NUCLEAR ENERGY RESEARCH INITIATIVE

Minor Actinide Doppler Coefficient Measurement Assessment

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Project Number: 05-024

Collaborators: Education, Research and Development Association of Georgia Universities

Related Program: AFCI

Project Description

This project will assess the viability of measuring the Doppler coefficient of minor actinides. Using a series of calculations, researchers will estimate the change in reactivity resulting from a change in the operating temperature of small (approximately 1 gram) quantities of pure minor actinides. Resultant data will be used to design experiments in order to validate the computer calculations.

Calculations will be performed as a function of five parameters (isotope, sample quantity, operating temperature, critical assembly, and data library), using the radiation transport code MCNPX. The objective is to determine the quantity of minor actinide material needed to effect a lE-5 change in reactivity due to a 200 degree Kelvin change in the operating temperature of the sample (e.g., from 800 K to 1000 K). Results from the calculations will be used to develop an experiment that will measure the Doppler coefficient of each isotope. For these experiments, researchers will place actinide sample material in the FLATTOP and COMET critical assemblies at the Los Alamos Critical Experimental Facilities. The isotopes proposed for this study are: Pu-239, Np-237, Pu-238, Am-242m, Am-243, Pu-241, Am-241, and Cm-244.

As part of the Advanced Fuel Cycle Initiative (AFCI), research using advanced fast reactors in combination with accelerator-driven systems for the transmutation of waste has shown the ability to reduce the amount of plutonium and transuranic materials for disposal. The Doppler coefficients of each isotope are needed so researchers can conduct safety assessments of transmutation systems containing fuel with a high minor actinide content.

Work Scope

This project will perform the following activities:

- Determine critical assembly setup and operating temperatures. Perform initial calculations to identify the range of sample quantities for each isotope.
- Perform MCNPX calculations and quantify the amount of each minor actinide required for an 1E-5 change in reactivity.
- Analyze calculation results to determine the possibility of performing experimental validation on the two critical assemblies.
- If results are favorable, design a set of benchmark experiments to measure the Doppler Coefficients.