

ENCLOSURE 6

M200033

Supplemental Information for MCNP6 Area of Applicability and
Qualification for NEDO-33866 Revision 6

Non-Proprietary Information

The following discussion is provided as supplemental information to the NRC and GEH meeting on Friday, March 13, 2020. This information is not intended to be included within the GE Model No. 2000 Safety Analysis Report [1], but rather provide additional clarification.

Supplemental Information 1:

Provide justification for MCNP6 Area of Applicability (AOA) for Uranium-235 (U-235) at 5 weight percent (wt.%) when the benchmarks used only go up to 4.3 wt.% U-235.

GEH Response

It is recognized that the selected Low Enriched Uranium (LEU) benchmark calculations presented in NEDO-33866 [1] do not cover the full range of enrichments up to 5 wt.% U-235. However, the benchmarks used do provide values up to 4.3 wt.% U-235. As indicated in the GEH response to NRC's Request for Additional Information (RAI) 6.2 [2], it is not expected that the small increase in U-235 enrichment would significantly affect the Upper Sub-critical Limit (USL) as determined by MCNP6.

The large margin to the USL in the limiting case from NEDO-33866 Section 6.1.2 [1], demonstrates that there is adequate confidence in the extension of the MCNP6 AOA up to 5 wt.% U-235.

Supplemental Information 2:

Provide justification for the acceptability of the bias and bias uncertainty development using MCNP Version 6.1 for MCNP Version 6.2 with the same cross-section library.

GEH Response

As stated in NEDO-33866 Section 6.8 [1], the bias and bias uncertainty determined for MCNP6 Version 1.0 [3] is applicable to the calculation with MCNP6 Version 2.0 [4] in NEDO-33866 Section 6.9.4, based on the demonstrated code-to-code comparison from LA-UR-17-24406 [5]. The Los Alamos National Laboratory Report [5] demonstrated identical results between the two codes when using the same cross-section library.

The calculations in NEDO-33866 Section 6.9.4 used the same cross-section library and are expected to produce the same results with either MCNP6 Version 1.0 or Version 2.0. It should be noted that the GEH version of MCNP6 Version 2.0 has been confirmed to be consistent with the LANL version via GEH's NRC approved quality assurance program [6] during the internal software qualification of MCNP6 Version 2.0.

The major pieces of a nuclear criticality safety program identified in NUREG/CR-6698 [7], NUREG/CR-5661 [8], and NUREG/CR-6361 [9] are captured related to MCNP6 Version 2.0 by the internal software and personnel qualification processes [6] and the direct code-to-code comparison in LA-UR-17-24406 [5].

It is possible that there are some small differences due to platform variations between the use of MCNP6 Version 1.0 and Version 2.0 in NEDO-33866 [1]. However, these are expected to be on the order of 1-2 standard deviations [5], which is considered statistically insignificant [8]. Based on the large available margin to the USL demonstrated in NEDO-33866 Section 6.6.2, it is acceptable to apply the calculated bias and bias uncertainty from MCNP6 Version 1.0 to MCNP6 Version 2.0.

References:

1. GE Hitachi Nuclear Energy, NEDO-33866 Revision 6, "Model 2000 Radioactive Material Transport Package Safety Analysis Report," April 2, 2020.
2. GE Hitachi Nuclear Energy, 005N0663 Revision 0, "Enclosure 2 M190195: GEH Responses to the U.S. NRC RAIs ML19296C273 for the GE Model No. 2000 (GE2000) Transportation Package," Revision 0, United States Nuclear Regulatory Commission ADAMS Accession Number ML20031C704.
3. T. Goorley et al., "Initial MCNP 6 Release Overview - MCNP6 Version 1.0," Los Alamos National Laboratory, LA-UR-13-22934, April 2013.
4. LA-UR-18-20808, "MCNP Version 6.2 Release Notes," Los Alamos National Laboratory.
5. LA-UR-17-24406, "Verification of MCNP6.2 for Nuclear Criticality Safety Applications," Los Alamos National Laboratory, June 2017.
6. GE Hitachi Nuclear Energy, NEDO-11029-A Revision 14, "Quality Assurance Program Description," Docket No. 71-0254, United States Nuclear Regulatory Commission ADAMS Accession Number ML18023A139.
7. NUREG/CR-6698, "Guide for Validation of Nuclear Criticality Safety Calculational Methodology," January 2001, United States Nuclear Regulatory Commission ADAMS Accession Number ML050250061.
8. NUREG/CR-5661, "Recommendations for Preparing the Criticality Safety Evaluation of Transportation Packages," April 1997.
9. NUREG/CR-6361, "Criticality Benchmark Guide for Light-Water-Reactor Fuel in Transportation and Storage Packages," March 1997.