



UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

SAFETY EVALUATION REPORT
Docket No. 71-9358
Model No. TN-LC Package
Certificate of Compliance No. 9358
Revision No. 8

SUMMARY

By letter dated February 15, 2023 (Agencywide Documents Access and Management System [ADAMS] Accession No. ML23046A179), TN Americas LLC (TN) submitted an application to revise Certificate of Compliance (CoC) No. 9358 for the TN-LC packaging. The amendment request introduced top and bottom damaged fuel ends caps (for damaged Pressurized Water Reactor (PWR) fuel assemblies) in lieu of the Fuel Assembly Can (FAC) that had been previously approved.

The applicant had found out that the required dimensions for the FAC were so close to the compartment opening dimensions that the FAC will not reasonably fit into the basket. On March 1, 2023, the applicant replaced Drawing Number 65200-71-92 Revision 0A with a new Revision 0B to allow the fabrication of the TN-LC damaged fuel end caps in one single machined piece; this change was made to facilitate the fabrication of the end caps by eliminating welding.

On May 19, 2023 (ADAMS No. ML23139A205), the applicant provided responses to staff's request for additional information (RAI) letter dated May 15, 2023 (ADAMS Accession No ML23121A133 and ML23121A134)

By letter dated June 27, 2023 (ADAMS No. ML23178A119), the applicant provided a consolidated application Revision No. 11.

Based on the statements and representations in the application, and the conditions listed in the CoC, the U.S. Nuclear Regulatory Commission staff (the staff) concludes that the package meets the requirements of Title 10 of the *Code of Federal Regulations* (10 CFR) Part 71.

EVALUATION

1. GENERAL INFORMATION

The TN-LC packaging has been developed for exclusive-use transport of irradiated test, research, and commercial reactor fuel, including several types of Boiling Water Reactor (BWR), PWR, Mixed Oxide Fuel, and Evolutionary Pressurized Reactor fuel assemblies and/or fuel pins. Additional payloads include National Research Universal Reactor, National Research Experimental Reactor, Material Test Reactor (MTR), and Training, Research and Isotope, General Atomics Reactor (TRIGA) fuel assemblies and fuel elements. The fuel is contained in specific baskets which fit into the TN-LC transport cask. The TN-LC transport package is limited to a maximum heat load of 3.0 kW depending on the fuel and basket being transported.

Editorial corrections were made in the application, including for example changing the term “failed” to “damaged” in appendix 6.10.5 of the application: There is no failed fuel transported in the TN-LC, only damaged fuel. Damaged fuel assemblies are defined as having the same configuration as intact fuel assemblies, except they contain missing or partial length or dummy fuel rods with cladding defects greater than hairline cracks or pinhole leaks. End caps are now used to transport those assemblies.

The applicant updated Note 7 of Drawing 65200-71-90 to (i) specify the maximum allowed axial gap (1 inch) between the basket and the cavity, (ii) state the direction of the gap, as well as between which components this gap needs to be verified. Drawing 65200-71-90 has been revised to Revision 9. Note 3 of Drawing 65200-71-92 has been updated to mention American Welding Society (AWS) D1.6 instead of AWS D1.3.

Drawing 65200-71-90 has been revised to change the quality category of the studs (Item 3) and the nuts (Item 7) to ITS Category C, to provide the size and material specification of the studs and nuts (Items 3 and 7), and to clarify on detail B that the studs are welded to the basket plates.

The packaging is constructed and assembled in accordance with the following Drawing Nos.:

65200-71-01 Revision 10	TN-LC Cask Assembly (11 sheets)
65200-71-20 Revision 5	TN-LC Impact Limiter Assembly (3 sheets)
5200-71-21 Revision 2	TN-LC Transport Packaging Transport Configuration (1 sheet)
65200-71-40 Revision 4	TN-LC-NRUX Basket - Basket Assembly (5 sheets)
65200-71-50 Revision 4	TN-LC-NRUX Basket - Basket Tube Assembly (5 sheets)
65200-71-60 Revision 4	TN-LC-MTR Basket General Assembly (4 sheets)
65200-71-70 Revision 4	TN-LC-MTR Basket Fuel Bucket (2 sheets)
65200-71-80 Revision 4	TN-LC-TRIGA Basket (5 sheets)
65200-71-90 Revision 9	TN-LC-1FA Basket (5 sheets)
65200-71-96 Revision 5	TN-LC-1FA BWR Sleeve and Hold-Down Ring (2 sheets)
65200-71-102 Revision 7	TN-LC-1FA Pin Can Basket (5 sheets)
65200-71-92 Revision 0	TN-LC-1FA PWR Basket Damaged fuel end caps (1 sheet)

2. STRUCTURAL EVALUATION

The objective of the structural evaluation is to verify that the applicant has adequately evaluated the structural performance of the package (packaging together with contents) and demonstrated that it meets the regulations in 10 CFR Part 71, “Packaging and Transportation of Radioactive Material.”

This section of the safety evaluation report documents the staff’s reviews, evaluations, and conclusions with respect to structural integrity of the amended transport package.

2.1 Description of the Amendment to the Structural Design

This amendment requests to use the top and bottom damaged fuel end caps in lieu of the previously approved FAC design for transporting damaged PWR fuel assembly, because the FAC cannot be installed into the 1FA basket due to fit-up problems. As described in the safety analysis report (SAR) rev. 11A of the application and SAR rev. 11B documents submitted with the responses to the RAI, the top

and bottom damaged fuel end caps are stainless steel square-section structures, each made of a short sheet metal liner, and a closure plate welded to this liner. The top end cap assembly simply sits within the recess at the top of the basket, above the fuel assembly, which itself sits on top of the bottom end cap assembly, which rests on the bottom of the cask. The TN-LC transport cask, the 1FA basket assembly, fuel contents and other associated components remain unchanged.

