NUCLEAR ENERGY RESEARCH INITIATIVE

Development of TRU Transmuters for Optimization of the Global Fuel Cycle

PI: Dr. John C. Lee, University of Michigan

Project Number: 05-142

Collaborators: Argonne National Laboratory

Related Program: AFCI

Project Description

This project will develop advanced fuel cycles for the transmutation of transuranic (TRU) elements in irradiated nuclear fuel from light water reactor (LWR) power plants. The research will focus on developing fast-spectrum nuclear reactors that could efficiently transmute long-lived TRUs, thereby significantly reducing the radioactivity of the irradiated fuel. Researchers will evaluate diverse fuel cycles and energy production systems in a systematic, integrated approach to optimize the global fuel cycle. The project will study deployment of fast-spectrum transmuters together with LWRs and other advanced reactors to minimize risks associated with the disposal and storage of irradiated nuclear fuel, including the radiological toxicity, proliferation risk, and radiological dose of the irradiated fuel in underground repositories. Researchers will develop an equilibrium fuel cycle methodology to consistently compare the performance of LWR transmuters with that of other designs. A key objective of this research is to develop a simplified, analytical fuel cycle methodology that could provide physical insights into the overall performance of an integrated nuclear energy and fuel cycle economy.

Work Scope

- Develop and optimize low conversion-ratio fast reactor transmuters.
- Apply LWR equilibrium cycle methodology to global power distribution calculations and fuel loading optimization.
- Evaluate diverse fuel cycle options with the DANESS code and enhance the model.
- Develop algorithms to optimize the global fuel cycle and map costs as a function of system parameters.
- Develop a simplified model to provide physical insights and guidance for evaluation of diverse fuel cycles.