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Sensitivity/Uncertainty Comparison Study Involving IRSN, LANL, and ORNL Tools to Support Validation

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Under a DOE Nuclear Criticality Safety Program (NCSP) task involving Analytical Methods [1], three Laboratories collaborated in a comparison of results obtained from Sensitivity/Uncertainty (S/U) packages relevant to validation of transport codes. The task involves Institut de Radioprotection et de Sûreté Nucléaire (IRSN), Los Alamos National Laboratory (LANL), and Oak Ridge National Laboratory (ORNL) comparing results of MORET 5/MACSENS V3.0, MCNP6.2/Whisper-1.1, and SCALE 6.2.3/TSUNAMI/USLSTATS respectively. All Monte Carlo transport code results utilize nuclear data from ENDF/B-VII.1 evaluation.

This study examines five cases from the International Handbook of Evaluated Criticality Safety Benchmark Experiments (ICSBEP Handbook) [2] selected as application models: IEU-MET-FAST-002-001, LEU-COMP-THERM-001-001, LEU-SOL-THERM-004-001, MIX-COMP-THERM-001-001, and U233-SOL-THERM-001-001. This is a continuation of a previous study [3] to examine Pu and HEU cases: HEU-MET-FAST-013-001, HEU-SOL-THERM-001-008, PU-MET-FAST-022-001, and PU-SOL-THERM-001-001. Ultimately, comparison is made between Upper Subcritical Limits (USLs) obtained using each code package for each application case. Since differences exist in whether packages take into account margin of subcriticality (MOS), the USL is computed using only bias and bias uncertainty, also known as the calculational margin (CM) in ANSI/ANS-8.24 [4]. Results comparison appears to show that benchmark selection has a greater influence on the USL than the method used for calculation of bias and bias uncertainty.

[1] The Mission and Vision of the United States Department of Energy Nuclear Criticality Safety Program, <https://ncsp.llnl.gov>

[2] International Handbook of Evaluated Criticality Safety Benchmark Experiments, NEA/NSC/DOC(95)03/I, Volume I, 2020 edition.

[3] J. Alwin, et al., “S/U Comparison Study with a Focus on USLs”, American Nuclear Society Transactions V123, N1, pp. 780-783, (2019).

[4] ANSI/ANS-8.24-2017, “Validation of Neutron Transport Methods for Nuclear Criticality Safety Calculations,” American Nuclear Society. La Grange Park, Illinois (2017).