71-9302: TN MP-197

Acceptance Review

Section 6.0 – Criticality Safety

I. Request for Supplemental Information (This information is needed in order for the staff to proceed with a technical review to confirm that the package design meets the criticality safety requirements of 10 CFR 71.55 and 71.59.)

1. The application includes the use of incompatible cross section libraries between the MP-197 criticality analysis and the associated benchmarking calculations in Chapter 6.0 of the SAR. Revise the benchmarking analysis to use the same cross section libraries consistently for all the calculations performed.

   The application includes an analysis of selected commercial reactor critical (CRC) state points as part of the benchmarking analysis in Section A.6.3.2 of the SAR. This analysis includes k_{eff} calculations of various CRC state points using SCALE 4.x with KENO V.a and the 238-group ENDF/B-V cross section library. The criticality analysis of the MP-197 system uses the same code system, but with the 44-group ENDF/B-V cross section library. Section A.6.3.2.2 of the SAR states that the 44-group library consistently over-predicts k_{eff} in comparison to the 238-group library, and incorrectly refers to NUREG/CR-6686, "Experience with the SCALE Criticality Safety Cross-Section Libraries," for justification. This NUREG/CR provided a comparison of the capabilities of various cross section libraries used with the SCALE code system modules, for calculating the k_{eff} of various fissile systems, including uranium oxide and mixed uranium and plutonium oxide systems. However, NUREG/CR-6686 did not compare the performance of these cross-section libraries when calculating k_{eff} for burned fuel compositions. Additionally, ANSI/ANS-8.24-2007, "Validation of Neutron Transport Methods for Nuclear Criticality Safety Calculations," states that "The calculational methods and analysis techniques (e.g., albedos, variance reduction, *cross-section* processing) used to analyze the set of benchmarks shall be the same as those used to analyze the system or process to which the validation is applied." The CRC state point analysis should be revised to use the 44-group cross section library, or the package criticality analysis should be revised to use the cross section library used consistently in the benchmarking analysis.

2. The application does not provide a technical basis for crediting greater than 50 GWd/MTU burnup of the spent fuel contents to be transported in the Model No. MP-197.

   Division of Spent Fuel Storage and Transportation Interim Staff Guidance 8 (ISG-8), Rev. 2, "Burnup Credit in the Criticality Safety Analyses of PWR Spent Fuel in Transport and Storage Casks," states that the licensing basis for burnup credit should be limited to "UO_2 fuel irradiated in a PWR to an assembly-average burnup value up to 50 GWd/MTU." The application should be revised to only credit fuel burnup up to 50 GWd/MTU, or to provide a specific technical analysis, with supporting data, to justify crediting greater than this amount of burnup.

3. The application does not include a description or justification of the methodology used to apply burnup credit to damaged fuel configurations in the 24PTH, 32PTH/32PTH1, and 37PTH canisters.

   ISG-8, Rev. 2 states: "The recommendations that follow are applicable to intact fuel. If burnup credit is requested for damaged fuel (basically intact, not debris), the recommendations of this guidance should be applied, as appropriate, to account for uncertainties that can be associated with the damaged fuel and establish an isotopic inventory and assumed fuel configuration for normal and accident conditions that bounds the uncertainties." Revise the criticality analysis to address the burnup credit assumptions for damaged furl configurations.

II. Observations

- The application does not discuss the applicability of a one-dimensional depletion code (SAS2H) for modeling the irradiation conditions of the fuel to be transported in the Model No. MP-197, as well as the radiochemical assay samples.

- The use of BONAMI/NITAWL for cross-section processing in the criticality analysis can be impacted by improper treatment of cases with significant resonance overlap, leading to significant errors in k_{eff} determination. The application does not discuss the applicability of this code for modeling spent fuel compositions in the criticality analysis. The applicant should revise the application to include this discussion, or consider using CENTRM/PMC (available in later versions of the SCALE code system), which provides a more robust cross-section treatment with little computational penalty.

- The application does not discuss the solver method of the DARWIN isotopic depletion code. This information will be useful to the NRC staff in determining the applicability of the code-to-code comparison in support of the MP-197 benchmarking analysis.

- The HTC benchmark isotopes are well known, and fabricated to correspond to a single, homogenous burnup of 37.5 GWd/MTU. The applicability of this indirect benchmark to the entire burnup range (0 - 60 GWd/MTU) for the package has not been demonstrated.