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SuperMC Benchmark with SINBAD

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Development of nuclear engineering software should be based on a rigid software engineering process, in which, verification & validation process should be executed to assess the accuracy of the computed results against the corresponding benchmark values, and also to demonstrate the code performing adequately for intended applications. Super Monte Carlo Program for Nuclear and Radiation Simulation (SuperMC) is a general, intelligent, accurate and precise simulation software system for the nuclear design and safety evaluation of nuclear systems, and has been verified by more than 2000 benchmark models and experiments from the handbook of International Criticality Safety Benchmark Evaluation Project (ICSBEP), the Shielding Integral Benchmark Archive Database (SINBAD), and the International Reactor Physics handbook Evaluation Program (IRPhEP), etc., and also some other benchmark cases collected in FDS Team.
In this paper, the validation of SuperMC based on the benchmark archive of SINBAD was presented. Benchmark experiments performed on the D-T fusion neutron source facilities of OKTAVIAN, FNS, FNG, IPPE were selected to assess the shielding analysis capability of SuperMC for fusion engineering project. The materials of selected benchmark cases cover beryllium, graphite, oxygen, aluminum, silicon, iron, nickel, vanadium, tungsten, silicon carbide and stainless steel, etc., while the geometries of selected benchmark cases cover simple spheres, slabs and also complicated shield mockups for fusion engineering. All the selected benchmark problems were modeled and simulated with SuperMC. The calculation results, such as leakage spectrums, energy deposition, reactions rates and fission rates, etc., were compared with MCNP results and experimental data. Comparing to MCNP, very good agreement with deviations lower than 0.1% for integrated values of neutron spectra over energy was achieved, and the maximum deviations for induced photon integral flux are about 1% because photon transport models may differ slightly. Also, the neutron spectra results are in good agreement with the experiments.
SuperMC has been verified with D-T fusion neutron source benchmark cases from SINBAD, and excellent agreement has been obtained between SuperMC and MCNP, and also the calculation results are in good agreement with experimental data in most of the selected cases. The correctness and reliability of SuperMC modeling and simulation functions were fully validated.

Eligible for student paper award?

No

Authors: Dr HAO, Lijuan (Institute of Nuclear Energy Safety Technology, CAS ·FDS Team); Mr LIN, Yongpo (Institute of Nuclear Energy Safety Technology, CAS ·FDS Team); Dr YANG, Qi (Institute of Nuclear Energy Safety Technology, CAS ·FDS Team); Dr SONG, Jing (Institute of Nuclear Energy Safety Technology, CAS ·FDS Team)

Presenter: Dr HAO, Lijuan (Institute of Nuclear Energy Safety Technology, CAS ·FDS Team)

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