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

SAFETY EVALUATION REPORT

Docket No. 71-9235
Model No. NAC-STC
Certificate of Compliance No. 71-9235
Revision 22

Summary

By application dated February 28, 2019 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML19064B321) NAC International, Inc., (NAC or the applicant) requested Revision to Certificate of Compliance (CoC or the certificate) No. 9235, for the Model No. NAC-STC package.

The staff used the guidance in NUREG-1617, "Standard Review Plan for Transportation Packages for Spent Nuclear Fuel," as well as associated interim staff guidance documents 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 of Title 10 of the *Code of Federal Regulations* (10 CFR) Part 71.

EVALUATION

1.0 GENERAL INFORMATION

1.1 Packaging Description

The packaging body is made of two concentric stainless steel shells. The inner shell is 1.5 inches thick and has an inside diameter of 71 inches. The outer shell is 2.65 inches thick and has an outside diameter of 86.7 inches. The annulus between the inner and outer shells is filled with lead.

The inner and outer shells are welded to steel forgings at the top and bottom ends of the packaging. The bottom end of the packaging consists of two stainless steel circular plates which are welded to the bottom end forging. The packaging is closed by two steel lids which are bolted to the upper end forging. The inner lid (containment boundary) is 9 inches thick and is made of Type 304 stainless steel. The outer lid is 5.25 inches thick and is made of SA-705 Type 630, H1150 (17-4PH) stainless steel. The inner lid is fastened by forty-two, 1.5-inch diameter bolts and the outer lid is fastened by thirty-six (36), 1-inch diameter bolts. The inner lid is sealed by two O-ring seals. The outer lid is equipped with a single O-ring seal. The inner lid is fitted with a vent and drain port which are sealed by O-rings and cover plates. The containment system seals may be metallic or Viton. Viton seals are used only for directly-loaded fuel that is to be shipped without subsequent long-term interim storage.

Four lifting trunnions are welded to the top end forging. The package is shipped in a horizontal orientation and is supported by a cradle under the top forging and by two trunnion sockets located near the bottom end of the packaging.

The package is equipped at each end with an impact limiter made of redwood and balsa. Two impact limiter designs consisting of a combination of redwood and balsa wood, encased in Type 304 stainless steel, are provided to limit the g-loads acting on the package during an accident. The predominantly balsa wood impact limiter is designed for use with all the proposed contents. The predominately redwood impact limiters may only be used with directly loaded fuel or the Yankee-multi-purpose canister configuration.

The package includes a stainless steel ring assembly which, when applicable, includes a top shield ring and shear ring. The stainless steel ring assembly is installed on the upper cask body, between the top impact limiter and the neutron shield shell in the upper region of the packaging. The shield ring consists of four sectors: bottom sector, top sector and two side sectors.

The package also includes shield plates at the periphery of the top weldment assembly which, when applicable, may be added to the periphery of the top weldment to provide augmented shielding at the top region of the fuel basket for specific configurations. The shield plates are 1.25 inches thick with a same axial height as the existing support plates and the ring in basket axial direction. The shield plates are fabricated from the same material as the top weldment plates (SA 240, Type 304 stainless steel).

1.2 Contents

There were no changes to the package's approved contents.

1.3 Drawings

NAC International revised 4 drawings:

Drawing 423-802, Rev. 27	Cask Body – NAC-STC Cask
Drawing 423-209, Rev. 3	Impact Limiter Assy-Upper, NAC-STC Cask
Drawing 423-210, Rev. 3	Impact Limiter Assy-Lower, NAC-STC Cask
Drawing 423-812, Rev. 8	Nameplates, NAC-STC Cask

2.0 STRUCTURAL EVALUATION

This revision updated drawing changes identified during the manufacturing process. The drawing changes are for the cask body (Drawing No. 423-802) and for the upper and lower impact limiters (Drawing Nos. 423-209 and 423-210). Furthermore, NAC requested that the cask nameplate drawing (Drawing No. 423-812) be revised to include space for customer requested information in addition to the information required by 10 CFR Part 71. Other than drawing changes, NAC modified two equations in the application and re-evaluated the shear stress in the shear rings attached to the cask body forging for resisting the package tie-down inertia load. Based on the statements and representations in the application, the staff concludes that these changes do not affect the ability of the package to meet the requirements of 10 CFR Part 71.

