CERTIFICATE OF COMPLIANCE
FOR RADIOACTIVE MATERIAL PACKAGES

1. a. CERTIFICATION NUMBER	b. REVISION NUMBER	c. DOCKET NUMBER	d. PACKAGE IDENTIFICATION NUMBER	PAGE	PAGES
9382	1	71-9382	USA/9382/B(U)F-96	1 OF	8

2. PREAMBLE

a. This certificate is issued to certify that the package (packaging and contents) described in Item 5 below meets the applicable safety standards set forth in Title 10, Code of Federal Regulations, Part 71, "Packaging and Transportation of Radioactive Material."

b. This certificate does not relieve the consignor from compliance with any requirement of the regulations of the U.S. Department of Transportation or other applicable regulatory agencies including the government of any country through or into which the package will be transported.

3. THIS CERTIFICATE IS ISSUED ON THE BASIS OF A SAFETY ANALYSIS REPORT OF THE PACKAGE DESIGN OR APPLICATION.

a. ISSUED TO (Name and Address)

TN Americas LLC
7160 Riverwood Drive, Suite 200
Columbia, MD 21046

b. TITLE AND IDENTIFICATION OF REPORT OR APPLICATION

TN Eagle Safety Analysis Report
Revision No. 1, dated February 20, 2025.

4. CONDITIONS

This certificate is conditional upon fulfilling the requirements of 10 CFR Part 71, as applicable, and the conditions specified below.

5.

(a) Packaging

(1) Model Nos: TN Eagle SC, TN Eagle LC

(2) Description: TN Eagle SC and TN Eagle LC

The packaging, designed for the transport of spent fuel stored in dry shielded canisters (DSCs), consists of a forged cask body equipped with a stack of neutron shielding rings shrink fitted onto its outer surface, a bolted steel lid, a steel bottom closure plate, and impact limiters. The bottom of the forged cask has an opening provided for the hydraulic ram access penetration of the cask for DSC loading and unloading operations. The ram access cover plate is part of the bottom closure system and is equipped with inner and outer elastomeric seals. The top and bottom impact limiters are composed of a steel casing enclosing aluminum honeycomb block, neutron shielding resin, and a stainless-steel adapter serving as the interface between the cask and the blocks of aluminum honeycomb. A layer of neutron shield resin is placed in the adapter of the impact limiter for additional shielding.

To accept varying DSC lengths, spacers are used (if needed) to limit the axial movement of the payload. In addition, a hollow bottom spacer (to accommodate for the ram access) may be used depending on the DSC length. The containment boundary is defined by the forged cask body, the primary lid and its inner fluorocarbon seals, the lid port plug and its metallic seal, the ram access cover plate, and its inner-fluorocarbon seal.

5.(a)*(2)* Description (continued)

The TN Eagle SC (Standard Canister) and TN Eagle LC (Large Canister) have the same overall dimensions except for the SC version with Type C1 neutron shielding rings because of its slightly larger outer diameter. However, because of different outside diameters for the DSCs, an inner sleeve is used for smaller diameter DSCs for the TN Eagle SC. The thickness of the forged cask body is different for the TN Eagle SC and TN Eagle LC to allow the loading of larger diameter DSCs.

The EOS-37PTH and EOS-89BTH DSCs are transported in the TN Eagle LC, while the 32PT, 32PTH1, 24PT1, 24PT4, and the Fuel-Only (FO) the Fuel/Control Components (FC), and the Failed Fuel (FF) DSCs are transported in the TN Eagle SC.

For both models, the packaging overall length is 8114 mm (319.45 in.) with the impact limiters and 5612 mm (220.95 in.) without the impact limiters, and the impact limiter outside diameter is 3550 mm (139.76 in.) or 3568 mm (140.47 in.) for the SC version with type C1 neutron shielding rings. The forged cask body outside diameter is 2142 mm (84.33 in.). The TN Eagle SC has (i) a forged cask body inner diameter of 1850 mm (72.83 in.), (ii) a cavity length of 5061 mm (199.25 in.), and (iii) and empty weight of 90,000 kg (198,416 lb). The TN Eagle LC has (i) a forged cask body inner diameter of 1940 mm (76.38 in.), (ii) a cavity length of 5086 mm (200.25 in.), (iii) and an empty weight of 87,400 kg (192,684 lb).

The weight of the impact limiters for both the TN Eagle SC and the TN Eagle LC is 10,200 kg (22,487 lb). The maximum weight of the contents is 55,200 kg (121,695 lb) for the TN Eagle LC and 53,400 kg (111,727 lb) for the TN Eagle SC. The maximum gross weight is 163,000 kg (359,574 lb) for the TN Eagle LC and 164,000 kg (361,558 lb) for the TN Eagle SC.

5.(a)(3) Drawings TN Eagle SC and TN Eagle LC

The package shall be constructed and assembled in accordance with the following TN Americas LLC, Drawing numbers:

<u>TN Eagle Package Drawings</u>

TN EAGLE01-1100 Rev 1	TN Eagle LC (Large Canister) and TN Eagle SC (Standard Canister) Transport Package (7 Sheets)

<u>EOS Drawings</u>

EOS01-71-1000 Rev 0	NUHOMS® EOS System Transportable Canister 37PTH DSC Main Assembly (7 sheets)
EOS01-71-1001 Rev 0	NUHOMS® EOS System Transportable Canister 37PTH DSC Shell Assembly (2 sheets)
EOS01-71-1005 Rev 0	NUHOMS® EOS System Transportable Canister 89BTH DSC Main Assembly (7 sheets)

5.(a)(3) Drawings, TN Eagle SC and TN Eagle LC (continued)

EOS01-71-1006 Rev 0	NUHOMS® EOS System Transportable Canister 89BTH DSC Shell Assembly (2 sheets)
EOS01-71-1010 Rev 0	NUHOMS® EOS System Transportable Canister 37PTH DSC Basket Assembly (15 sheets)
EOS01-71-1011 Rev 0	NUHOMS® EOS System Transportable Canister 37PTH Basket Transition Rails (6 sheets)
EOS01-71-1020 Rev 0	NUHOMS® EOS System Transportable Canister 89BTH DSC Basket Assembly (9 sheets)
EOS01-71-1021 Rev 0	NUHOMS® EOS System Transportable Canister 89BTH Basket Transition Rails (7 sheets)

24PT1 Drawings

NUH24PT1-71-1000 Rev 0	NUHOMS® 24PT1-DSC Main Assembly (6 sheets)

24PT4 Drawings

NUH24PT4-71-1001 Rev 1	NUHOMS® 24PT4 Transportable Canister for PWR Fuel Basket Assembly (5 sheets)
NUH24PT4-71-1002 Rev 1	NUHOMS® 24PT4 Transportable Canister for PWR Fuel Main Assembly (8 sheets)
NUH24PT4-71-1003 Rev 0	NUHOMS® 24PT4 Transportable Canister for PWR Fuel Failed Fuel Can (4 sheets)

