INTERNATIONAL NUCLEAR ENERGY RESEARCH INITIATIVE

Verification and Validation of High-Fidelity Multi-Physics Simulation Codes for Advanced Nuclear Reactors

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The objective of this project is to systematically verify and validate multi-physics simulation codes and high-fidelity whole-core neutron transport codes for very high-temperature reactors (VHTRs) and light water reactors (LWRs). The research team will expand upon and reorganize a suite of advanced simulation methods and codes developed under previous I-NERI projects to address both VHTR and LWR core types. They will focus on developing benchmark models for verification and validation of the neutronics code, both with and without feedback from the thermo-fluid components, and will attempt uncertainty evaluations on the experimental data used to develop the benchmark problems. The work scope will include generating improved cross-section libraries for the targeted reactor types and performing detailed comparisons of predicted reactor parameters against both Monte Carlo solutions and experimental measurements. The team will also verify and validate the two thermo-fluid tools against benchmark problems and relevant experiments for phenomena important to the VHTR and LWR. Parametric studies will help determine the optimized level of geometry representation and model complexity within the limits of existing computational machines. Researchers will assess the accuracy of coupled simulations using code-to-code benchmark problems and comparisons of results against available experimental measurements.

The R&D plan consists of the following three primary tasks:

- Verification and validation of the DeCART neutronics code for VHTRs
- Verification and validation of the DeCART and PROTEUS neutronics codes for LWRs
- Verification and validation of the multi-physics simulation code suites DeCART/ CORONA and DeCART/STAR-CCM+