SAFETY EVALUATION REPORT
Docket No. 71-9225
Model No. NAC-LWT Package
Certificate of Compliance No. 9225
Revision No. 38

SUMMARY

By application dated February 20, 2004, as supplemented, NAC International, Inc. (NAC), on behalf of the U.S. Department of Energy, requested an amendment to Certificate of Compliance No. 9225 for the Model No. NAC-LWT package. NAC requested that the package be authorized for the transport of up to 300 irradiated tritium-producing burnable absorber rods (TPBARs).

The TPBARs are similar in size and overall structure to commercial PWR stainless steel-clad burnable absorber rods. The internal components of the TPBAR consist of concentric shells of lithium aluminate pellets and zircaloy sheaths which are designed to produce and retain tritium. The TPBARs will be positioned within a consolidation canister for handling, which is transported within a modified NAC-LWT PWR basket with appropriate inserts.

NAC provided structural, thermal, shielding, and containment analyses for the package with the new contents, as well as updated package operations, maintenance program and acceptance tests.

Additionally, NAC submitted the following applications for amendment to Certificate of Compliance No. 9225:

- By application dated July 16, 2004, as supplemented, NAC requested a modification of the design of the TRIGA sealed canister (NAC International Drawing No. 315-40-087) to eliminate the manufacturer and part number for the diaphragm valve.

- By application dated August 10, 2004, NAC requested that the description of fuel in Condition No. 5(b)(2)(ix) of the Certificate of Compliance be revised for clarity.

- By application dated October 6, 2004, as supplemented, NAC requested that the package identification number for the package be revised to include the "-96" designation. NAC also requested that the Certificate of Compliance be renewed.

Based upon our review, the statements and representations in the applications, as supplemented, and for the reasons stated in this Safety Evaluation Report, we have concluded that the changes do not affect the ability of the package to meet the requirements of 10 CFR Part 71.

REFERENCES

NAC application dated February 20, 2004, as supplemented March 4, September 15, October 14, and November 12, 2004.

NAC application dated July 16, 2004, as supplemented August 4, 12, and 13, 2004.

NAC application dated August 10, 2004.

NAC application dated October 6, 2004, as supplemented December 30, 2004.

ADDITION OF TPBARS AS AUTHORIZED CONTENTS

1. GENERAL INFORMATION

1.1 Packaging Description

The NAC-LWT package is a steel-encased, lead-shielded shipping cask. The cask is designed to transport one PWR assembly or two BWR assemblies by truck. The overall dimensions of the package, with impact limiters, are 232 inches long by 65 inches in diameter. The cask body is approximately 200 inches in length and 44 inches in diameter. The cask cavity is 178 inches long and 13.4 inches in diameter.

The cask body consists of a 0.75-inch thick stainless steel inner shell, a 5.75-inch thick lead gamma shield, a 1.2-inch thick stainless steel outer shell, and a neutron shield tank. The cask lid is 11.3-inch thick stainless steel stepped design, secured to a 14.25-inch thick ring forging with twelve, 1-inch diameter bolts. The cask lid containment seal is a metallic O-ring. A second teflon O-ring and a test port are provided to leak test the seal. Other penetrations in the cask cavity include the fill and drain ports, which are sealed with port covers and O-ring seals.

The neutron shield tank is 164 inches long and 5 inches thick and contains an ethylene glycol and water solution that is 1 percent boron by weight. The cask is equipped with aluminum honeycomb impact limiters.

The maximum weight of the package is 52,000 pounds, and the maximum weight of the contents and basket is 4,000 pounds.

For the transport of TPBARs, the packaging includes a modified PWR basket, spacers that interface with the basket, a modified closure lid, and the Alternate B drain port covers that use metallic O-ring seals. The TPBARs are placed within an open-topped consolidation canister for handling, but these canisters do not perform a safety function in transport. The package containing TPBARs must be shipped within an ISO container or with the personnel barrier.

1.2 Contents

The applicant requested approval to ship up to 300 TPBARs, including a maximum of two damaged rods. The TPBARs are described in Section 1.2.3.6 of the application and in the DOE documents included in Section 1.5. The rods are designed to be inserted within a 17x17 PWR fuel assembly for irradiation, so they are similar in size and overall structure to commercial PWR stainless steel-clad burnable absorber rods.

A typical TPBAR consists of a welded closed Type 316 stainless steel clad rod. An aluminide coating is applied to the steel cladding to prevent tritium diffusion through the cladding. The absorber column is composed of lithium aluminate, which is surrounded by zirconium alloy getters. A gas plenum space and a bottom spacer are located above and at the bottom of the absorber column. The absorber column may run the full length of the rod, or may be composed of multiple pellet stack assemblies, called pencils. The package contents authorized for transport are as follows:

Type and form of material

Irradiated tritium-producing burnable absorber rods (TPBARs), as described in Section 1.2.3.6 of the application. Each TPBAR is approximately 153 inches in length and 0.381 inches in diameter and is stainless steel clad. The TPBARs contain lithium aluminate annular pellets, with an inner zircaloy liner and an outer nickel-plated zircaloy tube. Each TPBAR contains a maximum of 1.2 grams tritium. The minimum cool time is 30 days.

