NAC International

Docket No. 71-9356

INITIAL NON-PROPRIETARY REQUEST FOR ADDITIONAL INFORMATION

AND OBSERVATIONS

RELATED TO THE MODEL NO. MAGNATRAN APPLICATION

**Request for Additional Information:**

**Thermal Evaluation**

1. Provide a thermal analysis for hypothetical accident conditions that integrates the content and package components, thereby accounting for the content's thermal inertia effects.

   The HAC thermal analysis "calculates" the basket and fuel cladding temperatures by adding the maximum temperature difference between the cask inner shell and the component from the normal conditions of transport results to the peak temperature of the inner shell from the fire accident conditions. This method does not take into account the thermal inertia effects of canister contents and components, which includes spent fuel assemblies with decay heat of 23 kW. The results of a HAC thermal analysis model that integrates the content and package components should be provided for review.

   This information is needed to confirm compliance with the requirements in Title 10 of the *Code of Federal Regulations* (10 CFR) 71.73.

**Observations**

**Structural Evaluation**

1. Revise Section 2.7.13 of the application to provide a fuel basket stability evaluation for the pressurized-water reactor damaged fuel basket.

   For completeness, a geometric stability evaluation of the pressurized-water reactor damaged fuel basket is needed.

   This information is needed to confirm compliance with the requirements in 10 CFR 71.7(a), and 71.73.

2. Revise Section 2.12.2.3, "Benchmarking of LS-DYNA Impact Limiter Analysis Methodology," to recognize, as appropriate, that there were two series of scale-model impact limiter tests performed for the Model No. NAC-STC transportation package. The revision should include: (1) ascertaining the use of balsa wood LS-DYNA material models for individual scale-model tests used in benchmarking modeling approaches for specific drop orientations, and (2) modifying, and annotating the sketches in Figures 2.12.2-6 through 2.12.2-8 to depict the applicable impact limiter designs/orientations tested.

Figures 2.12.2-6, 2.12.2-7, and 2.12.2-8 appear to depict two different impact limiter designs: NAC-STC and NAC-STC-CY impact limiters for which scale-model drop test data were used to benchmark the modeling approaches to calculating package rigid body response for the side- and end/corner-drop events, respectively. However, starting with "Introduction" of the section, there is a lack of clarity in describing which parts of the two tests were considered in the benchmarking associated with the balsa wood material performance being represented by LS-DYNA material model Mat_Honeycomb or Mat_026. Specifically, in Figure 2.12.2-6, sketches should be properly annotated to depict that only the side-drop and slapdown-drop of the NAC-STC impact limiter are considered for model benchmarking, which would be used for analyzing the MAGNATRAN package side-drop accident. Conversely, if the NAC-STC-CY impact limiter scale model was only tested for the end and corner drops, sketches similar to those of Figure 2.12.2-6 on drop orientations should also be presented to facilitate staff review.

This information is needed to confirm compliance with the requirements in 10 CFR 71.7(a).

3. Correct the following underscored typographical or editorial errors, as appropriate:
   a. On page 2.6.7.5-6, "The drop orientations considered in the evaluation….are shown in Figure 2.6.7-7."
   b. On page 2.7.1.4-1, "As shown in Table 2.6.7-37 for the accident conditions, the side drop accelerations bound the accelerations of the end drop and corner drop orientations."
   c. On page 2.7.13.1-6, "The acceleration used to evaluate the TSC shell displacement has a factor of 1.3."
   d. On page 2.12.2-21, "A comparison of test results and analysis results is tabulated in Table 2.12.2-1."

This information is needed to confirm compliance with the requirements in 10 CFR 71.7(a).

**Shielding Evaluation**

1. Revise the shielding evaluation to ensure that the physical characteristics of the hybrid fuel assemblies represent or bound the proposed contents from Section 1.3.2. In addition, provide the non-proprietary fuel specifications for both pressurized-water reactor and boiling-water reactor hybrid fuel assembly categories used to analyze the proposed package contents.

   It does not appear that the contents used in the shielding evaluation adequately represent the desired contents in Chapter 1. For example, the maximum masses of the B&W15 and B&W17 fuel assembly in Chapter 1 are 0.5006 MTU and 0.4799 MTU, respectively, whereas the masses that appear to be evaluated in Chapter 5 are 0.4801 and 0.4681 for the respective fuel assemblies. The maximum uranium loading is an important parameter for the shielding evaluation.

   The application includes only some of the assembly parameters that are needed to define the characteristics of each hybrid fuel assembly category defined in the shielding evaluation. The application should include the assembly parameters that are necessary to completely define the hybrid assembly categories, including rod pitch, fuel rod outer diameter, cladding outer and inner diameter, and guide/instrument tube inner and outer diameter.