32PT Drawings

NUH32PT-71-1000 Rev 1	NUHOMS® 32PT Transportable Canister for PWR Fuel Summary Dimensions (1 sheet)
NUH32PT-71-1001 Rev 2	NUHOMS® 32PT Transportable Canister for PWR Fuel Main Assembly (5 sheets)
NUH32PT-71-1002 Rev 2	NUHOMS® 32PT Transportable Canister for PWR Fuel Shell Assembly (3 sheets)
NUH32PT-71-1003 Rev 2	NUHOMS® 32PT Transportable Canister for PWR Fuel “A” Basket Assembly (16 Poison/16 Compartment Plates) (8 sheets)

5.(a)(3) Drawings, TN Eagle SC and TN Eagle LC (continued)

NUH32PT-71-1004 Rev 2	NUHOMS® 32PT Transportable Canister for PWR Fuel Aluminum Transition Rail – R90 (2 sheets)
NUH32PT-71-1005 Rev 2	NUHOMS® 32PT Transportable Canister for PWR Fuel Aluminum Transition Rail –R45 (1 sheet)
NUH32PT-71-1006 Rev 2	NUHOMS® 32PT Transportable Canister for PWR Fuel “A/B/C/D” Basket Assembly (20 Poison/12 Compartment Plates) (6 sheets)
NUH32PT-71-1007 Rev 2	NUHOMS® 32PT Transportable Canister for PWR Fuel “A/B/C/D” Basket Assembly (24 Poison/8 Compartment Plates) (8 sheets)

<u>FO and FC Drawings</u>

DWG-NUH24P-FOFC-71-1000 Rev 0	NUHOMS® FO-DSC & FC-DSC for PWR Fuel Main Assembly (5 sheets)

<u>FF Drawings</u>

DWG-NUH24P-FF-71-1000 Rev 0	NUHOMS® FF-DSC for PWR Fuel Main Assembly (5 sheets)

<u>32PTH1 Drawings</u>

NUH32PTH1-71-1000 Rev 2	NUHOMS® 32PTH1 Transportable Canister for PWR Fuel Main Assembly (4 sheets)
NUH32PTH1-71-1001 Rev 2	NUHOMS® 32PTH1 Transportable Canister for PWR Fuel Basket Shell Assembly (5 sheets)
NUH32PTH1-71-1002 Rev 2	NUHOMS® 32PTH1 Transportable Canister for PWR Fuel Shell Assembly (4 sheets)
NUH32PTH1-71-1003 Rev 3	NUHOMS® 32PTH1 Transportable Canister for PWR Fuel Basket Assembly (8 sheets)
NUH32PTH1-71-1004 Rev 2	NUHOMS® 32PTH1 Transportable Canister for PWR Fuel Transition Rails (7 sheets)
NUH32PTH1-71-1010 Rev 2	NUHOMS® 32PTH1 Transportable Canister for PWR Fuel Alternate Top Closure (6 sheets)

5.(b) Contents of Packaging

(1) Type and Form of Material

(a) Intact, damaged or failed unconsolidated Babcock and Wilcox (B&W) 15x15, Westinghouse (WE) 14x14, WE 15x15, WE 17x17, Combustion Engineering (CE) 14x14, CE 15x15 and CE 16x16 class PWR fuel assemblies (with or without control components) that are enveloped by the characteristics listed in Table 1.6.1-1 of the application are shipped in the EOS-37PTH DSC.

(b) Intact unconsolidated 7x7, 8x8, 9x9, and 10x10 BWR fuel assemblies (with or without channels) that are enveloped by the FA design characteristics listed in Table 1.6.2-1 of the application are transported in the EOS-89BTH DSC.

(c) Intact (including reconstituted) Westinghouse-CENP 16x16 (CE 16x16) and/or damaged or failed CE 16x16 FAs with Zircaloy or ZIRLO™ cladding and UO_2 or (U, Er)O_2 or (U, Gd)O_2 fuel pellets can be transported in the 24 PT4 DSC with the characteristics in Appendix 1.6.3 of the application. Assemblies are with or without integral fuel burnable absorber rods or integral burnable poison rods.

(d) Intact PWR fuel assemblies with or without control components; damaged and failed fuels, loaded in an FFC, are allowed for the CE 14x14 fuel class in the 24-poison plate configuration with the characteristics described in Appendix 1.6.4 of the application.

(e) Intact (including reconstituted) PWR fuel assemblies with or without control components; damaged fuel is allowed in the 32PTH1 DSCs with the characteristics described in Appendix1.6.5 of the application.

(f) Intact WE 14x14 PWR fuel assemblies; UO_2 (stainless steel clad) and Mixed Oxide Zircalloy Clad (MOX UO_2 and PuO_2) fuel assemblies with or without integral control components in the 24PT1 DSC are allowed with the characteristics described in Appendix 1.6.7 of the application. Up to four stainless steel clad damaged or failed FAs in the 24PT1-DSC. A single damaged or failed WE 14x14 MOX FA in the 24PT1-DSC with no other damaged/failed assemblies.

(g) Intact, damaged or failed B&W 15x15 PWR fuel assemblies with or without control components can be transported in the FO/FC/FF DSCs with the characteristics in Safety Analysis Report Appendix 1.6.6.

(2) Maximum quantity of material per package:

(a) 37 PWR fuel assemblies in the TN Eagle LC with the EOS-37PTH DSC and a maximum heat load of 38.4 kW.

5.(b)(2) Contents of Packaging (continued)

(b) 89 BWR fuel assemblies in the TN Eagle LC with the EOS-89BTH DSC and a maximum heat load of 31.15 kW.

(c) 24 intact, damaged, or failed PWR fuel assemblies in the TN Eagle SC with the 24PT4 DSC. Alternatively, up to 12 damaged or failed fuel assemblies in FFC canisters with the balance being loaded with intact fuel. Maximum heat load of 1.26 kW per assembly and a maximum heat load of 24 kW per DSC.

(d) 32 PWR fuel assemblies in the TN Eagle SC with the 32PT DSC in any of four alternate heat zoning configurations with a maximum decay heat of 2.2 kW per assembly and a maximum heat load of 24 kW.

(e) 32 intact (including reconstituted) PWR fuel assemblies in the TN Eagle SC with the 32PTH1 DSC in any of the three alternate heat zoning configurations with a maximum decay heat of 1.5 kW per assembly and a maximum heat load of 26 kW. Up to a maximum of 16 damaged fuel assemblies placed in the center cells of the 32PTH1, with the remainder intact

(f) 24 PWR fuel assemblies; UO_2 and Mixed Oxide Zircalloy Clad (MOX UO_2 and PuO_2) fuel assemblies with or without integral control components in the TN Eagle SC with the 24PT1 DSC in any of the three alternate heat zoning configurations with a maximum decay heat of 0.583 kW per assembly and a maximum heat load of 14 kW. Up to 4 stainless steel clad damaged or failed fuel assemblies. A single damaged or failed WE 14x14 MOX FA may be stored in the 24PT1 DSC with no other damaged/failed assemblies.

