

NUCLEAR ENERGY RESEARCH INITIATIVE

Experimental Development and Demonstration of Ultrasonic Measurement Diagnostics for Sodium Fast Reactor Thermohydraulics

PI: Akira Tokuhira, Kansas State University

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Program Area: AFC R&D

Collaborators: None

Project Description

This research project will address some of the principal technology issues related to sodium-cooled fast reactors (SFR), primarily the development and demonstration of ultrasonic measurement diagnostics linked to effective thermal convective sensing under normal and off-normal conditions. Sodium is well-suited as a heat transfer medium for the SFR. However, because it is chemically reactive and optically opaque, it presents engineering accessibility constraints relative to operations and maintenance (O&M) and in-service inspection (ISI) technologies that are currently used for light water reactors. Thus, there are limited sensing options for conducting thermohydraulic measurements under normal conditions and off-normal events (maintenance, unanticipated events). Acoustic methods, primarily ultrasonics, are a key measurement technology with applications in non-destructive testing, component imaging, thermometry, and velocimetry.

This project will yield a better quantitative and qualitative understanding of the thermohydraulic condition of sodium under varied flow conditions. The scope of work will evaluate and demonstrate ultrasonic technologies and define instrumentation options for the SFR.

Workscope

The researchers will demonstrate ultrasonic technology through the following activities:

- Design, construct, and operate a small, simple, university-based sodium flow loop with inventory of approximately 5-6 liters
- Develop and demonstrate ultrasonic velocimetry and thermometry, with a focus toward improved SFR O&M (i.e., using velocimetry and thermometry as diagnostic tools during normal and off-normal operations)
- Test a compact sodium-to-supercritical CO₂ heat exchanger and generate convective heat transfer data, correlations, and operational experience under normal and off-normal operations