In addition, the applicant revised one of the drawings to correct misalignment of the note numbers with the notes.

2.2 Evaluation

For this structural review, the staff focused primarily on any changes to the structural behavior of the packaging that the use of the damaged fuel end caps could have on the TN-LC cask design. Any changes in the configuration, weight, and ability of the damaged fuel end caps to confine the new payload under Normal Conditions of Transport (NCT) and Hypothetical Accident Condition (HAC) are evaluated.

The cover plates of the top and bottom end caps are design features of the packaging that ensure that any fuel material is always confined within the basket compartment, and that fuel material cannot be released outside the basket compartment into the space between the 1FA basket and the TN-LC inner cavity. Per section 1.4.5.2.1 of the application, and as shown on Drawing 65200-71-92, both end caps can freely slide (i.e., they are not mechanically attached to the basket or the cask) along the axis of the cask but are restrained by the basket compartment walls in any direction perpendicular to the axis of the cask cavity.

However, neither end cap can come off of the basket compartment once the cask is closed because the maximum axial gap limit (1 inch) between the basket and the cask cavity is smaller than either the minimum thickness (1.2 inches) of the top end cap plate, or the combined thickness (1.20 inches) of the bottom end cap plate and its spacers including fabrication tolerance. The liners simply cover the slots through the basket walls and help the end caps remain straight as they slide within the compartment.

In table 1.4.5-1 of the application, the applicant identifies the maximum weight of the PWR fuel payload, including the damaged fuel end caps, as 1850 pounds. The weight of the 1FA basket without payload is 4200 pounds per Drawing 65200-71-90, rev. 8.

The staff found that the combined weight of the 1FA basket assembly with its payload including the damaged fuel end caps is less than 6061 pounds, which was the bounding weight accepted in previous structural analyses and evaluations, as provided in table 2 through 10 of the application. Since there is no design change to the 1FA basket and the TN-LC cask, the previous evaluations for the cask and the basket remain applicable for the damaged PWR fuel transport under NCT and HAC.

For side drops under NCT and HAC, both the cover plates of the top and bottom end caps are supported by basket walls. Also, both plates are not slender; therefore, there is no risk of buckling of the plates. For an end drop on the lid, the top end cover plate supports the fuel assembly including the bottom end cap, which in turn transfers this load through bearing on the shielding cap supported by the TN-LC lid. The staff concludes that top cover plate is structurally adequate to carry this load, since the top cover plate is of the same material as that of the

shielding cap and the payload, including the top and bottom end caps, remains bounded by that considered in the initial qualification of the cask lid.

For an end drop on the lid, the PWR fuel assembly is loaded with the bottom end cap, which weighs less than 30 pounds. The structural integrity of the PWR payload fuel assembly and fuel elements during NCT side and end drops was originally evaluated in appendix 2.13.11 of the application. The results of the original analysis indicate that the maximum principal strain in 14x14 fuel rod is 0.206 percent, which is far less than the corresponding yield strain of 0.970 percent.

Considering the magnitude of the additional load on a fuel rod assembly and the margin available in the original analysis to absorb additional strain, the staff expects the PWR fuel assembly to maintain its structural integrity under NCT. The staff notes that this evaluation is intended to provide additional assurance that the fuel geometry will be maintained for the analyzed loads under NCT.

However, the structural integrity of fuel/element geometry as demonstrated is not required under NCT and HAC in the criticality and thermal analyses as described in section 2.13.11.6 of the application. But it requires each fuel element/assembly to be confined within the corresponding fuel/element compartments. The presence of the damaged fuel end caps confines the fuel assembly rods and any fuel debris from a damaged fuel assembly within the 1FA basket compartment and does not change the assumptions for fuel rearrangement that are used in the criticality evaluation.

In addition, the applicant revised Drawing No. 65200-71-90 sheet 1 to correct misalignment of the note numbers and the notes. Also, several sections of the application have been revised to correct misprint errors and to resolve minor discrepancies between the application and supporting documents. The staff's review of these changes established that these are editorial changes and do not affect any important to safety component design. The staff addressed these changes here for completeness of staff's evaluation of this amendment request.

2.3 Evaluation Findings

Based on review of the statements and representations in the application, the staff concludes that the use of the top and bottom damaged fuel end caps is adequately described and evaluated to demonstrate that the package continues to perform its original safety function and meets the structural integrity requirements of 10 CFR Part 71.

CONDITIONS

The following changes were made to the Conditions of the certificate:

Item No. 3.b reflects the latest revision, rev.11, of the application dated June 2023.

Condition No. 5(a)(3) was modified to include revision 9 of licensing drawing 65200-71-90 and revision 0 of the new licensing drawing 65200-71-92 for the TN-LC-1FA PWR Basket Damaged Fuel End Caps.

Condition No. 5(b)(1) was modified to replace the wording of "Fuel Assembly Can" with "damaged fuel ends caps".

Condition No. 5(b)(2) was modified to replace the wording “Fuel Assembly Can” with “damaged fuel end caps”. Condition No. 11 authorizes the previous revision of the certificate for approximately one more year.

The expiration date of the certificate was not changed. The reference section of the certificate was modified to indicate Revision No. 11 of the consolidated application, dated June 2023.

CONCLUSION

Based on the statements and representations in the application, the staff finds that these changes do not affect the ability of the package to meet the requirements of 10 CFR Part 71.

Issued with CoC No. 9358, Revision No. 8.