(g) 24 intact PWR fuel assemblies in the TN Eagle SC with the FO or FC DSC with a maximum decay heat load per cask of 13.5 kW and either 0.764 kW per assembly (Type I) or 0.563 kW per assembly (Type II), or 13 intact, damaged or failed fuel assemblies in the TN Eagle SC with the FF DSC with a maximum decay heat load per assembly of 0.764 kW.

(3) Damaged fuel includes assemblies with known or suspected cladding defects greater than hairline cracks or pinhole leaks or an assembly with partial and/or missing rods. Damaged fuel assemblies shall be placed in failed fuel canisters (FFC) or between end caps. Loose rods are considered as part of failed fuel contents.

5.(d) Criticality Safety Index: "0"

6. Fuel assemblies with missing fuel rods shall not be shipped as intact fuel unless the missing fuel rods are replaced with dummy rods that displace an equal or greater amount of water.

7. In addition to the requirements of Subpart G of 10 CFR Part 71, the TN Eagle SC and TN Eagle LC packages shall:

   (a) Be prepared for shipment and operated in accordance with the Operating Procedures in Chapter 8.0, and

   (b) Meet the Acceptance Tests and Maintenance Program of Chapter 9.0.

8. Additional operating requirements of the TN Eagle SC and TN Eagle LC package include:

   (a) Verification that the fuel assemblies to be transported in any DSC meet the characteristics, maximum average initial enrichment and burnup combinations for both intact and failed fuel assemblies as stated in Appendix 1.6 of the application and are loaded per the Fuel Qualification Tables in Appendix 8.7 of the application.

   (b) The aging management plan and evaluation for each DSC, or set of DSCs, shall be submitted to the NRC prior to shipment.

   (c) The package is transported by rail in an exclusive use conveyance only. To ensure adequate fatigue strength is maintained, the packaging is limited to 800 one-way shipments (empty or loaded).

   (d) Lifting the package, while attached to the transport frame, is not authorized. The TN Eagle package is handled solely in a horizontal position.

9. Transport by air is not authorized.

10. The TN Eagle SC and TN Eagle LC packages authorized by this certificate are hereby approved for use under the general license provisions of 10 CFR 71.17.

11. Expiration Date: October 31, 2028.

REFERENCES

TN Eagle Safety Analysis Report, Revision No. 1, dated February 20, 2025.

FOR THE U.S. NUCLEAR REGULATORY COMMISSION

Signed by Diaz-Sanabria, Yoira
on 05/27/25

Yoira Diaz-Sanabria, Chief
Storage and Transportation Licensing Branch
Division of Fuel Management
Office of Nuclear Material Safety
and Safeguards

Date: May 27, 2025

SAFETY EVALUATION REPORT

Docket No. 71-9382
Model No. TN EAGLE Package
Certificate of Compliance No. 9382
Revision No. 1

Enclosure 2

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

SAFETY EVALUATION REPORT
Docket No. 71-9382
Model No. TN EAGLE Package
Certificate of Compliance No. 9382
Revision No. 1

SUMMARY

By letter dated July 11, 2024 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML24193A281), and as supplemented on January 22, 2025 (ML25022A100) and February 20, 2025 (ML25051A033), TN Americas LLC (the applicant thereafter) submitted a request for revising Certificate of Compliance (CoC) No. 9382 for the Model No. TN Eagle spent fuel package. The applicant requested to modify the design for cask configurations and to update the criticality analysis for the 32PT Dry Shielded Canisters (DSCs) as follows:

1) Design changes – Standard Canister (SC) cask configuration ONLY

   a. Addition of a new shielding ring type (C1)
   b. Gamma shielding ring made of carbon steel (no cast iron option)
   c. Filled with new Vyal-HT neutron shielding resin blocks and addition of new Vyal-HT resin block acceptance criteria.
   d. Update of paint characteristics (decrease the minimum emissivity and increase the maximum absorptivity)
   e. Thermal and shielding impact of new shielding ring type C1
   f. Shorten DSC rails to add tapped holes for a sleeve at the top of the cask cavity

2) Design changes – ALL configurations

   a. Add axial spacers and washers between forged body bottom and bottom shielding plate
   b. Add stainless steel cladding to some cask areas
   c. Double the quantity of tapped holes and screws for the bottom spacer plate
   d. Updates to the shape of the top handling ring cutouts
   e. Minor updates to machining details of shielding rings (overlap still present, no streaming gaps introduced)
   f. Some minor drawing updates
   g. Criticality analyses update - A criticality analysis has been added to the safety analysis report (SAR) to qualify 10 already loaded 32PT DSCs for transportation in the TN Eagle.

The United States (U.S.) Nuclear Regulatory Commission's (NRC's) staff (the staff thereafter) reviewed the application, as supplemented, using the guidance in the NUREG-2216, "Standard Review Plan for Transportation Packages for Spent Fuel and Radioactive Material." The package was evaluated against the regulatory standards in Title 10 of the *Code of Federal Regulations* (10 CFR) Part 71, including the general standards for all packages and the performance standards specific to fissile material packages under normal conditions of transport (NCT) and hypothetical accident conditions (HAC). The applicable quality assurance plan to this package is under Docket No. 71-0250.

Based on the statements and representations in the application, and the conditions listed in the CoC, the staff concludes that the package meets the requirements of 10 CFR Part 71.

1.0 GENERAL INFORMATION

1.1 Description of Changes

The summary section of this safety evaluation report (SER) includes a brief description of the changes requested by the applicant. Section *1.2* of this SER includes a discussion of the changes to the package's drawings.

1.2 Package Drawings

TN Americas LLC (TN) submitted an application to revise the Certificate of Compliance (CoC) No. 9382 for the TN Eagle Transportation Package.

The following drawing was revised for this amendment request:

Drawing No.	Drawing Title
TN EAGLE01-1100, Revision 1	TN Eagle LC (Large Canister) and TN Eagle SC (Standard Canister) Transport Package (7 Sheets)

Changes have been made to drawing TNEAGLE01-1100, Revision 0, to reconcile the current package design with the first of a kind (FOAK) fabricated unit. These changes included the following (but not limited to):

a. providing tapped holes for the DSC sleeve at the top of the TN Eagle cask SC configuration cask cavity,
b. requiring some stainless steel-clad areas at the seals,
c. updating the design of the top handling ring, providing some missing dimensions,
d. removing obsolete dimensions (or make them reference dimensions), and
e. relaxing some tolerances where possible.

The staff reviewed the drawings and found them to be an adequate representation of the package.

2.0 STRUCTURAL EVALUATION

The purpose of the structural evaluation is to verify that the applicant has adequately analyzed the structural performance of the transportation package (packaging plus contents) in view of the proposed modifications, and ensure continued compliance of CoC No.9382, Revision 1, with the regulations in 10 CFR Part 71, "Packaging and Transportation of Radioactive Material."

