End-to-End Lattice Physics to Core Design Educational Modules for Nuclear Fuel Management Training

Executive Summary

As a result of a multi-year and multi-institution collaboration between North Carolina State University, University of Tennessee (UT), and Oak Ridge National Laboratory (ORNL), a team of UT graduate students led by the Principal Investigator of this proposal alongside ORNL staff mentors have recently developed substantial and new enhancements to the NESTLE three-dimensional core simulator code, including the implementation of a two-phase drift-flux thermal hydraulic and flow redistribution model to facilitate modeling of Boiling Water Reactors (BWRs) as well as the integrated coupling of the SCALE/TRITON lattice physics to NESTLE so to produce a first-of-a-kind open-source end-to-end capability for Light Water Reactor simulations. In addition, similar work is underway for CANDU systems.

The objective of this project is to take full advantage of the above-noted developed software capability and to apply these end-to-end simulation tools to develop educational training modules that will focus specifically upon core design and fuel reload management. In this context, the newly available version of NESTLE will be employed for students to “walk through” the following elements of core reload design: lattice physics and cross-section generation (SCALE/NEWT/TRITON), transferring two-group lattice cross sections into NESTLE (TRITON-TO-NESTLE), fuel cycle design scoping studies, reload licensing core-design calculations, core operational management, and core tracking of reactivity and thermal margins, and their biases.

The benefits of this project include the wide dissemination of education and training in key applied areas of reactor physics that are needed though not available in standard nuclear engineering curricula, as well as the availability of training modules using open-source software and techniques historically only available to fuel vendors and large commercial nuclear utilities.

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