NUCLEAR ENERGY UNIVERSITY PROGRAMS

Data Collection Methods For Validation of Advanced Multi-Resolution Fast Reactor Simulations

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Abstract

This project supports validation and verification (V&V) of computational fluid dynamics (CFD) codes for liquid-metal-based systems such as the sodium-cooled reactor. The experimental challenge is the development and demonstration of spatiotemporal data generation, management, and processing techniques and strategies. The scope of work facilitates comparisons between simulation tool predictions and the validation data, focusing on three primary objectives:

- Design and construct liquid-metal thermal-hydraulic (LM TH) separate effects experimental facilities at two universities, each similar in scope, size, and specifications to an existing DOE laboratory facility; perform initial study on dual (parallel) jet, thermal mixing phenomena.
- Identify and qualify advanced instrumentation for use in liquid-metal coolants that provide higher-resolution spatiotemporal flow field data required for V&V, uncertainty quantification (UQ), and data management and standardization; also establish an accessible database consisting of large, time-correlated measurements that characterize similar thermal-hydraulics in liquid-metal fast reactors.
- Investigate, model, and simulate thermal mixing of dual jets as a separate effects experiment and, computationally, at additional scales of relevance to SFR flows. The CFD study will essentially dictate the prototypic condition of the experiments; in addition, results of the simulation will be “tuned” to spatiotemporal scales that match the corresponding measurement of the convective field.

As CFD codes are increasingly relied upon for design, performance, and safety analysis, it becomes critical to ensure that they describe the physical world to an acceptable level of accuracy. V&V of high-resolution models of physical systems requires comparisons with similarly fine-scaled experimental data. This necessitates the use of “modern” instrumentation and measurement techniques.