NUCLEAR ENERGY RESEARCH INITIATIVE

BWR Assembly Optimization for Minor Actinide Recycling

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Project Number: 05-125

Collaborators: Oak Ridge National Laboratory, Los Alamos National Laboratory, and Westinghouse Electric Company

Related Program: AFCI

Project Description

The primary objective of this project is to apply and extend the latest advancements in light water reactor (LWR) fuel management optimization to design advanced boiling water reactor (BWR) fuel assemblies for the recycling of minor actinides. Two specific objectives include; (1) developing a new methodology for the direct coupling between the pin-by-pin bundle loading control variables and the core-wide (bundle-by-bundle) optimization objectives, and (2) extending this new methodology into a new application that includes control variables, objectives, and constraints designed to maximize targeted minor actinide incineration. The first objective is expected to uncover considerable dormant thermal margin, while the second objective (the addition of minor actinides) is expected to consume some of this uncovered margin. Therefore, a goal of this project is for optimization-led improvements in fuel cycle efficiency to offset potential losses in efficiency associated with the recycling of minor actinides.

This project implements an Advanced Fuel Cycle Systems Analysis program initiative to investigate spent fuel treatment and recycling options for current generation light water reactors, and supports the DOE's technical assessment of a second high-level waste repository.

Work Scope

- Perform within-bundle related developments. Define candidate minor actinides; specify control variables, objectives, and constraints at the bundle level. Generate families of lattices and bundles as a function of relevant parameters (exposure, void fraction, etc.).
- Perform core-wide activities. Define bundle-to-core coupling. Generate families of core loadings and corresponding operational strategies (control rod patterns, core flow). Validate diffusion theory analyses via transport theory benchmarks.
- Complete global integration of the project. Verify proper functioning of models, generate optimized advanced BWR bundles and associated fuel cycle strategies.