Maximum quantity of material per package

300 TPBARs, including a maximum of 2 damaged rods, positioned within a consolidation canister, as shown in Figure 1.2-10 of the application. The maximum decay heat is 2.31 watts per rod and 693 watts per package. The maximum weight of the TPBARs and the consolidation canister is 1,000 pounds.

1.3 Drawings

The applicant submitted the following revised packaging drawings:

315-40-02, Sheets 1 and 2, Rev. 16	Body Assembly
315-40-03, Sheets 1 through 6, Rev. 20	Transport Cask Body
315-40-08, Sheets 1 through 5, Rev. 16	Cask Parts Detail
315-40-10, Sheets 1 and 2, Rev. 7	PWR Basket

These drawings were revised to incorporate the following design changes:

- Add the Alternate B port cover design. This port cover is used for TPBAR shipments. It incorporates a metallic O-ring containment seal.
- Add the design for a modified PWR basket that will be used for TPBAR shipments.
- Add an alternate cask nameplate for TPBAR shipments to include the Type B(M) designation in the package identification number.

The applicant submitted the following additional packaging drawings:

315-40-127, Sheets 1 and 2, Rev. 1	Spacer Assembly, TPBAR Shipment
315-40-128, Rev. 1	Transport Cask Assembly, TPBAR Shipment

These drawings show the spacer that is mechanically attached to the bottom of the cask lid for TPBAR shipments, and show a general arrangement for TPBAR shipments.

2. STRUCTURAL

The applicant requested approval of the following design changes to the package to support transport of TPBARs:

- The PWR basket was reconfigured to support the consolidation canister, which contains up to 300 TPBARs.
- The cask port cover plates were redesigned to accommodate a metallic O-ring seal and increased internal pressure. These Alternate B port cover assemblies must be used for TPBAR shipments.

In addition, the applicant provided the following change to the structural evaluation for the package:

- The cask body was reevaluated for TPBAR contents, including increased pressures to 300 psig under normal conditions of transport and 600 psig under hypothetical accident conditions.

2.1 Reconfigured Basket

For normal conditions of transport, the applicant analyzed the basket body, basket upper fitting and basket lower fitting (i.e., spacer) including bolting, for the loadings associated with the 1-foot side drop and 1-foot end drop. For hypothetical accident conditions, the applicant analyzed these components for the loadings associated with the 30-foot side drop and 30-foot end drop. The equivalent g loading factors for determining the loads were taken from Table 2.6.7-34 of the application, “Summary of Cask Drop Equivalent G Load Factors.” These analyses demonstrated that the components were within the allowable stress limits of Table 2.1.2-2 for non-containment structures.

2.2 Cask Body

The applicant performed an ANSYS analysis for the cask body using a 3-dimensional, half-symmetrical model. The model included the top and bottom forgings, sidewalls, lead shielding, and bolts. The neutron shield tank and its water contents were modeled only as mass elements, conservatively ignoring any structural strength contribution. An internal pressure of 300 psig was used for normal conditions of transport, and 600 psig was used for hypothetical accident conditions. These values bound the pressures determined for the maximum normal operating pressure (MNOP) and the fire accident, respectively. For the normal condition 1-foot drop, an inertia load of 25 g was used for the side drop, and an inertia load of 20 g was used for the end and corner drops. For the accident condition 30-foot drop, an inertia load of 60 g was used for all drop orientations. These inertia loads were consistent with or bounded the values identified in Table 2.7.7-34 of the application, “Summary of Cask Drop Equivalent G Load

Factors." The ANSYS analysis results are presented in Tables 2.10.14-2 through 2.10.14-16 for the 1-foot drop, and Tables 2.10.14-17 through 2.10.14-28 for the 30-foot drop. These results showed that the stress categories meet the allowable stresses for containment structures identified in Table 2.1.2-1 of the application.

2.3 Cask Closure Lid

For the cask closure lid, the applicant performed a bolt preload evaluation using an increased internal pressure of 600 psig and demonstrated that the previously determined preload and the bolt torque of 260 foot-pounds were still bounding. No further evaluation of the cask lid was necessary since the previously analyzed loading for the PWR fuel bounds the TPBAR contents.

2.4 Alternate B Port Cover

For the Alternate B port cover plate, the applicant preformed a bolt preload evaluation considering the additional loading due to increased internal pressure, additional loading to seat the metallic O-ring seal, and the differential thermal expansion between the high strength bolts and the stainless steel port cover. The analysis demonstrated that the bolt torque of 280 inch-pounds on the high strength Alternate B port cover bolts is sufficient to meet the related design criteria and sealing requirements.

2.5 Pressure Test

To demonstrate the structural integrity of the modified NAC-LWT design for the transport of TPBARs, a post-fabrication hydrostatic pressure test is performed to 450 psig.

2.6 Conclusion

Based on the statements and representations in the application, as supplemented, and independent confirmatory calculations, the staff concluded that the applicant has demonstrated that the package, with the TPBARs as contents, complies with the structural requirements of 10 CFR Part 71 under normal conditions of transport and hypothetical accident conditions.

3. THERMAL

The applicant performed a thermal evaluation for the package with the TPBARs as contents. The thermal evaluation included an analysis of package component temperatures under normal conditions of transport and hypothetical accident conditions. The maximum normal operating pressure and accident condition pressure were also calculated for the new contents.