The staff has reviewed the changes and evaluated those that have the potential to impact the structural integrity of the package. The staff has reviewed the proposed revisions in view of their risk significance for the structural integrity of the transportation package to ensure that the previously accepted risk for CoC No. 9382 is not increased by the modifications.

2.1 Structural Evaluation

The applicant designed the package components using deterministic design codes with prescribed margins against failure. This American Society of Mechanical Engineers (ASME) design approach resulted in an acceptable level of risk against loss of confinement under all prescribed regulatory conditions. The staff in its review identifies the changes that have the potential to challenge the risk to the structural integrity of the package and evaluate the changes to establish if they increase the risk to the structural integrity of the package from that established by following the design code. Therefore, if the demand is within the design code allowable, the staff concludes that the risk to the structural integrity of the package is no greater than the accepted risk.

The staff review of the changes (1) a.,1) b.,1) c.,1) e.,2) a.,2) b., and 2) d.) indicates that these changes have the potential to affect the mass and center of gravity of the package, which will influence the impact loads considered in its design evaluation. The change in the paint characteristics has the potential to change the emissivity of the package, leading to a change in the temperature considered in the structural integrity evaluation for the CoC. The addition of spacers below the bottom closure plate (BCP) has changed the response of the BCP to the impact load. The staff has reviewed these changes by assessing their risk significance to the continued maintenance of compliance with the regulatory requirements.

Table 2-2, "TN Eagle SC Configuration Calculated Weights and Centers of Gravity," TN Eagle SC Configuration, shows the calculated weights and centers of gravity of the different components. A comparison of the changes in mass and center of gravity with those in Revision 0 of the CoC No. 9382 (Safety Analysis Report, Revision 0, (ML23263B109)) shows that the changes are small and will not influence the dynamic response of the TN Eagle SC configuration to the extent of impacting the structural integrity evaluation undertaken for CoC No. 9382.

The application Safety Analysis Report (SAR or SAR, Revision 1) section 2.11.2.2 has included an analysis of the bottom end drop to evaluate the introduction of the spacers between the bottom of the forged cask body and the BCP. The placing of the spacers creates a gap. The gap is a result of using depth varying spacers at the location of the BCP bolts to account for the final shielding ring tolerance stack-up. The maximum gap considered is 35 millimeters (mm).

The non-linear analysis considered the material as elastic-plastic, as per Note 2 of Table 2-3, "Containment Vessel and DSC Shell Stress Limits", to assesses the stresses in the forged cask body, the BCP, and the adapter.

The model included the forged cask body, the spacers, BCP, and the adapter of the bottom Impact Limiter (IL). All bodies are meshed with SOLID185 elements (Figure 2.11.2-11, “Geometry and Mesh of Modeled Parts”). The material properties used in the model are shown in Table 2.11.2-4, “Material Properties for ANSYS Analysis of Bottom End Drop”, of the SAR. All components but the spacers have a bilinear isotropic hardening material model.

When evaluating the results from the nonlinear elastic plastic analysis for the accident conditions, the applicant evaluated the general primary membrane stress intensity against the acceptance criteria in XXVII-3300 from the American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME BPVC), Section III, Subsection NG, and Appendices, 1998 Edition with 2000 Addenda. The criteria for ferritic steels and for other steels in XXVII-3311 were used by the applicant.

The applicant applied loads on the ANSYS model are based on an acceleration of 54g, which bounds the acceleration of 52.7 for the bottom end drop shown in Table 2.11.3-1, “HAC and NCT Drops – Description, Acceleration, and Duration”. The stresses on the forged cask body and the BCP are reported in Table 2.11.2-5, “Stresses from Bottom End Drop”. The maximum stress intensity on the forged cask body is 319 Mega Pascal (MPa) as shown in Figure 2.11.2-14, “Forged Cask Body – Cylinder – Stress Intensity”.

The maximum stress intensity on the BCP is 385 MPa, which is derived through a weighted average of the stress intensities between the BCP bolt holes. The stress intensities of the nodes used to calculate the weighted average of 385 MPa are shown in Figure 2.11.2-15 “BCP – Stress Intensities of Nodes used in the Weighted Average”. The membrane stresses shown in Table 2.11.2-5 are the maximum membrane stresses calculated by stress linearization of all the through thickness paths of the forged cask body and the BCP. The maximum effective plastic strain of 19.64 percent (%) is at the gussets of the adapter as shown in Figure 2.11.2-16 “Effective Plastic Strain at 54g.” This strain is lower than the allowable strain of 21.89% shown in Table 2.11.2-4.

The staff determined that the proposed change does not challenge the previously accepted risk for the structural integrity of the package and is therefore acceptable.

The temperature increases due to Vyal HT and change in paint emissivity and absorption characteristics are bounded by the characteristics in Section A.2.13.7.3 A. of Orano TN, “NUHOMS®-MP197 Transportation Packaging Safety Analysis Report”, Revision 20, Docket No. 71-9302, (ML19319B042). The allowable stresses for the analysis of the canister are taken at 500 degrees Fahrenheit (°F), whereas the maximum DSC shell temperature is 444°F per Table 3.6.5-7 “Comparison of Maximum DSC Shell Temperatures under NCT”. The 9°F increase shown in Table 3.6.5A-1 “Maximum Temperatures of Key Components in TN Eagle SC Loaded with 32PTH1 Type 1 DSC under NC” bounds the 32PT. This increase is acceptable since the max temperature becomes (444 + 9)°F = 453°F, which is less than the 500°F considered in the package design.

2.1 Evaluation Findings

The staff concludes that the proposed changes to CoC No: 9382 does not challenge the accepted risk to the structural integrity of the package. The staff in their review identified changes that have the potential to challenge the risk to the structural integrity of the package. The staff finds in all evaluated cases, the demand is within the design code allowable, therefore the staff concludes that the risk to the structural integrity of the package is no greater than the accepted risk. The modified package Rev. 1 to CoC No. 9382 continues to comply with the regulations in 10 CFR Part 71, "Packaging and Transportation of Radioactive Material".

3.0 THERMAL EVALUATION

The purpose of the NRC staff review of TN Eagle transportation package is to verify that the thermal performance of the package has been adequately evaluated for the tests specified under NCT and HAC and that the package design satisfies the thermal requirements of 10 CFR Part 71. This case is also reviewed to determine whether the package fulfills the acceptance criteria listed in Section 3 of NUREG-2216.

3.1 Thermal Model

The applicant performed a thermal analysis of new shielding ring design (Type C1) with Vyal-HT resin in the TN Eagle Standard Canister (SC). The new Vyal-HT resin has a higher temperature limit, compared to the VYAL-B resin. The applicant modified the thermal model with the thermal properties (included in Revision 1 of the application) with the new Vyal-HT resin. Also, to account for the coating uncertainty, the minimum emissivity of 0.75 table and maximum absorptivity of 0.75 are conservatively assumed by the applicant for the paintings on the outside surfaces of the TN Eagle SC package. The thermal analysis methodology used for Type C1 shield ring design is identical to that used for Type C shield ring design described in SAR, Revision 0, for both NCT and HAC. The staff reviewed the thermal model and justification provided in the application and found that the modified thermal model was adequately used to perform the thermal analysis.

