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Application of ADVANTG Variance Reduction Parameters for MCNP6 at ESS

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The Monte-Carlo method is the de-facto standard for radiation shielding calculations at spallation neutron sources. Calculations can often require the transport of particles through several meters of biological shielding, and there are continuous requests to simulate weaker and weaker phenomena. Therefore, variance reduction methods become absolutely critical for the success of a calculation. In this work, we report on the performance of generating variance reduction parameters for MCNP6 via the CADIS and FW-CADIS methodologies using ADVANTG with spallation neutron source applications in mind.

The CADIS and FW-CADIS methodologies have primarily been applied to low energy, i.e., less than 20 MeV, neutron and photon shielding applications. However, with the use of the HILO2K library, these methods can be extended up to 2 GeV for neutron and photon sources. At the European Spallation Source (ESS), we have recently been investigating the potential of generating variance reduction parameters for MCNP6 with the software ADVANTG and the HILO2K cross section library. For this study, we have selected a few representative problems that might be typically encountered at a spallation neutron sources to test ADVANTG's implementation of CADIS and FW-CADIS. These problems include neutron and proton sources. The use of a proton source in the MCNP6 simulation with the FW-CADIS methodology requires an intermediate step to generate a neutron source for ADVANTG's discrete ordinates simulations, i.e., a neutron source for DENOVO.

We will report on the performance of the variance reduction parameters generated by ADVANTG for MCNP6 for the scenarios that were investigated. We will also make some recommendations for applying CADIS and FW-CADIS to applications at spallation neutron sources.

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