3.1 Thermal Analysis

The applicant performed the thermal analysis using the ANSYS computer code. The analysis was performed to determine the effects of the TPBARs on cask component temperatures under the normal condition heat test and the accident condition fire test. The maximum heat load analyzed was 2.31 watts for each TPBAR with a peaking factor of 1.15. This represents a total decay heat of 693 watts per package for the TPBAR contents.

3.2 Normal Conditions of Transport

The normal condition model included a half-symmetry, cross sectional, two-dimensional planar model of the aluminum basket, consolidated canister, TPBARs, and the helium inside the cask. The model captured conduction, radiation (using radiation matrix elements), and convection; however, convection was ignored in several areas of the model (see Section 3.4.1.9 of the application). A constant temperature was applied to the outer surface of the model. The temperature applied was based on the analysis of the previously-approved TRIGA fuel contents for the package, which have a maximum decay heat of 1.05 kilowatts. The applicant's approach for this analysis is conservative and is acceptable to the staff.

The table below presents a summary of normal condition temperatures for the LWT from the analysis of TPBARs.

NAC LWT Cask Temperatures for Analysis of TPBARs		
Normal Conditions of Transport Results		
Cask Component	**Calculated Temperature (°F)**	**Temperature Limit (°F)**
Liquid Neutron Shield	207[1]	—[2]
Outer Shell	207[1]	185[3]
Lead Gamma Shield	221[1]	600
Inner Shell	222[1]	—
TPBARs (Cladding)	290	—
Aluminum Basket (maximum)	228	300[4]
Consolidation Canister	245	—
Cavity Gas (average)	246	n/a

Notes:
1. Cask component temperatures from Condition 1 of TRIGA Fuel Cluster Rod Analysis (Table 3.4-9 of the application)
2. Temperature limit not provided by applicant.
3. Limit for Normal Conditions of Transport. Personnel barrier must be used for transport.
4. At 300°F the aluminum basket material retains it's structural strength and retains its capability as a mechanical component.

The outer surface of the cask during normal conditions of transport was calculated to be greater than 185°F, which exceeds the maximum package surface temperature limit specified in 10 CFR 71.43(g) for exclusive use shipments. Therefore the package with the TPBARs must be shipped with its personnel barrier, or within an ISO container. Condition No. 12 of the Certificate of Compliance includes this restriction.

3.3 Maximum Normal Operating Pressure (MNOP)

The applicant provided a revised internal pressure calculation for the TPBARs (Section 3.4.4.4 of the application). The revised analysis used a methodology similar to that presented for previously-approved contents, taking into account the features and materials of the TPBARs. The applicant's calculation accounted for 298 TPBARs which were assumed to undergo cladding failure under normal transport conditions, and 2 damaged, waterlogged TPBARs. For a period of one year, the MNOP was calculated as 289 psig. This MNOP is greater than previously approved contents for this design; therefore, the applicant has instituted a hydrostatic pressure test of 450 +15/-0 psig, which is 150 percent of MNOP (see Section 4.1.2.1.2 of the application).

This MNOP exceeds 100 psig, and therefore, as specified in 10 CFR 71.4, the package is designated as Type B(M). The package, when shipped with TPBARs, must be marked as a Type B(M) package. Condition No. 14 of the Certificate of Compliance has been added to specify that when shipping TPBARs the package must be marked with a package identification number with the Type B(M) designation.

3.4 Hypothetical Accident Conditions

For hypothetical accident conditions, the applicant used results from the fire transient evaluated in Section 3.5.3.2 of the application for the MTR fuel contents. The maximum component temperatures for the TPBAR contents were obtained by adding the temperature difference between the cask inner shell and the maximum component temperature for normal conditions to the maximum accident cask inner shell temperature obtained from the MTR evaluation. This approach is conservative and is acceptable to the staff. Maximum component temperatures for hypothetical accident conditions are shown in the table below.

NAC LWT Cask Temperatures for Analysis of TPBARs	
Hypothetical Accident Condition Results	
Cask Component	**Calculated Temperature (°F)**
TPBARs (Cladding)	402
Aluminum Basket (maximum)	340
Consolidation Canister	357
Cavity Gas (average)	358

The applicant provided a revised internal pressure calculation for accident conditions for the TPBARs (Section 3.5.4.4 of the application). The calculation was based on the average cavity gas temperature shown above. In addition, the internal pressure considered an additional time period of one year following the accident. The maximum pressure calculated was 337 psig. This is significantly less than the design pressure of 600 psig used for the structural evaluation. In addition, the packaging will be subjected to a hydrostatic pressure test of 450 psig prior to use for TPBAR shipments.

3.5 Conclusion

The staff reviewed the thermal section (Chapter 3) of the application for completeness. The staff verified material properties provided in the application and reviewed calculations as well as descriptions and element plots of the ANSYS finite element analysis models as described in the application (Section 3.4.1.9).

Based on the staff's review of the application, as supplemented, the staff agrees that the package meets the requirements of 10 CFR Part 71 with the TPBAR contents.

4. CONTAINMENT

4.1 Description of the Containment System

The containment system of the package is composed of the cask inner shell, bottom end plate, lid, upper ring forging, main closure lid inner metallic O-ring, port covers, and inner metallic O-rings on the port covers. For shipments of TPBARs, the package must be configured with the Alternate B port covers and metallic O-ring seals, as shown in NAC International Drawing No. LWT 315-40-08, Sheet 5 of 5. The Alternate B port cover is designed to remain leak-tight to tritium.

