SMR Inventec (Holtec International)
partnered with
Oak Ridge National Laboratory

RFA-17-14585, SMR-160 Primary Flow Stability

YEAR AWARDED: 2017

TOTAL PROJECT VALUE: $500k (DOE Funds Awarded: $400k; Awardee Cost Share: $100K)

STATUS: Completed

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DESCRIPTION: Holtec International's SMR-160 is a pressurized light-water thermal spectrum reactor that relies on natural circulation, thereby eliminating the need for reactor coolant pumps during normal operation. As part of the Gateway for Accelerated Innovation in Nuclear (GAIN) Small Business Voucher program, Oak Ridge National Laboratory (ORNL) and SMR Inventec, a subsidiary of Holtec International, entered into a cooperative research and development agreement to explore the primary flow stability of the SMR-160. The SMR-160 includes several unique design features. Most notable for this stability study is the investigation of an unborated core and primary loop, which necessitates active reactivity control with control rods, and the straight tube, once-through steam generator. Changes in any number of external parameters (e.g., control rod position or feedwater flow rate) will create a disturbance in the primary flow loop that will evolve over time.

BENEFIT: Given the coupled physics of this system, it is necessary to investigate the stability of the system at operational power levels when natural circulation is the driver of the primary flow to show that operation of the plant is stable, predictable, and controllable.

IMPACT: To investigate primary flow stability, researchers created a model of the SMR-160 in the Modelica environment and performed simple code-to-code benchmarking of the TRANSFORM tool to RELAP5-3D. The generic single-channel comparison showed differences in the calculated heat transfer coefficients and pressure drop expected to be found given the codes' different treatment of two-phase flow. A comparison between TRANSFORM and RELAP5-3D models of the SMR-160 primary loop and steam generator showed general agreement on global parameters important to stability studies. In subsequent transient benchmarking, the two models showed general agreement in the timing of important events such as peaks in reactor power. The time response was found to be favorable between the two models, so the researchers followed with a parametric linear stability study. The response in the core power was compared with the input signal to determine the stability of the primary loop. While small perturbations produced expected resonances, stability was demonstrated for the conditions investigated.

NEXT STEPS: In 2020, Holtec International was awarded $116 million in funding from the U.S. Department of Energy to develop its SMR-160 through the Advanced Reactor Demonstration Program. In the same year, SMR Inventec received a subsequent GAIN Voucher Assistance award ($500k total project value) to investigate plant transient behaviors in the VERA code suite with ORNL. The company hopes to deploy its 160-megawatt reactor by 2029.