This information is needed to confirm compliance with the requirements in 10 CFR 71.33, 71.47, and 71.51.

2. Revise Chapter 5 to ensure that the description and shielding evaluation of all non-fuel hardware components is complete. As a minimum, provide the following additional detail and evaluations for the proposed non-fuel hardware contents:
   a. Materials of construction and masses for each assembly zone (i.e., top end fitting, upper plenum, active fuel zone, etc.),
   b. Evaluations and results that provide the source term for each assembly zone,
   c. Evaluations that address the activation of neutron source assembly hardware for those that do not include thimble plugs or burnable absorber rodlets, and
   d. Evaluations that address axial dose rates from neutron source assemblies.

   Some mass information is provided for some of the proposed non-fuel hardware contents; however the materials comprising that mass in each zone are not described. Additionally, the application proposes to include Hafnium Flux Reduction Assemblies as allowable contents but does not include information on the materials and masses in each assembly zone. The application evaluates the gamma source for neutron source assemblies that include absorber rodlets or thimble plugs. However, neutron source assemblies without these features also have hardware components that are activated and result in a gamma source. The application should address this gamma source and provide a description of the activated neutron source assembly components (e.g., materials and masses in the different assembly zones) similar to what is done for other proposed non-fuel hardware contents. Additionally, the neutron source assemblies may have impacts on axial dose rates that should be evaluated in the application. The current application appears to only address radial dose rates. The application should clearly explain the physical distribution of the non-fuel hardware source terms (i.e., the source strength in each assembly zone).

   This information is needed to confirm compliance with the requirements in 10 CFR 71.33, 71.47, and 71.51.

**Criticality Evaluation**

1. Verify that whenever a Westinghouse 15x15 fuel assembly with an enrichment of up to 3.8 weight percent $^{235}U$ is transported with no burnup credit, that a rod cluster control assembly (RCCA) with a maximum exposure of 200,000 MWd/MTU is required for the criticality safety of the package(s). It appears that a maximum of nine of these assemblies can be transported in a single package.

   The safety analysis report for the MAGNATRAN spent fuel transportation package states that "A maximum of nine RCCA assemblies may be loaded in MAGNATRAN." However, for nuclear criticality safety, the important limit is the minimum number of RCCA assemblies required for the package to meet the criticality safety requirements. NRC staff want to ensure that, based on the criticality analyses, any time one of these fuel assemblies is shipped that a rod cluster control assembly is required.

   This information is needed to confirm compliance with the requirements in 10 CFR 71.55 and 71.59.

2. Provide applicable critical experiments for criticality safety analysis computer code benchmarking for packages containing RCCA inserts.

   The safety analysis report selected critical experiments for criticality safety analysis computer code benchmarking. However, it is not clear if the selected critical experiments will be applicable to the packages containing RCCA inserts as criticality control. The applicant is requested to provide justification for the adequacy of the selected critical experiments for criticality safety analysis computer code benchmarking for packages containing RCCA inserts.

   This information is needed to confirm compliance with the requirements in 10 CFR 71.55 and 71.59.

**Acceptance Tests**

1. Confirm the appropriateness of using a dry steam methodology in the thermal acceptance test.

   There are a number of issues that need to be resolved in order to confirm that the acceptance test would provide valid results/conclusions:

   a) The energy balance provided in Section 8.7.1 of the safety analysis report only includes the effect of the condensate. There is no explanation describing why other energy components were not included, including exit steam quality, exit steam temperature, uniformity (if any) of the exit steam's saturation, etc.
   b) Justify the appropriateness of using a surface temperature, which is influenced by local ambient conditions, to confirm steady state operation, which is necessary to achieve meaningful results. It is expected that more thermocouples, including some placed axially as well as the top, bottom, and sides of the vessel, would be added. All of the thermocouples would need to be "steady" in order to have an indication of a steady-state process.
   c) Calculations/analyses with assumed test parameters (using an analytical tool such as a spreadsheet or other mathematical software) is presumed to have been performed to confirm the feasibility of the acceptance test procedure and assess the sensitivity of test results to perturbations in the test conditions. Results of this study should be provided.

   Note: The test description is very brief. It is critical to have accurate temperature and flow measurement. Weighing the collected water might be appropriate, but there would be an inevitable time-lag in the data. This is an additional source of uncertainty/sensitivity that needs to be considered in the calculation spreadsheet analysis.

   This information is needed to confirm compliance with the requirements in 10 CFR 71.43 and 71.87.