4.2 Containment Analysis

The applicant revised the containment analysis for the package to include the TPBARs as authorized contents. For these contents the applicant demonstrated that the cask, configured for TPBAR shipments, is leak-tight as defined in ANSI N14.5 - 1997, "Leakage Tests on Packages for Shipment," under both normal conditions of transport and hypothetical accident conditions. The new Alternate B port cover design, which uses a Helicoflex metallic face seal (silver type), was added as a package design modification, and will be used for all TPBAR shipments. The leak-tight criterion is demonstrated by leakage testing to the maintenance leakage rate of 2×10^{-7} std cm^3/s of helium (equivalent to 1×10^{-7} ref cm^3/s) as described in Section 8.1.3 of the application, prior to each shipment. No change was made to the containment boundary metallic O-ring (stainless steel) of the main closure lid. Containment system metallic O-rings are replaced prior to each shipment.

The applicant also provided the following DOE reports: TTQP-1-015, Revision 12, "Description of the Tritium Producing Burnable Absorber Rod for the Commercial Light Water Reactor," and TTQP-1-091, Revision 8, "Unclassified TPBAR Releases, Including Tritium." These reports describe the TPBAR assembly type and condition and provide additional assurance that the tritium will be stored in the form of a second phase intermetallic particle in a zircaloy getter. These reports are included in the application in Section 1.5. For intact rods, the amount of releasable tritium per TPBAR is less than 0.00012 curie based on a maximum amount of 1.2 grams of tritium per TPBAR. For damaged rods, the amount of releasable tritium per TPBAR is less than 55 curies. For a full load of TPBARs, the amount of tritium released is less than 1 percent of the total volume of the gas in the cask.

The maximum temperature of the TPBARs under accident conditions was calculated by the applicant as 402°F. This is well below the second phase dissolution temperature of approximately 670°F and provides further assurance that the tritium will be contained in the second phase microstructure of the getter. The maximum accident conditions temperature of the metallic O-ring was previously calculated by the applicant as 571°F, which was well below the design temperature limit of 831°F. That analysis was performed for the most limiting cask loading and assumed a decay heat exceeding the maximum decay heat authorized for the TPBAR shipments.

4.3 Flammable Gas Generation

The applicant also provided a combustible hazard assessment given that tritium, which is a form of hydrogen, may be released from the TPBARs. The applicant demonstrated that there is no flammability hazard for intact TPBARS and that tritium release from damaged TPBARs would result in a concentration of below 1 percent by volume, which is below the flammability limit for hydrogen. The staff concluded that the transport of TPBARs will not result in a flammable mixture of gasses during transportation. The staff also concluded that no chemical or galvanic reactions would occur between the materials present in the package and that the containment characteristics of the package will not be affected by chemical or galvanic reactions.

4.4 Evaluation

The staff confirmed the applicant's conclusions by independent confirmatory analysis of the newly designed Alternate B port cover and leakage testing procedures and determined that the package remains leak-tight under both normal conditions of transport and hypothetical accident conditions.

The staff performed independent calculations which verify that the tritium inventory of 1.2 grams can be readily absorbed by the zircaloy getters, resulting in a robust second phase intermetallic particle microstructure which stores the tritium. The staff agrees that 0.00012 and 55 curies of releasable tritium (for normal and accident conditions, respectively) are reasonable values given the robust tritium storage second phase microstructure.

The staff performed calculations which determined that the accident condition scenario utilizing 55 curies per TPBAR event release would result in a maximum tritium partial pressure of 3.4 psi. Additionally, the staff performed calculations using this maximum tritium partial pressure and determined that the leakage requirements in ANSI N14.5 and 10 CFR 71.51 would be satisfied due to the metallic seals on the package, which are resistant to tritium permeability at the highest calculated seal temperatures of (571°F).

4.5 Conclusion

The robust cask design, utilizing metallic O-ring seals for the containment boundary, and the intermetallic particle tritium storage mechanism in the getter, further ensures that the package will meet the leak-tight standard as defined in ANSI N14.5 for tritium under both normal conditions of transport and hypothetical accident conditions. Therefore, the staff concludes that by adding the TPBAR contents, the applicant has shown that the package meets the containment and leakage requirements of ANSI N14.5 - 1997, 10 CFR 71.43(f) and 71.51(a)(1) under normal conditions of transport, and 10 CFR 71.51(a)(2) under hypothetical accident conditions.

5. SHIELDING

The applicant provided a shielding evaluation for the package containing the TPBARs in Chapter 5 of the application.

5.1 Cask Contents

The package has previously been authorized to carry MTR fuel assemblies and plates, TRIGA and DIDO fuel elements, metallic fuel rods, pressurized water reactor fuel, and boiling water reactor fuel. The applicant requested authorization to ship up to 300 TPBARs, of which two could be damaged. This section of the safety evaluation report describes the changes to the shielding evaluation for the addition of TPBARs to the authorized package contents.

