Request for Additional Information
Docket No. 71-9235
Model No. STC Package

By letter dated May 9, 2022 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML22130A774), NAC International (NAC, the applicant) submitted an application to amend Certificate of Compliance No. 9235 for the Model No. STC package to credit the flexural rigidity of the fuel pellet using the guidance in NUREG-2224 to revise high burnup fuel discussions in safety analysis report chapters 2 and 3. This request for additional information letter identifies information needed by the U.S Nuclear Regulatory Commission staff in connection with its review of the application. NUREG-2216, "Standard Review Plan for Transportation Packages for Spent Fuel and Radioactive Material," was used by the staff in its review of the application.

Each individual RAI describes information needed by the NRC staff to complete its review of the application to determine whether the applicant has demonstrated compliance with the regulatory requirements.

Structural Review

2.1 Provide responses to the following questions related to Safety Analysis Report (SAR) Section 2.13.6.15.2, "Fuel Rod Assessment for HBU Fuel for 30-foot Side Drop," Revision 22A:

a. Describe how the maximum stress on SAR page 2.13.6-55, Revision 22A was calculated,
b. Justify the dynamic load factor (DLF) of [ ] used in the stress calculation, explain the effects of the DLF on the HBU fuel rods, and provide the technical justifications for not using the DLF of 2.0 recommended in NUREG-2224,
c. Provide a benchmark study between a response spectra analysis and a physical model test that demonstrates the use of a response spectra analysis is a valid method to represent HBU fuel rod behavior in a cask under 30-foot side drop conditions, and
d. Justify the factor of [ ] used in calculating the HBU rod moment of inertia when a response spectra analysis is used.

In Revision 22A of the SAR, the applicant recalculated the maximum fuel rod stresses following the guidance in NUREG-2224 Section 2.3.3 (Reference 2.2) and using a response spectra analysis with the ANSYS finite element computer program. The maximum stress calculated in this manner increased by approximately twenty-one percent versus the maximum fuel rod stress calculated in SAR Section 2.13.6.15.2, "Fuel Rod Assessment for HBU Fuel for 30-foot Side Drop," Revision 20 (Reference 2.1). The staff did not find a detailed discussion in Revision 20 of the SAR of how the maximum stress value was calculated, and Revision 22A of the SAR does not contain a detailed discussion that explains the increased maximum stress values versus Revision 20 of the SAR. Therefore, the staff needs more information to understand how the maximum stress was calculated in Revision 22A.

A HBU fuel assembly system has characteristics that are dependant on the physical characteristics of the fuel assembly, the fuel rod, the cask, and the impact limiters (e.g., natural frequency, load duration and load time history shape). The staff is uncertain if a response spectra analysis is appropriate in evaluating a HBU fuel assembly system. Therefore, the staff requests the applicant provide a benchmark study between a response spectra analysis and a physical model test, or similar information, that demonstrates the use of a response spectra analysis is a valid method to represent HBU fuel rod behavior in a cask under 30-foot side drop conditions.

In addition, the guidance in Section 2.3.5.2 of NUREG-2224 (Reference 2.2) suggests the use of a DLF of 2.0 to account for uncertainties involved in natural frequency, load duration, and load time history shape which depend on the physical characteristics of the fuel assembly, the rod, the cask and the impact limiters. However, the applicant used a DLF of [ ] in the stress calculation, which implies that there are [ ] on a HBU fuel system in a cask during a drop. Therefore, the staff requests the applicant justify not using the DLF of 2.0 recommended in NUREG-2224.

This information is needed to verify compliance with Title 10 of the *Code of Federal Regulations* (10 CFR) Part 71.73(c)(1).

2.2 Explain the small maximum strain of 0.002% for Case No. 6 shown in the SAR table on page 2.13.6-59, Revision 22A.

In SAR Section 2.13.6.15.4, “Fatigue Evaluation for HBU Fuel for Normal Conditions of Transport,” Revision 22A, the applicant provided the maximum fuel cladding stresses and strains during normal conditions of transport shown below. Those values are from the response spectrum analyses performed on the Westinghouse 17×17 fuel rods using the data from seven test cases as documented in the Data Analysis of ENSA/DOE) Rail Cask Tests (Reference 2.3). The staff wants to understand why the calculated strain value of 0.002% is extremely small for Case No. 6 compared with other cases.

Case No.	**Max Stress (ksi)**	**Max Strain (%)**
1	0.95	0.009
2	1.74	0.016
3	2.10	0.019
4	2.05	0.019
5	3.41	0.031
6	2.15	0.002
7	2.83	0.026

This information is needed to determine compliance with 10 CFR 71.71(c)(5).

2.3 Provide responses to the following questions related to SAR Section 2.13.6.15.2, “Fuel Rod Assessment for HBU Fuel for 30-foot Side Drop,” Revision 22A:

a. Justify the use of different spacer grid locations in the end drop model as compared to the side drop and fatigue models,
b. Explain the different factor used in the moment of inertia calculation for the side drop and fatigue models versus the end drop model, and
c. Explain the use of different cladding stress allowables in the end drop and side drop analyses.

The SAR, Revision 22A, evaluates the Westinghouse 17×17 as the bounding HBU fuel rod geometry for the side drop, end drop, and normal conditions of transport fatigue models, but some parameters are different between the models. Provide an explanation for the different spacer grid geometry used and the different material assumptions made to allow the staff to evaluate the analysis.

This information is needed to determine compliance with 10 CFR 71.71(c)(5) and 10 CFR 71.73(c)(1).

2.4 Explain the loading inputs evaluated in SAR Section 2.13.6.15.4, “Fatigue Evaluation for HBU Fuel for Normal Conditions of Transport,” Revision 22A.

Seven shock response spectra from recent rail cask testing (Reference 2.3) were selected as input loading cases for the HBU fuel rod model. However, there is no discussion in Revision 22A of the SAR why these cases were selected from the 10 test cases documented in the reference. The staff also noted that the three cases not selected exhibited the highest maximum accelerations on the instrumented fuel assemblies (Figures 5-183 and 5-184, Reference 2.3). In addition, there is no discussion in Revision 22A of the SAR on how data from the package used in this test campaign is applicable to the NAC-STC package.

This information is needed to determine compliance with 10 CFR 71.71(c)(5).

References:

2.1 NAC International, Safety Analysis Report (SAR) for the NAC Storage Transport Cask (NAC-STC), Revision 20, July 2019.

2.2 NUREG-2224, Dry Storage and Transportation of High Burnup Spent Nuclear Fuel – Final Report, November 2020.

2.3 SAND2018-13258R, Data Analysis of ENSA/DOE Rail Cask Tests, Spent Fuel and Waste Disposition, US Department of Energy, Spent Fuel and Waste Science and Technology, November 2018.

Materials Review

6.1 Justify the flexural rigidity factor applied to the bending response of the M5 fuel cladding.

The structural analysis of the fuel cladding credits the flexural rigidity supplied by the fuel pellet, as described in NUREG-2224. The staff notes that the rigidity factor used in the calculation was not derived from testing of M5 cladding, and new data exists that may be informative of the fuel pellet contribution to M5 fuel flexural response (ORNL/SPR-2020/1780 Revision 1, “Sister Rod Destructive Examinations (FY21) – Appendix F: Cyclic Integrated Reversible-Bending Fatigue Tests,” Oak Ridge National Laboratory, March 31, 2022.).

This information is needed to ensure that the package meets the requirements of 10 CFR 71.71 and 10 CFR 71.73.