Request for Additional Information
for the Review of the
Model No. TN-40 Package
Docket No. 71-9313

By letter dated December 16, 2021 (Agencywide Documents Access and Management System Package Accession No. [ADAMS] ML21350A282), TN Americas LLC submitted an amendment request for Revision No. 4 to Certificate of Compliance No. 9313 for the Model No. TN-40 package. The application was accepted, with Observations, for a detailed technical review on June 15, 2022 (ADAMS ML22164A321)

This request for additional information (RAI) identifies information needed by the staff in connection with its detailed review of the application.

Each individual RAI describes information needed by the staff to complete its review of the application and to determine whether the applicant demonstrated compliance with the regulatory requirements of Title 10 of the Code of Federal Regulations (10 CFR) Part 71.

CHAPTER 2 STRUCTURAL AND MATERIALS EVALUATION

2.1 Justify the use of a 25% flexural rigidity increase when stress and strain of the fuel rod were calculated during the 30-ft end drop under hypothetical accident conditions (HAC) and provide the maximum principal strain of the fuel rod without the use of the 25% flexural rigidity increase.

Subsection 2.10.7.2.2, “TN-40 Fuel End Drop Analysis,” of the SAR, Revision 17A (Reference 2.1) indicates that a 25% flexural rigidity increase was used to calculate stress and strain of the fuel rod during the 30-ft end drop under HAC. The 25% flexural rigidity increase was based on a statement in NUREG-2224 (Reference 2.2) for the purpose of calculating lateral displacements. It would be important to consider flexural rigidity of the fuel rod under a side drop, where bending dominates the structural responses. However, flexural rigidity of the fuel rod may not be significant under an end drop, where axial compression and the associated buckling of the fuel rod dominate the structural responses. The staff requests a justification for the use of a 25% flexural rigidity increase to calculate stress and strain of the fuel rod during the 30-ft end drop under HAC and provide the maximum principal strain of the fuel rod without the use of the 25% flexural rigidity increase in the analysis.

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

2.2 Provide a buckling analysis and buckling load of the fuel rod with an initial gap of 1.45 in. between the bottom of the fuel rod and the cask.

A stress analysis was performed to calculate the maximum principal strain of the fuel load during the 30-ft end drop under HAC in Subsection 2.10.7.2.2, “TN-40 Fuel End Drop Analysis,” of the SAR, Revision 17A. However, it appears that there is no buckling analysis performed. Since axial compression and the associated buckling of the fuel rod dominate the structural responses, the staff requests a demonstration of the structural adequacy of the fuel load with respect to buckling during the 30-ft end drop under HAC.

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

2.3 Provide responses to the following questions related to Subsection 2.10.7.2.2, "TN-40 Fuel End Drop Analysis," of the SAR, Revisions 16 (Reference 2.3) and 17A:

(a) Provide (i) the maximum principal stress, and (ii) the calculated maximum stress and strain in the three-dimensional (3-D) cylindrical coordinate system.

(b) Provide a factor of safety (FS), which is defined as a ratio of the maximum stress with respect to the yield stress of the fuel rod. If the calculated FS is less than 1.0, explain why the fuel rod is structurally adequate during the 30-ft end drop under HAC.

(c) Explain how the initial gap size (i.e., 0.04 in., 0.5 in., 1.0 in., and 1.45 in.) influences and attributes to the different stress and strain in the fuel rod.

The table below presents the results of the stress analysis from Subsection 2.10.7.2.2, "TN-40 Fuel End Drop Analysis," of the SAR, Revisions 16 and 17A.

Case No.	Initial Gap between Pin and Cask (in.)	Internal Pressure (psi)	Maximum Principal Strain (%)
1	0.04	0	0.35
2	0.04	1,400	0.37
3	0.50	1,400	0.47
4	1.00	1,400	0.70
5	1.45	1,400	1.42

The table only presents the results of the maximum principal strain. It is requested that the applicant provide (i) the maximum principal stress, (ii) the calculated maximum stress and strain in the three-dimensional (3-D) cylindrical coordinate system (i.e., longitudinal, rotations and radial directions), and (iii) the calculated FS in a tabular form for all five (5) cases.

Additionally, explain how the initial gap size (i.e., 0.04 in., 0.5 in., 1.0 in., and 1.45 in.) influences and attributes to the different stress and strain in the fuel rod. It is staff's understanding that the methodology and assumptions used for all five cases are similar and the only main difference is the initial gap size. It is not clear how the gap size induces the different stress and strain, especially an elastic behavior to a plastic behavior of the fuel rod during the 30-ft end drop. It is requested that the applicant explain how the initial gap size (i.e., 0.04 in., 0.5 in., 1.0 in., and 1.45 in.) influences and attributes to the different stress and strain in the fuel rod during the 30-ft end drop under HAC.

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

References:

2.1 TN Application for Revision 4 to Certificate of Compliance No. 9313 for the Model No. TN-40 Packaging, Docket No. 71-9313, December 16, 2021.

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

2.3 TN-40 Transportation Packaging Safety Analysis Report, Revision 16, June 2011.

2.4 Provide a description of the non-destructive evaluations (NDE) performed on the base materials for the containment boundary components and a justification for why the NDE performed is sufficient in lieu of leakage testing**.**

In Section 1.2.1.1, “Containment Vessel” of the SAR, the applicant states that the inner shell, bottom inner plate, lid outer plate will be examined in accordance with Subsection NB of the ASME Code to the maximum extent practicable. However, the actual NDE that was performed on these components is not described in the application.

NUREG-2216, Section 7.4.2.2 describes the ASME Code requirements for fabrication of components. A fabrication leakage test of the containment boundary seals is specified as a way of meeting the requirement for leak testing in compliance with ANSI N14.5.

However, leak tests are not performed on the base materials of the components that provide a containment function (inner shell, bottom inner plate, lid outer plate, and shell flange) in accordance with ANSI N14.5.

This information is needed to determine compliance with 10 CFR 71.31(c), 71.43(f), and 71.51.

RAI letter for the Model No. TN40 package DATE February 9, 2023

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