NUCLEAR ENERGY RESEARCH INITIATIVE

Development of an Engineered Product Storage Concept for the UREX+1 Combined Transuranic/Lanthanide Product Streams

PI: Dr. Sean M. McDeavitt, Purdue University

Project Number: 05-066

Collaborators: Argonne National Laboratory

Related Program: AFCI

Project Description

This project will develop a storage form for transuranic (TRU) oxides and rare earth fission product (REFP) oxides isolated from spent nuclear fuel using advanced aqueous processing methods. The candidate storage forms include simple powder storage with engineered barriers and manufactured cermet forms that would be enable TRU burning in a fast reactor after an intermediate storage period.

Transuranic and rare earth oxides are being extracted from spent nuclear fuel through the aqueous processing methods developed under the Advanced Fuel Cycle Initiative (AFCI). The goal of this project is to secure these oxides in a proliferation-resistant state until the closed fuel cycle fast reactor infrastructure is in place. The required TRU storage "lifetime" is estimated to be 50 to 60 years before a fast burner technology is available, but the maximum design storage duration is set at approximately 500 years.

The goals of the project are to (1) design and develop the individual processing steps required to take the uranium and transuranic products from an aqueous nitrate solution to a final storage state, and (2) evaluate the impact of phenomena that govern durability of the storage form, material processing, and TRU utilization in fast reactor fuel.

Work Scope

The first task will develop the processing logic and methods for converting actinide and lanthanide nitrate solutions into oxide powders, recycling the irradiated Zircaloy cladding to be used as a cermet matrix, and fabricating a cermet storage form that may be used as a TRU burning fuel pin in a future fast reactor system. In task two, computational methods will be used to evaluate the TRU burning performance of the cermet storage/fuel pin in a simulated Generation IV reactor system and to compare the proposed cermet storage form with alternative approaches such as sealed container storage of TRU oxide powders.