INTERNATIONAL NUCLEAR ENERGY RESEARCH INITIATIVE

Study of Burning Transuranic Elements in Heavy and Light Water Reactors

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Project Abstract

The objective of this project is to examine and compare the isotopic evolution of actinide bearing fuel under irradiation in Heavy Water Reactors (HWRs) and Light water Reactors (LWRs), with emphasis upon PWRs, to understand the physics processes involved and to provide a comparative analysis of the burning performance in the two reactor types. This will provide greater understanding of using these reactors as intermediate-tier burners of transuranics (TRU), bridging thermal reactors using uranium-dioxide fuel and fast reactors that could be used for ultimate consumption of the TRU (plutonium and minor actinides). As previously noted, the project will also provide the capability to link uranium resources from LWR spent fuel processing to fuel in HWRs to provide a complete evaluation.

The current effort at ORNL is focused on the development of lattice physics and full core models to perform the analysis to compare homogenous and heterogeneous recycle options for LWRs on based on full core analysis. These lattice configurations will be used in full-core analysis to assess appropriate actinide loadings and to assess reactor performance. The initial phase of the work will not be focused on establishing truly optimized core designs. Rather base-line homogeneous and heterogeneous core designs will be obtained by using the established Mixed Oxide (MOX) loading pattern as shown above and make homogeneous and heterogeneous TRU-containing assembly substitutions to provide a comparison of the relative performance of the two options.

In regards to HWRs, published work to date has been limited to lattice-cell calculations of $(U,Pu)O_2$ MOX and group-extracted transuranics in Uranium (TRU-U) inert matrix (TRUIMF) fuel. Lattice-cell calculations are excellent for scoping out a large range in possible fuel cycles, but full-core simulations are required to verify the potential of a candidate fuel cycle and determine a number of important fuel cycle parameters.