Transmutation Feature Within MCNPX

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ABSTRACT

A feature recently developed for MCNPX [1] is the ability to perform transmutation calculations. Although this capability has been available to users via various post-processing utilities, such as Monteburns [2], it would be the first time this process is entirely automated within MCNPX. Such an enhancement provides many benefits to the user by eliminating the need to learn other post-processing codes, reducing errors in normalizations and auxiliary input, and eliminating file manipulation and tracking issues.

This transmutation option is implemented with a batching scheme that updates material properties at various user-specified time steps. The number of particle histories sampled per batch is also specified by the user. Within each time step, MCNPX tallies a 63-group neutron flux averaged over each material within the geometry. At the end of the time step, the neutron flux data and various 1-group cross sections, along with related isotopic atom densities, are passed through an interface routine to CINDER90 [3]. In its usual fashion, CINDER90 uses the neutron fluxes to perform activation, depletion, and decay. It then updates the isotopic inventory, which then is returned to MCNPX for use during transport of the next time step. As usual, users can perform various time-dependent tallies across the entire simulation process.

During this first phase of the transmutation implementation, we focus on comparisons between MCNPX and Monteburns. As the MCNPX implementation approaches that of Monteburns, it is expected that the results will be quite similar. For a seven-can HEU configuration, we show that the MCNPX and Monteburns k_{eff} results are within a few percent. While these initial results are encouraging, work continues on understanding the differences (e.g., there are notable differences in the cross sections used by MCNPX and CINDER90).

REFERENCES

1. L. WATERS, ed., "*MCNPX User's Manual Version 2.4.0*," Los Alamos National Laboratory document LA-CP-02-408 (2002).

2. H. R. TRELLUE and D. I. POSTON, "*User's Manual, Version 2.0, for Monteburns, Version 5B,*" Los Alamos National Laboratory document LA-UR-99-4999 (1999).

3. W. B. WILSON et al., "*Recent Development of the CINDER'90 Transmutation Code and Data Library for Actinide Transmutation Studies*," *Proc. GLOBAL'95 Int. Conf. on Evaluation of Emerging Nuclear Fuel Cycle Systems*, Versailles, France, September 11–14, 1995, p. 848 (1995).