This new VYAL-HT resin material can withstand higher temperatures than the existing VYAL-B resin but has a lower density and different thermal properties. The application also updates the bounding paint emissivity and absorptivity values from 0.8 to 0.75 minimum and from 0.7 to 0.75 maximum, respectively, for the TN Eagle cask SC configuration.

3.2 Thermal Evaluation Under Normal Conditions of Transport and Hypothetical Accident Conditions

The applicant noted that the maximum component temperatures of 32PTH1 Type 1 Dry Shielded Canister (DSC) in the TN Eagle SC based on design load case (LC#1), represent the bounding temperatures for all non-EOS DSCs loaded in TN Eagle SC under NCT. Therefore, the applicant selected the same load case (LC#1a) listed in the application, Table 3.6.5-2, "Design Load Cases of 32PTH1 DSC in TN Eagle SC with Impact Limiters under NCT," for the 32PTH1 Type 1 DSC with maximum heat load of 26 kW during NCT in the TN Eagle SC with Type C1 shield ring design, to evaluate thermal impact of Type C1 shield ring design on the thermal performance of TN Eagle SC during the transport operations. The HAC results for the maximum cask components of the TN Eagle Large Canister (LC) with EOS-37PTH DSC with 38.4 kW in Table 3-16 "Maximum Temperatures of Key Components in TN Eagle LC Loaded with EOS-37PTH DSC for HAC" of SAR, Revision 0, remain bounding for the TN Eagle SC with non-EOS DSCs and no further thermal analyses are required for these DSC types. Table 3.6.5A-1 of the application included the maximum calculated temperatures for the new resin. The reported temperature results provided in the application show that all components remain below their respective design temperature limit for the new resin, with adequate margin. The minor increase in the DSC shell temperature will result in a minor increase in the cladding temperature, but this temperature will remain below the allowable limit with adequate margin.

The maximum accessible surface temperatures under shade for TN Eagle LC for impact limiter shell and personnel barrier, respectively, as calculated in Section 3.3.4 of SAR, Revision 0, bound the maximum accessible surface temperatures under shade for TN Eagle SC with Type C1 new shield ring. This temperature remains below the maximum temperature limit of 185°F (85°C) for the accessible packaging surfaces, in accordance with 10 CFR 71.43(g). The maximum normal operating pressure calculated in SAR, Revision 0, for the bounding DSC and heat load configuration remains bounding for all DSC types.

The staff reviewed all predicted temperatures and justification provided in the application and concludes the predicted temperatures are adequately calculated and consistently reported in this application. The applicant's results are below allowable limits with adequate margin. The staff reviewed the pressure calculations and predicted results and concludes that previous evaluation for the bounding DSC configuration continues to provide reasonable assurance that predicted results will not exceed application allowable limits for the new resin. The staff reviewed the applicant's thermal models used in the analyses. The staff reviewed the code input in the calculation packages and confirmed the material properties and boundary conditions that were used. The staff verified that the applicant's selected code models and assumptions were adequate for the heat transfer characteristics prevailing in the TN Eagle transportation package geometry and analyzed conditions. The staff also reviewed licensing drawings to verify that geometry dimensions were representative in the analysis models and the material properties to verify that they were appropriately referenced and used.

3.3 Evaluation Findings

1) The staff reviewed the package description and evaluation and found reasonable assurance that they satisfy the thermal requirements of 10 CFR Part 71.

2) The staff reviewed the material properties and component specifications used in the thermal evaluation and found reasonable assurance that they are sufficient to provide a basis for evaluation of the package against the thermal requirements of 10 CFR Part 71.

3) The staff reviewed the methods used in the thermal evaluation and found reasonable assurance that they are described in sufficient detail to permit an independent review, with confirmatory calculations, of the package thermal design.

4) The staff reviewed the accessible surface temperatures of the package as it will be prepared for shipment and found reasonable assurance that they satisfy 10 CFR 71.43(g) for packages transported by exclusive-use vehicle.

5) The staff reviewed the package design, construction, and preparations for shipment and found reasonable assurance that the package material and component temperatures will not extend beyond the specified allowable limits during normal conditions of transport, consistent with the tests specified in 10 CFR 71.71.

6) The staff reviewed the package design, construction, and preparations for shipment and found reasonable assurance that the package material and component temperatures will not exceed the specified allowable temperature

limits during hypothetical accident conditions, consistent with the tests specified in 10 CFR 71.73

5.0 SHIELDING EVALUATION

The purpose of this shielding evaluation is to verify the proposed design changes to Model TN-Eagle, as these pertain to the shielding component(s) of the package, provide adequate protection to immediate area workers and members of the public against direct radiation that is above the regulatory limits stated in 10 CFR 71 for NCT and HAC. The staff reviewed this application using the guidance in NUREG-2216.

5.1 Shielding Design

The applicant requested a revision to CoC No. 9382, Model No. TN-Eagle. The TN Eagle design change adds a new Type C1 neutron shield filled with a new Vyal-HT Resin with higher heat tolerances in its SC-C1 configuration. The source term remains unchanged from the previous analysis. The shielding model from the earlier version also remains unchanged.

The TN Eagle has two configurations: large canister (LC) and standard canister (SC). This analysis is based on the SC configuration with a Type C1 shielding ring filled with Vyal-HT resin.

A new neutron shielding ring type C1 (which is made of carbon steel only; cast iron is not a material option for this new ring type), filled with a new type of neutron shielding resin (VYAL-HT) to the TN Eagle cask SC configuration.

5.2 Model Specification

The applicant's evaluation used Monte Carlo N-Particle (MCNP) code for the analysis with reduced variance in its model. MCNP is a three-dimensional code and is acceptable for this analysis.

5.2.1 Shielding Evaluation

The staff verified the application, specified the composition and minimum density of the Vyal-HT resin. The Vyal-HT is lower in density. To compensate for the low density of the new resin, the applicant increments the thickness of the shielding ring, which is composed of higher-density carbon steel. The staff verified a sensitivity analysis was performed for the new shielding ring Type C1 with the Vyal-HT resin. Also, the staff verified that the analyses in this application appropriately considered and evaluated some aspects of the package in identifying locations of maximum radiation levels.

5.2.2 Maximum External Radiation Levels

The applicant reported the maximum radiation dose rates for NCT from the TN Eagle SC equipped with the Type C1 neutron shield rings in Table 5.6.1-29 of the application. These dose rates are compared to the maximum dose rates from the TN Eagle LC reported in Table 5-80, and the TN Eagle SC equipped with the Type B neutron shield rings reported in Table 5.6.1-23 of the application. The applicant demonstrated that:

(1) the maximum radiation dose rates for the TN Eagle SC equipped with the Type C1 neutron shield rings are comparable to the TN Eagle SC equipped with the Type B neutron shield rings.

