NUCLEAR ENERGY RESEARCH INITIATIVE

Analysis of Advanced Fuel Assemblies and Core Designs for the Current and Next Generations of LWRs

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Project Number: 07-059

Program Area: AFC R&D

Collaborators: None

Project Description

This research will focus on developing light water reactor (LWR) fuel assemblies that can efficiently transmute plutonium and minimize the minor actinide inventories. The project will study various fuel types, namely high burn-up advanced mixed oxides and inert matrix fuels, in various geometrical designs that are compliant with the core internals of current and future light water reactors. A total of 10 fuel pin designs and 13 fuel assembly designs will be analyzed and neutronic/thermal hydraulic effects will be considered. The best performing designs will be used in 3-D core depletion methodology to determine overall transmutation performance in various fuel cycle scenarios. Transmutation efficiency and safety parameters will be used to rank the various designs. Researchers will also assess the number of Generation IV reactors needed to close the fuel cycle.

The reprocessing of spent nuclear fuel can delay or avoid the need for a second geological repository in the US. Current light water reactor fuel assembly designs under investigation could reduce the plutonium inventory of reprocessed fuel. Nevertheless, these designs are not effective in stabilizing or reducing the inventory of minor actinides. This project will develop and analyze advanced light water reactor fuel assembly designs with improved thermal transmutation capability regarding transuranic elements and especially minor actinides.

Workscope

This project will perform the following tasks:

- Develop and optimize fuel pin concepts
- Develop and optimize fuel assembly designs with improved transuranics transmutation capability
- Perform thermalhydraulic subchannel analysis
- Analyze the neutronic/thermal hydraulic effects
- Perform and optimize 3-D depletion cycles
- Evaluate diverse fuel cycle options
- Assess and rank designs for transmutation efficiency, safety, and radiotoxicity