5.2 Source Term

The TPBARs physically resemble fuel rods, however they contain no fissile material and therefore present a gamma-only source term. Each TPBAR is a Type 316 stainless steel rod with a 0.381-inch outer diameter and a 0.336-inch inner diameter and a post-irradiation length of approximately 154 inches. Design basis parameters of the TPBARs are summarized in Tables 5.1-1 and 5.1-2 of the application.

The TPBARs are designed to be placed in a Westinghouse or Framatome 17x17 fuel assembly for irradiation in a commercial power reactor. The components of the TPBARs become radioactive as a result of neutron capture. Once the TPBARs have been irradiated to produce tritium, they are removed from the fuel assembly and placed in a consolidation can, which can hold up to 300 TPBARs. There are three major contributors to the gamma-only source term:

- TPBARs
- Thimble plugs
- Hold-down assemblies

The applicant used the ORIGEN-S module of the ORIGEN2 Version 2.1b code to determine the gamma source term. The reactor data the applicant used to determine the amount of TPBAR irradiation were described on page 1.5-27 of the application. To determine activation source terms for the TPBAR components, the applicant used the parameters in Table 2 on page 1.5-28 of the application, with a cool time of 30 days.

5.3 Dose rates

The applicant used the three-dimensional MCNP Monte Carlo code (version 4C), which is a general-purpose particle transport code, to determine the dose rates for the package. The package was modeled explicitly for analyses under both normal conditions of transport and hypothetical accident conditions. In the MCNP analysis, a peaking factor of 1.15 was applied over the entire TPBAR length to bound the actual discharge irradiation profile.

Table 5.3-72 of the application lists radial and axial maximum and average dose rates under normal and hypothetical accident conditions. The dose rates were based on a payload of 300 TPBARs with a 30 day cool time. For the accident analysis, the neutron shield and shell were conservatively modeled as voids, reducing the amount of shielding available. For normal conditions of transport, the maximum surface dose rate was 82.3 millirem per hour, and the maximum dose rate at 2 meters from the vehicle was 8.4 millirem per hour. Under accident conditions, the maximum 1 meter dose rate was calculated as 50.8 millirem per hour. These dose rates are within the external radiation standards of 10 CFR 71.47 and 71.51(a)(2).

5.4 Confirmatory Calculations

The staff reviewed the unclassified TPBAR description and found sufficient detail to determine that the package with the TPBARs as contents meets the external radiation standards in 10 CFR Part 71.

The staff performed confirmatory analyses of the gamma source term for the TPBARs. Staff used ORIGEN-ARP of the SCALE4.4a system of computer codes, whereas the applicant used ORIGEN-S module of the ORIGEN2 Version 2.1b code. The staff also performed confirmatory shielding calculations using MCNP5. The staff developed a three-dimensional shielding model of the cask and calculated dose rates for normal conditions of transport. The dose rates calculated by the staff were consistent with those reported in the application. Dose rates calculated by staff were within the external radiation limits of 10 CFR Part 71.

5.5 Conclusion

Based upon the information provided by the applicant and the staff’s confirmatory calculations, the staff has reasonable assurance that the applicant’s shielding analyses demonstrate that the package design meets external radiation standards in 10 CFR Part 71. In addition, the package operations specify that radiation surveys are taken prior to each shipment.

6. CRITICALITY

The TPBARs do not contain fissile material. Therefore criticality is not a concern.

7. PACKAGE OPERATIONS

The applicant included supplemental sections in the application that describe wet loading and dry unloading operations for TPBAR shipments (Sections 7.1.9 and 7.2.4). Section 7.1.9 references NAC International Drawing No. LWT 315-40-128 which depicts the cask configuration for TPBAR shipments. For these shipments the cask must be configured with the TPBAR spacer, the TPBAR basket, the Alternate B port covers with metallic O-ring seals, and a cask marking that includes the Type B(M) designation. The leakage testing of the package is performed according to the specifications in Sections 8.1.3.1 and 8.1.3.3 of the application. For TPBAR shipments, the acceptance criterion is 2×10^{-7} std cm^3/s (helium) for the main closure and the port cover seals. Condition No. 14 of the certificate has been added to include specific restrictions for TPBAR shipments and to reference this new drawing. In addition, the applicant made editorial changes throughout Chapter 7 of the application for clarity.

8. ACCEPTANCE TESTS AND MAINTENANCE PROGRAM

The applicant provided revised Sections 8.1.2 and 8.1.3 to address TPBAR shipments. Section 8.1.2 was revised to include a post-fabrication hydrostatic test to 450 +15/-0 psig for the containment system configured for TPBAR shipments. This was revised based on the increased MNOP calculated by the applicant, as described above in Section 3.0, “Thermal,” of this Safety Evaluation Report. Section 8.1.2 of the application was revised to include the leak-tight criterion for the main closure seal and the Alternate B port cover seals when making TPBAR shipments. Condition No. 14 of the certificate specifies this revised pressure test for packagings used for TPBAR shipments, and the revised leakage testing acceptance criterion. In addition, the applicant made editorial changes throughout Chapter 8 of the application for clarity.

Conclusions

Based on the statements and representations in the application, as supplemented, the staff agrees that the addition of TPBARs as authorized contents does not affect the ability of the package to meet the requirements of 10 CFR Part 71.