(2) the maximum dose rates are conservatively bounded by the maximum dose rates from the TN Eagle LC since the side dose rates for the vehicle surface and the 2 meters from vehicle surface are the limiting dose rates around the package.

5.3 Evaluation Findings

After reviewing all changes and the shielding analysis, the staff finds that the Fuel Qualification Tables (FQTs) for the TN Eagle SC with Type B neutron shield rings, developed from the FQTs of the EOS-37PTH DSC in the TN Eagle LC, remain valid for the TN Eagle SC equipped with the Type C1 neutron shield rings.

Based on the statements and representations in the application, as supplemented, the staff agrees that the package continues to meet the requirements of 10 CFR Part 71.

6.0 CRITICALITY SAFETY EVALUATION

The objective of this review is to ensure that the applicant performed an adequate criticality safety evaluation to demonstrate that the package will be maintained in a subcritical configuration under NCT and HAC.

6.1 Criticality Safety Design Features

The applicant requested an amendment to the CoC for the Model Nos. TN-Eagle LC and TN-Eagle SC packages with the following changes accounted for in the criticality safety evaluation:

1) Addition of loading curve with 30-year cooling time for intact Combustion Engineering (CE) 14x14 fuel assemblies in 16 poison plate (16PP) and 24 poison plate (24PP) 32PT Dry Storage Canister (DSC) configurations.

2) Consideration of as-loaded, assembly by assembly loading configurations in the 16PP and 24PP 32PT DSCs.

The following sections describe the staff's review of each of the proposed changes listed above.

6.2 Loading Curve for 30-year Cooled CE 14x14 Fuel Assemblies

The applicant developed a new loading curve for 30-year cooled CE 14x14 fuel assemblies in the 16PP and 24PP 32PT DSCs. The applicant used the same methodology to calculate the new loading curve as was used to develop the previously approved loading curves for CE 14x14 fuel at 5 years, 10 years, 15 years, and 20 years cooling time. This includes using the same package and fuel materials and geometry, using the same fuel irradiation assumptions, and crediting the same irradiated fuel nuclides as was used by the applicant to develop the previously approved loading curves for CE 14x14 fuel in the 32PT DSC in the TN-Eagle package.

Similar to the previously approved application for the 32PT DSC in the TN-Eagle package, the applicant evaluated three-dimensional models of a single package and arrays of packages under both NCT and HAC. The applicant explicitly modeled the fuel rods and cladding, guide tubes, water gaps, basket structure, and neutron absorber in the basket. The criticality models for the 32PT DSC in the TN Eagle package include assumptions intended to produce a conservative estimate of system k_{eff}. These assumptions include:

a. Modeling the fuel pellet stack at a minimum of 96.5% of theoretical uranium oxide density, with no allowance for pellet dishing or chamfer,
b. Flooding of the fuel-pellet gap with full density water,
c. Uniform lattice-average or assembly-average enrichments, with no credit for burnable absorbers or natural uranium blankets,
d. Most reactive combination of material and fabrication tolerances, and eccentric positioning of fuel assemblies in the basket guide tubes,
e. Neglecting package spacing provided by the impact limiters,
f. For hypothetical accident conditions, replacing the external neutron shield and stainless-steel skin with water, and
g. Neglecting fuel assembly structural material that would absorb neutrons or displace moderator, such as grid plates, spacers, rod plenums, end fittings, and channels above and below the active fuel.

Sensitivity studies performed by the applicant for CE 14x14 fuel in the 32PT DSC to determine the most reactive condition in the previously approved application for the TN Eagle package remain applicable to CE 14x14 fuel in the 32PT DSC with the new loading curve for 30-year cooled fuel. Similar to the previously approved loading curves for the 32PT DSC in the TN Eagle package, the applicant performed the HAC single package and array evaluations for the TN Eagle package with the interior of the DSC dry, with the exception of the analysis for subcriticality under 10 CFR 71.55(b), as the package is designed to exclude moderator under HAC. The applicant modeled a single TN Eagle package with a 32PT DSC assuming full moderation by water, with fuel in the as-loaded condition to demonstrate subcriticality per the requirements of 10 CFR 71.55(b). For consideration of package arrays, the applicant modeled infinite arrays of TN-Eagle packages with the 32PT DSC under HAC, which bound consideration of infinite arrays under NCT. Since an infinite array of packages are demonstrated by the applicant to be subcritical under both normal conditions of transport and hypothetical accident conditions, the resulting criticality safety index (CSI) is 0.0.

For the fresh fuel criticality analysis of CE 14x14 fuel in the 32PT DSC, the applicant used the CSAS5 sequence of the SCALE 6.1.3 computer code system, with the KENO V.a three-dimensional Monte Carlo neutron transport code and the 238-group ENDF/B-VII cross section library. For burnup credit criticality calculations, the applicant used the STARBUCS burnup credit criticality sequence of the SCALE 6.1.3 computer code system, with the ORIGEN-ARP isotopic depletion code, KENO V.a three-dimensional Monte Carlo neutron transport code, and the 238-group ENDF/B-VII cross section library. The SCALE code is a standard in the nuclear industry for performing Monte Carlo criticality safety and radiation shielding calculations. These are the same calculation methods used for the previously approved application for the 32PT DSC in the TN-Eagle package, and the applicant's previously approved code validation analysis remains applicable.

The applicant's resulting loading curve and maximum k_{eff} values for CE 14x14 fuel in the 32PT DSC are shown in Table 6.8.5-14 for the 32PT DSC with 16PP, and in Table 6.8.5-15 for the 32PT DSC with 24PP. The maximum k_{eff} of 0.9407, including bias and all reported uncertainties, is below 0.95. Single misload analyses had previously been performed for the 32PT DSC in criticality analysis supporting transportation of this DSC in the NUHOMS®-MP197HB package. These misload analysis are applicable to the TN Eagle package, as the DSCs are identical, and the TN Eagle package materials and dimensions are like those of the NUHOMS®-MP197HB package. For multiple assembly misloads, the applicant considered fully misloaded 32PT 16PP and 24PP DSCs, with uniformly reduced burnup. This is conservative with respect to the recommendation in NUREG-2216 to consider 50% of the fuel assemblies underburned. The applicant's resulting k_{eff} values for a fully misloaded DSC are shown in Table 6.8.5-26 for the 16PP configuration and in Table 6.8.5-27 for the 24PP configuration. All reported k_{eff} values are below the applicant's misload upper subcriticality limit (USL) with a 2% administrative margin.

The staff performed confirmatory criticality evaluations of the TN Eagle package using the ORIGAMI isotopic depletion sequence and the KENO VI three-dimensional Monte Carlo criticality sequence in the SCALE 6.2.4 code system, and the continuous energy ENDF/B-VII.1 cross section library. Using assumptions similar to the applicant's, the staff calculated k_{eff} values for select configurations which bounded or were statistically similar to those calculated by the applicant and confirmed that the package will meet the criticality safety requirements of 10 CFR Part 71.

