract

This project will investigate the flow behavior that can occur in the reactor cavity cooling system (RCCS) with water coolant under the passive cooling-mode of operation. The team will conduct separate-effects tests and develop associated scaling analyses, and provide system-level phenomenological and computational models that describe key flow phenomena during RCCS operation, from forced to natural circulation, single-phase flow and two-phase flow and flashing. The project consists of the following tasks:

- Conduct separate-effects, single-phase flow experiments and develop scaling analyses for comparison to system-level computational modeling for the RCCS standpipe design. A transition from forced to natural convection cooling occurs in the standpipe under accident conditions. These tests will measure global flow behavior and local flow velocities, as well as develop instrumentation for use in larger scale tests, thereby providing proper flow distribution among standpipes for decay heat removal.
- Conduct separate-effects experiments for the RCCS standpipe design as two-phase flashing occurs and flow develops. As natural circulation cooling continues without an ultimate heat sink, water within the system will heat to temperatures approaching saturation , at which point two-phase flashing and flow will begin. The focus is to develop a phenomenological model from these tests that will describe the flashing and flow stability phenomena. In addition, one could determine the efficiency of phase separation in the RCCS storage tank as the two-phase flashing phenomena ensues and the storage tank vents the steam produced.
- Develop a system-level computational model that will describe the overall RCCS behavior as it transitions from forced flow to natural circulation and eventual two-phase flow in the passive cooling-mode of operation. This modeling can then be used to test the phenomenological models developed as a function of scale.