MODIFICATION OF THE DESIGN OF THE TRIGA SEALED CANISTER

By application dated July 16, 2004, as supplemented August 4, 12, and 13, 2004, NAC International requested a design change to the TRIGA sealed canister, and submitted a revised drawing (NAC International Drawing No. 315-40-087, Rev. 5). The revised drawing eliminated the manufacturer and part number for Item 6, Diaphragm Valve, in the bill of materials. The applicant stated that the part number and manufacturer are not necessary, since the diaphragm valve is a commercial grade product and is procured under the NAC International quality assurance program. The sealed canister for TRIGA fuel served as the second containment boundary as previously required for shipments with a plutonium content greater than 20 curies (0.74 terabecquerel). However, effective October 1, 2004, the regulations in 10 CFR Part 71 no longer require a secondary containment system for these shipments. Therefore, the diaphragm valve no longer serves a safety function for regulatory compliance, and the use of a commercial grade diaphragm valve is considered acceptable.

The Certificate of Compliance has been revised to incorporate the revised drawing for the TRIGA sealed canister.

REVISION OF CONTENT DESCRIPTION FOR HIGH BURNUP PWR RODS

By application dated August 10, 2004, NAC International requested that Certificate of Compliance No. 9225 be amended to clarify that the high burnup PWR rod contents may include irradiated guide tubes and guide tube segments. The applicant stated that the fuel assembly lattice may represent a complete irradiated fuel assembly skeleton, including guide/instrument tubes, spacer grids, and end fittings. Therefore, guide tubes or guide tube segments are already authorized for transport. The revision of the Certificate of Compliance is intended to add clarity. The Certificate of Compliance has been revised to clarify the authorized contents, as requested by the applicant. Condition No. 5(b)(2)(ix) has been revised to specify that irradiated guide tubes and guide tube segments placed in a fuel rod insert are authorized for transport in the package.

EVALUATION FOR “-96" DESIGNATION

Background

On January 26, 2004, the NRC published its final rule revising 10 CFR Part 71 to address compatibility with the 1996 Edition of the International Atomic Energy Agency’s (IAEA) transportation safety standards, “Regulation of the Safe Transport of Radioactive Material” (TS-R-1) and other transportation safety amendments. The revised 10 CFR Part 71 final rule became effective on October 1, 2004 (69 FR 3698).

Evaluation

By application dated October 6, 2004, NAC requested an amendment to Certificate of Compliance No. 9225 for its Model No. NAC-LWT package to include the designation “-96" in the identification number, as specified in 10 CFR 71.19(e). NAC also requested that the Certificate of Compliance be renewed. To support its request for the “-96" designation, NAC provided a table addressing the nineteen issues considered in the rulemaking process that resulted in the revised rule. The staff evaluated the applicant’s request, as described below.

- Issue 1, Changing Part 71 to the International Systems of Units (SI) Only.

  This proposal was not adopted in the final rule, and therefore no changes are needed in the package application or the Certificate of Compliance to conform to the new rule.

- Issue 2, Radionuclide Exemption Values.

  The final rule adopted radionuclide activity concentration values and consignments activity limits in TS-R-1 for the exemption from regulatory requirements for the shipment or carriage of certain radioactive low-level materials. In addition, the final rule adopted an exemption from regulatory requirements for certain natural material and ores containing naturally occurring radionuclides. The applicant indicated that this revision was not applicable to the Model No. NAC-LWT package. The staff agrees based on the design purpose of the package and the allowed contents specified in the certificate. Thus, no changes are needed to conform to the new rule.

- Issue 3, Revision of A_1 and A_2.

  The final rule adopted changes in the A_1 and A_2 values from TS-R-1, with the exception of two radionuclides. The A_1 and A_2 values were modified in TS-R-1 based on refined modeling of possible doses from radionuclides, and the NRC agreed that incorporating the latest in dosimetric modeling would improve transportation regulations. The applicant provided an updated containment analysis in Chapter 4 of the application incorporating the revised A_2 values, which are for radioactive material in normal form. In general, the A_2 values for radionuclides important to the containment requirements for spent fuel shipments were increased. The increased A_2 values increased the maximum allowable leakage rates calculated for the various types of spent fuel authorized for transport, as shown in the revised Tables 4.2-2 and 4.3-2 of the application. Although the calculated maximum allowable leakage rates (L_N and L_A) were increased, the applicant retained the maximum allowable leakage rate that is demonstrated for the cask through leak testing (5.5×10^{-7} std-cm^3/sec helium). Therefore the cask was shown to provide larger safety margins with respect to meeting the requirements of 10 CFR 71.51. The staff agrees that the package meets the containment requirements of 10 CFR 71.51 considering the changes in the A_1 and A_2 values in Appendix A, Table A-1, of the revised 10 CFR Part 71.

- Issue 4, Uranium Hexafluoride (UF_6) Package Requirements.

  These changes are not applicable, since the package is not authorized for the transport of uranium hexafluoride. Therefore, no changes are needed to conform to the new rule.

- Issue 5, Criticality Safety Index (CSI).

  The final rule adopted the CSI requirement from TS-R-1. The applicant revised Chapters 1, 5, and 6 of the package application to incorporate the CSI nomenclature. The Certificate of Compliance has been revised to delete reference to the Transport Index for criticality control.

- Issue 6, Type C Packages and Low Dispersible Material.

