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Implementation of Uncertainty Propagation in TRITON/KENO

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Task 41

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BACKGROUND

Monte Carlo methods are beginning to be used for three-dimensional fuel depletion analyses to compute various quantities of interest, including isotopic compositions of used nuclear fuel. The TRITON control module, available in the SCALE 5.1 code system, can perform three-dimensional (3-D) depletion calculations using either the KENO V.a or KENO-VI Monte Carlo transport codes, as well as the two-dimensional (2-D) NEWT discrete ordinates code. To overcome problems such as spatially non-uniform neutron flux and non-uniform statistical uncertainties in computed reaction rates and to improve the fidelity of calculations using Monte Carlo methods, uncertainty propagation is needed for depletion calculations.

ACADEMIC YEAR HIGHLIGHTS

- T. Sloma and C. Sanders, "Evaluation of PWR Rim Effect Utilizing TRITON," oral presentation, 2008 Student Conference of the American Nuclear Society, College Station, TX, February 29, 2008.

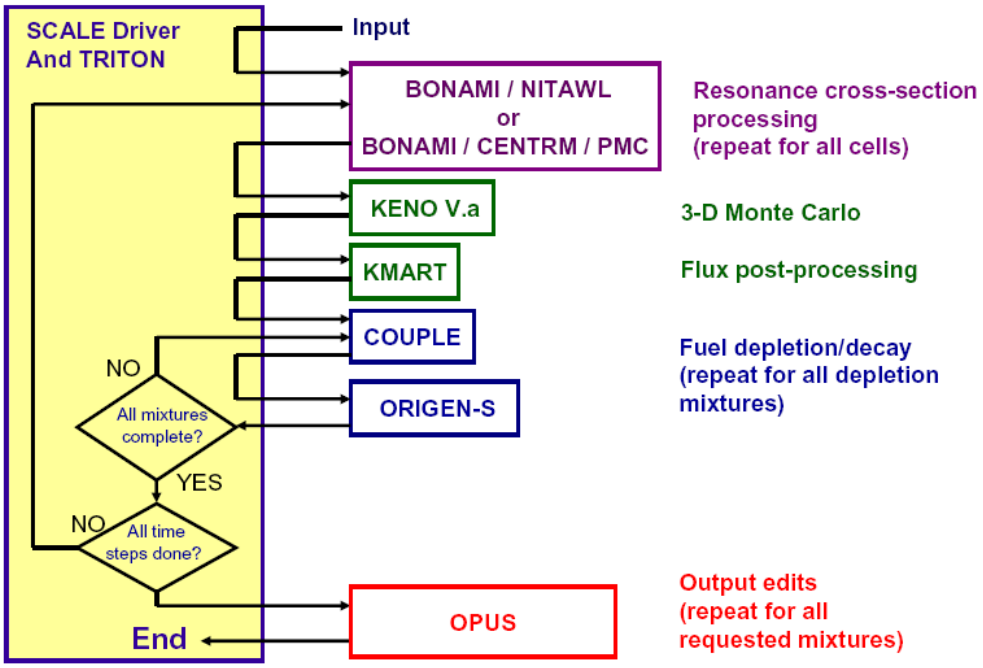
RESEARCH OBJECTIVES AND METHODS

To enhance and expand the proper/informed use of Monte Carlo methods for 3-D depletion analyses, statistical uncertainty propagation will be developed and implemented in the TRITON/KENO sequence of SCALE. In particular, work will focus on development and implementation of an approach to determine the uncertainty in isotopic predictions based on the compound effects of multiple calculations (depletion time steps) with stochastic uncertainties in the spatial fluxes in each time step. Subsequently, an evaluation of the statistical uncertainties for an actual commercial used fuel sample will be performed to verify the implementation and develop a better understanding of the importance of statistical uncertainties in the prediction of isotopic compositions.

RESEARCH ACCOMPLISHMENTS

This project was initiated in collaboration with Oak Ridge National Laboratory. The first step was initial acquisition of the TRITON/KENO code system from ORNL and identification of a test problem for evaluating the code. An initial test problem was identified and modeled in TRITON and KENO.

Studies of the Pressurized Water Reactor Rim Effect were used to verify the TRITON code implementation. Examination of uncertainty propagation will follow verification and benchmarking studies.



Flowchart of TRITON-K-5 Sequence (photo from the Nuclear Science and Technology Division, Oak Ridge National Laboratory).

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