



NES Colloquium

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CASL: Progress on Light Water Reactor Modeling and Simulation and Plans for its Second Phase

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The Consortium for Advanced Simulation of Light Water Reactors (CASL) was established in 2010 as the first U.S. Department of Energy Innovation Hub. CASL's mission is to develop advanced modeling and simulation (M&S) capabilities that can help address Light Water Reactor operational and safety performance challenges. In its first five years (Phase 1), CASL has developed a M&S capability called the Virtual Environment for Reactor Applications (VERA) that integrates simulation capabilities for key physical phenomena for pressurized water reactors (PWRs) with a focus on in-vessel physics: neutronics, thermal-hydraulics, chemistry, and material performance.

Key accomplishments in Phase 1 include transport capability to model fuel-pin resolved core detail, enhancing computational performance for subchannel thermal-hydraulics, improved physics models for two and three dimensional fuel performance assessment, enhanced chemistry treatment for deposition of corrosion products, and CFD capability that better utilizes HPC resources. Significant progress has been made in coupling and integrating these physics areas to apply to address CRUD induced power shift (CIPS), pellet clad interaction (PCI), and departure from nucleate boiling (DNB). Further, VERA has been deployed to early adopters through the CASL Test Stand program and applied to such things as modeling the AP1000® startup, comparisons to industry-standard fuel performance codes, and modeling flow throughout a reactor vessel.

CASL has recently been renewed for a second five-year phase (Phase 2). For this second phase, VERA activities on PWR modeling will be expanded along with broader research for light-water based small modular reactors (SMRs) and boiling water reactors (BWRs). This brings new development areas related to such areas as natural circulation and multi-phase thermal-hydraulics and neutronics modeling of BWRs. In addition, CASL will continue to pursue deployment of capabilities for broad use and application.