6.3 Assembly-by-Assembly Loading Configurations for CE 14x14 Fuel in 16PP and 24PP DSCs

The applicant performed criticality calculations to demonstrate subcriticality of 10 as-loaded 32PT DSCs, using assembly-by-assembly burnup and enrichment information. The applicant used the same package and fuel materials and geometry, fuel irradiation assumptions (except for burnup and enrichment), credited irradiated fuel nuclides, and conservative modeling assumptions as was used for the 30-year loading curve analyses described above. The 10 as-loaded 32PT DSCs are loaded with fuel with burnup and enrichment for each assembly as described in Tables 6.8.5-16 through 6.8.5-20 and as shown in Figures 6.8.5-8 through 6.8.5-17. DSCs -01 through -09 have the 16PP configuration, and DSC-10 has the 24PP configuration.

The applicant's resulting maximum k_{eff} values for each as-loaded DSC are shown in Table 6.8.5-21 of the SAR. The maximum k_{eff} values are from the applicant's calculations for each as-loaded DSC fully flooded with water, which previous analyses identified as the most reactive condition. The maximum k_{eff}, including bias and bias uncertainty, was 0.9395, less than the 0.95 recommended maximum from NUREG-2216. The applicant used the burnup-dependent bias and bias uncertainty for each DSC based on the maximum fuel burnup of any assembly in each DSC. This is conservative, as the bias uncertainty at maximum burnup is higher than at lower burnups.

For the as-loaded DSC burnup credit criticality calculations, the applicant used the STARBUCS burnup credit criticality sequence of the SCALE 6.1.3 computer code system, with the ORIGEN-ARP isotopic depletion code, KENO V.a three-dimensional Monte Carlo neutron transport code, and the 238-group ENDF/B-VII cross section library.

The staff performed confirmatory criticality evaluations of the as-loaded 32PT DSCs in the TN Eagle package using the ORIGAMI isotopic depletion sequence and the KENO VI three-dimensional Monte Carlo criticality sequence in the SCALE 6.2.4 code system, and the continuous energy ENDF/B-VII.1 cross section library. Using assumptions similar to the applicant's, the staff calculated k_{eff} values for select configurations which bounded or were statistically similar to those calculated by the applicant and confirmed that the package will meet the criticality safety requirements of 10 CFR Part 71.

The staff finds the applicant has demonstrated that the TN Eagle package, when loaded with 32PT DSCs containing CE 14x14 fuel assemblies meeting the characteristics of the contents described in Table 1.6.4-6 “Maximum Planar Average Initial Enrichment/Minimum Burnup Combinations - Intact Fuel NUHOMS®-32PT” of the application, will be adequately subcritical under all conditions. Therefore, the applicant has shown, and the staff finds that the TN Eagle package meets the fissile material requirements of §71.55 for single packages, and §71.59 for arrays of packages with a CSI of 0.0 for CE 14x14 fuel in 32PT DSCs.

6.4 Evaluation Findings

Based on review of the statements and representations in the application, the staff has reasonable assurance that the proposed package design and contents satisfy the nuclear criticality safety requirements in 10 CFR Part 71. In making this finding, the staff considered the regulation itself, appropriate regulatory guides, applicable codes and standards, accepted engineering practices, and the staff’s own independent confirmatory calculations.

7.0 MATERIALS EVALUATION

The staff reviewed and evaluated the information provided by the applicant requested in Revision 1. The specific changes evaluated in this section for materials impacts include:

a. Change No. 1: Changes to Drawing No. TNEAGLE01-1100, Revision 0, to reconcile the currently licensed cask design with the first of a kind (FOAK) fabricated unit.

b. Change No. 2: Application changes to correct editorial errors.

c. Change No. 4: Application updates to (1) add a new neutron shielding ring type C1, made of carbon steel, filled with a new type of neutron shielding resin (Vyal-HT) to the TN Eagle cask SC configuration, and (2) the bounding paint emissivity and absorptivity values from 0.8 to 0.75 minimum and from 0.7 to 0.75 maximum.

The staff used the guidance in NUREG-2216 Chapter 7, “Materials Evaluation”, to perform the review of the proposed packaging changes. Based on the statements and representations in the application, as supplemented, and the conditions listed in the following chapters, the staff concludes that the package meets the requirements in 10 CFR Part 71.

7.1 Change No. 1: Changes to Drawing No. TNEAGLE01-1100, Revision 0

In the application, Revision 1, Section 1.5.1, the applicant revised drawing No. TNEAGLE01-1100. In addition to changes made to reflect the as-built configuration, the revised drawing includes the new shielding ring configuration using Vyal-HT resin, updates to the design of the top handling ring, provides certain previously missing dimensions, relaxes certain tolerances, adds construction notes, and includes previously missing welding instructions.

The staff notes that the level of detail in the new drawings, including the packaging design, construction, examination requirements and material specifications are consistent with the guidance in NUREG-2216. The staff reviewed the drawing content with respect to the guidance in NUREG/CR-5502, "Engineering Drawings for 10 CFR Part 71 Package Approvals," and confirmed that the drawings provide an adequate description of the materials, fabrication, component dimensions and tolerances, and examination requirements.

7.2 Change No. 2: Application changes to correct editorial errors

In SAR, Revision 0, page 1.6-1 referred to an Appendix 1.6.8 for code alternatives for the TN Eagle packaging and the dry shielded canisters (DSCs) that are approved contents for the TN Eagle transportation package. This Appendix did not exist in that document. Rev. 1 corrects this to refer to the existing Appendix 9.4.1, "Code Alternatives".

The staff reviewed the editorial change and determined that the changes corrected the error. Staff also confirmed that application Appendix 9.4.1 includes the approved ASME BPVC alternatives for the TN Eagle transportation package and the DSCs that are listed in the application SAR Section 1.2.3, "Contents of Packaging". Therefore, the staff determined that the proposed revision to the SAR, Revision 0, to correct the editorial error is acceptable.

7.3 Change No. 4: (1) New neutron shielding ring

The applicant provided information regarding a new neutron shielding resin and consequent design changes to the shielding rings in the following TN Eagle SAR, Revision 1 chapters and appendices:

a. Chapter 1, "General Information Evaluation",
b. Chapter 2, "Structural Evaluation",
c. Appendix 2.11.10, "Evaluation of Non-EOS Contents for Transportation in the TN Eagle Cask",
d. Chapter 3, "Thermal Evaluation",
e. Appendix 3.6.5, "Thermal Evaluation of TN Eagle SC with Non-EOS DSCs",
f. Appendix 3.6.5A, "Thermal Reconciliation for TN Eagle SC with Type C1 Neutron Shield Rings",
g. Appendix 5.6.1, "Shielding Evaluation for TN Eagle SC",
h. Chapter 7, "Material Evaluation",
i. Chapter 9, "Acceptance Tests and Maintenance Program Evaluation".

