NUCLEAR ENERGY RESEARCH INITIATIVE

Development of Modeling Capabilities for the Analysis of Supercritical Water-Cooled Reactor Thermal-Hydraulics and Dynamics

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Project Number: 05-086

Collaborators: None

Related Program: Gen IV

Project Description

The supercritical water-cooled reactor (SWCR) has several advantages over existing light water reactor (LWR) systems. For example, the SWCR uses a direct cycle with a single-phase working fluid and has high thermal efficiency. The objective of this project, undertaken in collaboration with Royal Institute of Technology in Stockholm, Sweden, is to develop improved analytical and computational models, supported by new databases and validated scalable correlations, to simulate SWCR behavior during normal operation and transients. Existing analytical techniques developed for current reactor technology are outdated and may cause inaccuracies in predicated system response. Advanced, next generation codes under development will be applied to supercritical water reactors. Researchers will also study the effect of coupling between hydrodynamic/thermal phenomena and reactor neutronics. The results of the experiments will be used to model SCWR thermal-hydraulics and dynamics.

Work Scope

- Develop an accurate and calibrated experimental database for supercritical water reactors.
- Develop and validate new scalable correlations and mechanistic models of flow and heat transfer.
- Implement, test, and validate the new models for application in existing reactor system analysis codes (RELAP) and computational fluid dynamics codes. The major computational tool will be NPHASE.
- Perform numerical simulations of supercritical water system dynamics using the NPHASE code.