Advanced Multiphysics Thermal Hydraulic Models for the High Flux Isotope Reactor

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Abstract

Engineering design studies of the feasibility of conversion of the High Flux Isotope Reactor (HFIR) from high-enriched uranium (HEU) to low-enriched uranium (LEU) fuel are ongoing at Oak Ridge National Laboratory (ORNL) as part of an effort sponsored by the U.S. Department of Energy's (DOE's) Global Threat Reduction Initiative (GTRI)/Reduced Enrichment for Research and Test Reactors (RERTR) program. HFIR is a very high flux, pressurized light-water-cooled and moderated, flux-trap type research reactor whose current missions are to support neutron scattering experiments, isotope production, and materials irradiation, including neutron activation analysis. Advanced three-dimensional multiphysics models for HFIR were developed in COMSOL Multiphysics® software for (1) best estimate (nominal) and (2) safety basis (worst case) operating conditions. Several physics e.g., multilayer heat conduction, conjugate heat transfer, turbulent flows (RANS model) and structural mechanics were coupled together and solved for the inner and outer elements of HFIR. Alternate design features of the new LEU fuel were evaluated using these multiphysics models and led to a new "reference" LEU design that combines a permanent absorber in the lower unfueled region of all of the fuel plates, a burnable absorber in the inner element side plates, and a relocated and reshaped (but still radially contoured) fuel zone.

Figures used in the abstract

Figure 1

Figure 2

Figure 3

Figure 4