  This proposal was not adopted for the final rule. Thus, no changes are necessary.

- Issue 7, Deep Immersion Test.

  The final rule adopted an extension of the previous version of 10 CFR 71.61 from packages for irradiated fuel to any Type B package containing activity greater than 10^5 A_2. Because the Model No. NAC-LWT package is designed to transport irradiated fuel the applicant previously submitted information demonstrating compliance with the required deep immersion test. The staff in its Safety Evaluation Report dated November 20, 1998 has already confirmed that the stresses on the package containment system components resulting from this type of event are within allowable values. Thus, no changes are necessary to conform to the new rule.

- Issue 8, Grandfathering Previously Approved Packages.

  The final rule adopted a process for allowing continued use, for specific periods of time, of a previously approved packaging design without demonstrating compliance to the final rule. The applicant has decided in accordance with 10 CFR 71.19(e) to submit information demonstrating compliance with the final rule. Thus, grandfathering the design of the package is not necessary.

- Issue 9, Changes to Various Definitions.

  The final rule adopted several revised and new definitions. These changes were adopted to provide clarity to Part 71. No change is necessary to conform to the new rule.

- Issue 10, Crush Test for Fissile Material Packages.

  The revised 10 CFR 71.73 expanded the applicability of the crush test to fissile material packages. The crush test is required for packages with a mass not greater than 500 kilograms (1100 pounds). Since the Model No. NAC-LWT package has a mass greater than this, the crush test is not applicable. Therefore the requirement to perform a crush test is not applicable to the package, and no change is necessary to conform to the new rule.

- Issue 11, Fissile Material Package Design for Transport by Aircraft.

  The final rule adopted a new section, Section 71.55(f), which addresses packaging design requirements for packages transporting fissile material by air. The applicant stated that this requirement is not applicable to the Model No. NAC-LWT package. Therefore, for clarity, the Certificate of Compliance has been revised to specify that air transport is not authorized.

- Issue 12, Special Package Authorizations.

  The final rule adopted provisions for special package authorization that will apply only in limited circumstances and only to one-time shipments of large components. This provision is not applicable to the Model No. NAC-LWT package. Thus, no change is necessary to conform to the new rule.

- Issue 13, Expansion of Part 71 Quality Assurance (QA) Requirements to Certificate Holders.

  The final rule expanded the scope of Part 71 QA requirements to apply to any person holding or applying for a Certificate of Compliance. QA requirements apply to design, purchase, fabrication, handling, shipping, storing, cleaning, assembly, inspection, testing, operation, maintenance, repair, and modification of components of packaging that are important to safety. The applicant revised the safety analysis report to explicitly indicate that its QA program satisfies the specific requirements of 10 CFR 71.101(a), (b), and (c). No further change is needed to conform to the new rule.

- Issue 14, Adoption of the American Society of Mechanical Engineers (ASME) code.

  This proposal was not adopted in the final rule. Thus, no change is needed to conform to the new rule.

- Issue 15, Change Authority for Dual-Purpose Package Certificate Holders.

  This proposal was not adopted for the final rule. Thus, no change is necessary to conform to the new rule.

- Issue 16, Fissile Material Exemptions and General License Provisions.

  The final rule adopted various revisions to the fissile material exemptions and the general license provisions in Part 71 to facilitate effective and efficient regulation of the transport of small quantities of fissile material. The criticality safety of the package does not rely on limiting fissile materials to exempt or generally licensed quantities. Chapter 6 of the package application demonstrates criticality safety of the package with the authorized fissile contents. Therefore, no change is necessary to conform to the new rule.

- Issue 17, Double Containment of Plutonium.

  The final rule removed the requirement that packages with plutonium in excess of 0.74 terabecquerel (20 curies) have a second separate inner container. NAC revised the package application to remove references and discussions related to the second inner container requirement. Further, the Certificate of Compliance has been revised to delete the limits based on previous double containment requirement in the following conditions:

  Condition 5(b)(1)(viii), deleted the words "Spent fuel, with plutonium in excess of 20 curies per package, in the form of debris, particles, loose pellets, or fragmented rods is not authorized."

  Condition 5(b)(1)(ix), deleted the words "Spent fuel, with plutonium in excess of 20 curies per package, in the form of debris, particles, loose pellets, or fragmented rods is not authorized."

Condition 5(b)(2)(vi)(b), deleted the words “The plutonium content of the filters shall not exceed 20 curies per package.”

Condition 5(b)(2)(vii)(c), deleted the words “If the total failed fuel plutonium content of the package is greater than 20 Ci, all failed fuel containing plutonium must be enclosed in a sealed canister which is then leak tested to 3.2 x 10^{-7} std cm^3/sec (He) prior to shipment.”

Condition 5(b)(2)(viii)(b), deleted the words “If the total failed fuel plutonium content of the package is greater than 20 Ci, all failed fuel containing plutonium must be enclosed in a sealed canister which is then leak tested to 3.2 x 10^{-7} std cm^3/sec (He) prior to shipment.”

Condition 5(b)(2)(ix), deleted the words “Spent fuel, with plutonium in excess of 20 curies per package, in the form of debris, particles, loose pellets, or fragmented rods is not authorized.”

