MON I-E5

VALIDATION OF NEW NEUTRON PRODUCTION CROSS SECTIONS FOR TUNGSTEN ISOTOPES

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Purpose: Recently, the neutron production cross sections of tungsten isotopes such as W-182, -183, -184, -186 have been evaluated for fusion applications. An improvement of the neutron-induced emission spectra was made in the fast energy range when compared with the existing nuclear data files. So, in this study, the newly evaluated data has been validated through some fusion neutronics shielding experiments in the Shielding Integral Benchmark Archive Database (SINBAD).

Methods and Materials: The nuclear data validation has been carried out with the MCNPX-2.5.0 code. The neutron leakage spectra were calculated with the ACE (A Compact ENDF) format libraries based on the new tungsten data and compared with the measurements. Also, additional calculations based on the ENDF/B-VII.0, JEFF-3.1, JENDL-3.3, and FENDL-2.1 libraries have been performed to confirm the differences from the new data.

Results: For the OKTAVIAN W sphere experiment, the neutron leakage spectra calculated with the ENDF/B-VII.0, JEFF-3.1, JENDL-3.3, and FENDL-2.1 libraries had a tendency to greatly underestimate the measurements in the fast energy range of more than about 7 MeV. However, the newly evaluated data can successfully reproduce the measured neutron leakage spectra. Especially for neutrons of around 10 MeV, a remarkable progress was achieved. The calculation results for the FNS-W experiment were also greatly improved in the fast energy range while showing good agreements with the measurements, when compared with the results based on the other libraries.

Conclusions: The new neutron production cross sections of tungsten isotopes can provide a remedy for the large discrepancies in the current fast neutron leakage spectra. Hence, this data will be very useful for various fusion neutronics applications.

MON II-A1

SIMULTANEOUS OPTIMIZATION OF TALLIES IN DIFFICULT SHIELDING PROBLEMS

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Purpose: For many years, hybrid methods that use information derived from deterministic calculations have been studied in attempts to speed up Monte Carlo calculations. CADIS (Consistent Adjoint Driven Importance Sampling) is one such methodology that has been successfully applied to both MCNP (in the ADVANTG patch) and to MAVRIC (part of SCALE 6) to use an approximate discrete ordinates calculation to determine both the transport weight window target values and a biased source distribution to optimize one tally of interest in the Monte Carlo (MC) code. What is needed is a way to obtain more than one tally in the same MC calculation with each tally having roughly the same relative uncertainty — simultaneous optimization.

Methods and Materials: The MC tallies appear in the adjoint calculation as adjoint sources. By weighting each of these by the inverse of the expected tally response (flux, dose, etc.), the final adjoint flux creates an importance map and biased source that more uniformly converge the tallies in the final MC calculation.

Results: This new method, using a forward-weighted adjoint source and the CADIS methodology (called FWCADIS), is demonstrated on a difficult shielding problem — finding the dose equivalent rates all along the
boundary of the controlled area of an independent spent fuel storage installation.

Conclusions: The FW-CADIS method can be used to calculate a mesh tally in which the dose equivalent rate varies over orders of magnitude but the relative uncertainties are roughly equal.

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