Section 2.5.2.3.2 of the applicant reevaluated the structural integrity of the two shear rings for withstanding the package tie-down inertia force in meeting the 10 CFR 71.45(b) tie-down devices requirement. Each of the 3.5-inch deep by 1.5-inch thick by 43.9-inch long shear rings, which span a 58^{o} circumferential angle, is attached to the outside diameter of the cask top forging using a partial penetration weld of 1.5 inches on both sides of the ring (the total weld length is 3.0 inches).

As analyzed in the NAC submittal, the applicant modified the two equations used for computing the shear stress and corresponding stress margin of safety. By conservatively replacing the previously used total weld length of 3.0 inches with a weld length of 2.75 inches, the applicant calculated, for the two shear rings, a revised shear area of 241.4 square inches, which is smaller than the previously used area of 267.8 square inches. For the resulting shear stress of 10,400 psi, the applicant calculated a stress margin of safety of +0.15, which is positive and acceptable, based on the at-temperature allowable shear stress of 12,000 psi.

2.1 Drawing Changes, Materials Review

The applicant included changes to the drawings for the package body, upper impact limiter, lower impact limiter and the nameplates. Changes to the package body drawing included (1) the addition of backing allowed on the neutron shield shell to the neutron shielding shell endplate weld, (2) allowed reduction in the width of the shear ring and (3) minor revisions to dimensional tolerances and dimensions. Changes to the upper and lower impact limiter drawings included the addition of commercial fire block for the protection of the wood impact limiter material near the stainless steel impact limiter shell closure weld locations. Changes to the nameplates include additional information as requested by the customer and increased nameplate size to accommodate the additional information. The staff reviewed the changes to the drawings and determined that the changes did not impact the materials performance of the package and were appropriately documented in drawings included in the application.

2.2 Material Properties

The applicant provided material properties for stainless steel and aluminum alloys to support structural evaluation of the NAC-STC Transport Cask with HBU contents. For the stainless steels, the applicant provided tensile strength, yield strength, allowable stress, elastic modulus and thermal expansion coefficient as a function of temperature. The applicant also provided values for Poisson's ratio and density. For the aluminum alloy, the applicant provided tensile strength and yield strength as a function of temperature as well as values for Poisson's ratio and density. The staff reviewed the material properties and determined that the temperature dependent properties as well as the values for Poisson's Ratio and density for the stainless steels are consistent with the values in American Society of Mechanical Engineers Boiler and Pressure Vessel Code Section II Part D. The staff determined that the values for the temperature dependent tensile strength and yield strength as well as the value for Poisson's ratio and density for the aluminum alloy are consistent with the values published in the American Society for Metals Handbook Volume 2 Properties and Selection: Nonferrous Alloys and Special-Purpose Materials.

Based upon the review of the information and analyses presented in the application, the staff concludes that the NAC-STC transportation package will continue to be structurally capable of meeting the 10 CFR Part 71 requirements.

3.0 THERMAL EVALUATION

There were no changes that affected the package's thermal evaluations.

4.0 CONTAINMENT

There were no changes that affected the package's containment analysis.

5.0 SHIELDING EVALUATION

There were no changes that affected the package's containment analysis.

6.0 CRITICALITY EVALUATION

There were no changes that affected the package's criticality evaluations.

7.0 PACKAGE OPERATIONS

There were no changes that affected package operations.

8.0 ACCEPTANCE TESTS AND MAINTENANCE PROGRAM REVIEW

There were no changes that affected the acceptance tests or maintenance program.

9.0 CONDITIONS

The staff made editorial changes to improve the readability of the CoC. The CoC includes the following condition(s) of approval:

The following drawings were revised and incorporated into the certificate of compliance:

Drawing 423-802, Rev. 27	Cask Body – NAC-STC Cask
Drawing 423-209, Rev. 3	Impact Limiter Assy-Upper, NAC-STC Cask
Drawing 423-210, Rev. 3	Impact Limiter Assy-Lower, NAC-STC Cask
Drawing 423-812, Rev. 8	Nameplates, NAC-STC Cask

The references section was updated to include the application for this amendment dated February 28, 2019.

10.0 CONCLUSIONS

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

Issued with Certificate of Compliance No. NAC-STC, Revision No. 22.