Condition 5(b)(2)(x), delete the words “Spent fuel, with plutonium in excess of 20 curies per package, in the form of debris, particles, loose pellets, or fragmented rods is not authorized.”

While these changes are not necessary for compliance with the final rule, the basis for the 20 curie limit for plutonium is no longer included in 10 CFR Part 71.

- Issue 18, Contamination Limits as Applied to Spent Fuel and High Level Waste Packages.

  This proposal was not adopted for the final rule. Thus, no change is needed to conform to the new rule.

- Issue 19, Modification of Events Reporting Requirements.

  The final rule adopted modified reporting requirements. While the final rule is applicable to the package, no change is needed to either the Certificate of Compliance or the package application to conform to the new rule.

Conclusion

Based on the statements and representations in the application, the staff concludes that the design has been adequately described and meets the requirements of the revised 10 CFR Part 71. Thus, the staff agrees that including the designation “-96” in the identification number is warranted. To allow time to modify the packaging markings to include the “-96" designation in the package identification number, the certificate has been conditioned to allow use of packagings marked with the “-85" designation for a period of approximately one year. After December 31, 2005, the packaging must be marked with the package identification number including the “-96" designation. This condition does not apply to packagings used for TPBAR shipments, since they must be marked with package identification number USA/9225/B(M)-96, as specified in Condition No. 14 of the certificate.

CERTIFICATE RENEWAL AND CONSOLIDATED APPLICATION

By application dated October 6, 2004, NAC also requested that the Certificate of Compliance be renewed. The applicant provided a consolidated application by supplement dated December 30, 2004, in accordance with 10 CFR 71.38(c). The consolidated application incorporated changes to Certificate of Compliance No. 9225 that were incorporated by reference in Revision 37 of the certificate. The applicant also requested some changes to wording in the certificate, for added clarity.

The staff reviewed the consolidated application and concluded that the application incorporated the changes to the safety analysis report that were previously referenced in the Certificate of Compliance. Minor wording changes were also incorporated. The expiration date on the certificate was revised accordingly.

The certificate has been renewed for a five-year term that expires February 28, 2010.

CONDITIONS

In summary, the following changes were made to the Certificate of Compliance:

- The packaging description in Condition No. 5(a) was revised for clarity.

- The list of drawings in Condition No. 5(a)(3) was updated, and new drawings were included to support the shipment of TPBARs. In addition, Framatome ANP drawings previously listed were replaced by Figure 1.2-11 in the application. Therefore these drawings were deleted from the drawing list.

- Conditions that included restrictions based on previous regulations that required double containment for plutonium were revised. These conditions are described above in this Safety Evaluation Report.

- Conditions No. 5(b)(1)(viii), 5(b)(1)(ix), 5(b)(2)(ix) and 5(b)(2)(x) describe high burnup PWR and BWR rods that are authorized for transport. These conditions were revised to clarify the authorized shipping configurations, as requested by the applicant.

- Conditions No. 5(b)(1)(xii) and 5(b)(2)(xiii) were added. These conditions describe the TPBAR contents, as requested by the applicant.

- Condition No. 5(b)(2)(vii)(a) and 5(b)(2(viii)(a) were revised to specify intact fuel elements, as requested by the applicant.

- Condition No. 5(c) was revised to delete reference to the Transport Index for criticality control.

- Condition No. 8 was revised to include tolerances to the torques for the cask lid and port cover bolts, consistent with the application. In addition, the bolt torque for the Alternate B port cover bolts, which are used for shipment of TPBARs, was added.

- Condition No. 10, which specifies that the cask cavity is inerted with helium prior to shipment, was revised to include TPBAR shipments.

- Condition No. 12 was revised to specify that the ISO container or the personnel barrier must be used when shipping TPBARs.

In addition, the following additional conditions were included in the revised certificate:

- Condition No. 14, which includes specific provisions for TPBAR shipments, was added:

  14. For shipment of TPBARs:

      (a) Prior to first use for shipment of TPBARs, each packaging must be hydrostatic pressure tested to 450 +15/-0 psig, as described in Section 8.1.2 of the application;

      (b) The package must be marked with Package Identification Number USA/9225/B(M)-96;

      (c) The package must be configured as shown in NAC International Drawing No. 315-40-128, Rev. 1; and

      (d) Prior to each shipment, after loading, each cask containment seal must be tested to show no leakage greater than 2×10^{-7} std-cm^3/s (helium).

- Condition No. 15, which allows a cask marking that shows either the "-85" or the "-96" designation for the package identification number for a period of approximately one year. This allows time to fabricate and install revised cask markings.

  15. Except for shipment of TPBARs, packagings may be marked with Package Identification Number USA/9225/B(U)F-85 until December 31, 2005, and must be marked with Package Identification Number USA/9225/B(U)F-96 after December 31, 2005.

- Condition No. 16 clarifies that air transport is not authorized, since this package was not evaluated for the new regulations for fissile material packages transported by air that became effective October 1, 2004.

  16. Transport by air is not authorized.

CONCLUSION

Based upon our review, the statements and representations in the applications, as supplemented, and for the reasons stated in this Safety Evaluation Report, and with the conditions listed above, we have concluded that the changes do not affect the ability of the package to meet the requirements of 10 CFR Part 71.

Issued with Certificate of Compliance No. 9225,
Revision No. 38, on January 25, 2005 .