The changes to the application SAR included description, specifications, evaluations and acceptance testing of a new shielding resin, Vyal-HT. The applicant stated that this resin has improved resistance to high temperatures but is less dense than the previous resin, Vyal-B, as shown in laboratory test results the applicant provided. Consequently, the shielding ring that contains the resin will be made of steel instead of cast iron. The application stated that the denser steel restores the gamma shielding capability lost to the less dense polymer. This new shielding ring has different dimensions than the previous configurations: the new drawing includes the dimensions for all configurations of shielding ring. The revision also includes thermal modeling of the new shielding ring configuration.

The staff reviewed the information provided by the applicant in application SAR Chapter 1, Chapter 2, Appendix 2.11.10, Chapter 3, Appendix 3.6.5, Appendix 3.6.5A, Appendix 5.6.1, Chapter 7, and Chapter 9. The staff also reviewed the laboratory report, “Qualification of a New Neutron Shielding Material of Resin: VYAL HT-1”, which the applicant provided as Enclosure 8 to the application. This report summarized the tests of material properties of the Vyal-HT. These tests included the following International Organization for Standardization (ISO) standards and test methods to determine the following:

- the density according to ISO 1183, method A,
- the coefficient of thermal expansion according to ISO 11359-2,
- the specific heat coefficient according to ISO 11357-4, and
- the thermal conductivity according to ISO 8302.

The staff reviewed the test methods used by the applicant to determine the density, thermal expansion, specific heat capacity, and thermal conductivity using the ISO standards. These test methods are acceptable because they are internationally accepted standards used to determine the relevant physical and thermal properties of the shielding resin.

The applicant included the results of thermal modeling of the various fuel loading configurations, using the ANSYS FLUENT computational fluid dynamics software. This modeling shows that the temperature of the shielding resin stays below the limiting temperature for the new Vyal-HT resin for NCT.

Staff reviewed the applicant’s thermal modeling results and confirmed that the results show that the temperature of the shielding resin remains below the temperature limit for the Vyal-HT resin under NCT. Therefore, the staff determined that the new Vyal-HT resin will not undergo thermal degradation under NCT. The staff’s review of applicant’s thermal evaluation is included in Chapter 3 of this SER.

7.4 Change No. 4: (2) Update the bounding paint emissivity and absorptivity values

In SAR, Revision 1 Drawing TNEAGLE01-1100 Rev 1A and Appendix 3.6.5A, the applicant changed the limits to the acceptable paint emissivity (from 0.8 to 0.75 minimum) and absorptivity (from 0.7 to 0.75 maximum). The applicant stated that the change to the paint emissivity value is intended to allow more flexibility in paint selection.

The staff reviewed the information provided by the applicant in SAR, Revision 1 Drawing TNEAGLE01-1100 Rev 1A and Appendix 3.6.5A. The new limits on emissivity and absorptivity, as inputs to the thermal analysis, provide a more conservative prediction of maximum internal temperature for NCT. The staff determined that the revised drawing contains a note that identifies the paint as a quality category C item with a maximum absorptivity and a minimum emissivity value. Therefore, the staff determined that the change is acceptable because the thermal analysis incorporating the revised thermal specifications for the paint coating indicates that the temperature of the resin neutron shield does not exceed its thermal limit.

Based on review of the statements and representations in the application, the NRC staff concludes that the materials used in the transportation package design have been adequately described and evaluated and that the package meets the requirements of 10 CFR Part 71.

9.0 ACCEPTANCE TESTS AND MAINTENANCE PROGRAM EVALUATION

The staff reviewed and evaluated the information provided by the applicant requested in Revision 1. The specific changes evaluated for material property impacts in this section include:

Change No. 5: Practical acceptance criteria for Vyal-HT blocks

The staff used the guidance in NUREG-2216, Chapter 9, "Acceptance Tests and Maintenance Program Evaluation", to perform the review of the proposed packaging changes. Based on the statements and representations in the application, as supplemented, and the information in application SAR, Section 9.1.7, as discussed below, the staff concludes that the package meets the requirements of 10 CFR Part 71.

9.1 Change No. 5: Acceptance criteria for Vyal-HT blocks

In the application Section 9.1.7, "Shielding Tests", the applicant provided acceptance criteria for Vyal-HT shielding blocks. The criteria define an acceptable extent of voids, cracks and chips in the delivered resin blocks, criteria that were not in the initial application (SAR, Revision 0). This change also reflects the as-fabricated first production item.

The staff reviewed the information provided in the application, Section 9.1.7. and notes that the change aligns with the as-produced units and is considered in the thermal analysis. The staff reviewed the examination methods and acceptance criteria for the Vyal-HT blocks provided by the applicant. The staff determined that the examination methods were appropriate for the Vyal-HT shielding blocks and the acceptance criteria are sufficient to preclude defective or damaged shielding blocks that could affect shielding performance. Therefore, the staff determined that the examination methods and acceptance criteria for the Vyal-HT blocks were acceptable. The staff's review of the TN Eagle transportation package is included in Chapter 5 of this SER.

CONDITIONS

The following changes were made to the certificate:

a. Item No.3(b) was revised to reference the TN Eagle Safety Analysis Report, Revision No. 1, dated February 20, 2025.

b. Condition No. 5(a)*(2)* was revised to reword the statement regarding neutron shielding resin without differentiation, to clarify that the SC version with Type C1 neutron shielding rings has a slightly larger outer diameter, and revise the packaging overall length of the package to 8114 mm (319.45 in.) with the impact limiters and 5612 mm (220.95 in.) without the impact limiters. Also, the impact limiter outside diameter has been revised to 3550 mm (139.76 in.) or 3568 mm (140.47 in.) for the SC version with type C1 neutron shielding rings. The TN EAGLE drawing 01-1100 is now at Revision No. 1 for both the

TN Eagle LC (Large Canister) and TN Eagle SC (Standard Canister) Transport Packages.

c. Condition No. 5(a)(3) was revised to update the drawing revision number.

d. A new condition No. 5(b)(1)(g) was added to specify that intact, damaged or failed Babcock & Wilcox (B&W) 15x15 pressurized-water reactor (PWR) fuel assemblies with or without control components can be transported in the FO/FC/FF DSCs with the characteristics in Safety Analysis Report Appendix 1.6.6.

e. A new Condition No. 5(b)(2)(g) was added to specify that there are 24 intact PWR fuel assemblies in the TN Eagle SC with the FO or FC DSC with a maximum decay heat load per cask of 13.5 kW and either 0.764 kW per assembly (Type I) or 0.563 kW per assembly (Type II), or 13 intact, damaged or failed fuel assemblies in the TN Eagle SC with the FF DSC.

CONCLUSION

Based on the statements and representations contained in the application, and the conditions listed above, the staff concludes that the Model No. TN Eagle package has been adequately described and evaluated and that the package meets the requirements of 10 CFR Part 71.

Issued with Certificate of Compliance No. 9382, Revision No. 1, on May 27, 2025.