September 24, 2009

Mr. Anthony Patko
Director, Licensing
Engineering
NAC International
3930 East Jones Bridge Road, Suite 200
Norcross, GA 30092

SUBJECT: REVISION 51 OF CERTIFICATE OF COMPLIANCE NO. 9225 FOR THE MODEL NO. NAC-LWT PACKAGE

Dear Mr. Patko:

By letter dated March 23, 2009, as supplemented by 2 letters dated July 30, 2009, NAC International submitted a revised application in accordance with 10 CFR Part 71 for an amendment to Certificate of Compliance No. 9225 for the Model No. NAC-LWT package to include a shipping configuration for up to 25 Tritium Producing Burnable Absorber Rods (TPBARs) in a PWR/BWR Rod Transport Canister utilizing a 5X5 rod insert, allow the use of an alternate design of the 5X5 Rod Transport Canister to accommodate an oversize nonfuel-bearing component and up to 21 fuel rods, and to update the Drawings. Changes made to the enclosed certificate are indicated by vertical lines in the margin. The staff's Safety Evaluation Report is also enclosed.

Those on the attached list have been registered as users of the package under the general license provisions of 10 CFR 71.17 or 49 CFR 173.471. This approval constitutes authority to use the package for shipment of radioactive material and for the package to be shipped in accordance with the provisions of 49 CFR 173.471. Registered users may request, by letter, to remove their names from the Registered Users List.

If you have any questions regarding this certificate, please contact me at (301) 492-3294 or Kim Hardin of my staff at (301) 492-3339.

Sincerely,
/RA/

Steven L. Baggett, Acting Chief
Licensing Branch
Division of Spent Fuel Storage and Transportation
Office of Nuclear Material Safety
and Safeguards

Docket No. 71-9225
TAC No. L24329

Enclosures: 1. Certificate of Compliance
No. 9225, Rev. No. 51
2. Safety Evaluation Report
3. Registered Users List

cc w/encls. 1& 2: R. Boyle, Department of Transportation
J. Shuler, Department of Energy
Registered Users

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SAFETY EVALUATION REPORT

Docket No. 71-9225
Model No. NAC-LWT Package
Certificate of Compliance No. 9225
Revision No. 51

SUMMARY

By letter dated March 23, 2009, as supplemented by 2 letters dated July 30, 2009, NAC International (NAC or the applicant) requested a revision to Certificate of Compliance (CoC) No. 9225 for the Model No. NAC-LWT package. NAC requested the incorporation of a shipping configuration of up to 25 Tritium Producing Burnable Absorber Rods (TPBARs) in a Pressurized Water Reactor (PWR)/Boiling Water Reactor (BWR) Rod Transport Canister utilizing a 5X5 rod insert, authorization for the use of an alternate design of the 5X5 rod insert for the PWR/BWR Rod Transport Canister that accommodates an oversize nonfuel-bearing component (Combustion Engineering guide tube or BWR water rod) and up to 21 fuel rods, and to update the License Drawings.

Twenty NAC International Drawings were revised to update the CoC for this request and to incorporate changes due to several letter authorizations issued recently to accommodate minor fabrication difficulties identified by NAC.

Accordingly, CoC No. 9225 has been amended based on the statements and representations in the application, and staff agrees that the changes do not affect the ability of the package to meet the requirements of Title 10 of the Code of Federal Regulations (10 CFR) Part 71.

EVALUATION

The submittal was evaluated against the regulatory standards in 10 CFR Part 71, including the general standards for all packages, standards for fissile material packages, and performance standards under normal conditions of transport (NCT) and hypothetical accident conditions (HAC). Staff reviewed the application using the guidance in NUREG-1609, "Standard Review Plan for Transportation Packages for Radioactive Material," and its Supplement 2, "Standard Review Plan for Transportation Packages for Irradiated Tritium-Producing Burnable Absorber Rods (TPBARs)."

Based on the statements and representations in the application, as supplemented, and the conditions listed in the CoC, the staff has reasonable assurance that the design has been adequately described and evaluated and meets the requirements of 10 CFR Part 71.

REFERENCES

NAC International, application dated December 10, 2008.

NAC International, supplements dated March 23 and 2 on July 30, 2009.

1.0 GENERAL INFORMATION

1.1 Package Description

The Model No. NAC-LWT package is shipped by truck, within an ISO container, or by railcar, as a Type B(U)F-96 package, as defined in 10 CFR 71.4. Changes to the packaging in this application are defined on the revised drawings.

1.2 Packaging Drawings

The applicant submitted twenty revised drawings. The revised drawings include:

LWT 315-40-10, Rev. 8	LWT Cask, PWR Basket
LWT 315-40-45, Rev. 6	Weldment, 7 Element Basket, 42 MTR Fuel Base Module, Safety Analysis Report
LWT 315-40-46, Rev. 6	Weldment, 7 Element Basket, 42 MTR Fuel Intermediate Module, Safety Analysis Report
LWT 315-40-47, Rev. 6	Weldment, 7 Element Basket, 42 MTR Fuel Top Module, Safety Analysis Report
LWT 315-40-49, Rev. 6	Weldment, 7 Element Basket, 28 MTR Fuel Base Module, Safety Analysis Report
LWT 315-40-50, Rev. 6	Weldment, 7 Element Basket, 28 MTR Fuel Intermediate Module, Safety Analysis Report
LWT 315-40-51, Rev. 6	Weldment, 7 Element Basket, 28 MTR Fuel Top Module, Safety Analysis Report
LWT 315-40-070, Rev. 6	Weldment, 7 Cell Basket, TRIGA Fuel Base Module
LWT 315-40-071, Rev. 6	Weldment, 7 Cell Basket, TRIGA Fuel Intermediate Module
LWT 315-40-072, Rev. 6	Weldment, 7 Cell Basket, TRIGA Fuel Top Module
LWT 315-40-080, Rev. 4	Weldment, 7 Cell Poison Basket, TRIGA Fuel Base Module

LWT 315-40-81, Rev. 4	Weldment, 7 Cell Poison Basket, TRIGA Fuel Intermediate Module
LWT 315-40-82, Rev. 4	Weldment, 7 Cell Poison Basket, TRIGA Fuel Top Module
LWT 315-40-90, Rev. 4	Weldment, 7 Element Basket, 38 MTR Fuel Base Module
LWT 315-40-91, Rev. 4	Weldment, 7 Element Basket, 38 MTR Fuel Intermediate Module
LWT 315-40-92, Rev. 4	Weldment, 7 Element Basket, 38 MTR Fuel Top Module
LWT 315-40-98, Rev. 6	PWR/BWR Transport Canister Assembly
LWT 315-40-102, Rev. 2	5X5 Insert, PWR/BWR Transport Canister
LWT 315-40-104, Rev. 5	Legal Weight Truck Transport Cask Assy., PWR/BWR Rod Transport Canister
LWT 315-40-128, Rev. 3	Legal Weight Truck Transport Cask Assy., TPBAR Shipment

The drawings were revised to incorporate changes due to several letter authorizations issued recently to accommodate minor fabrication difficulties identified by NAC and to support this revision.

1.3 Contents

Currently, NAC-Legal Weight Truck (LWT) is authorized to transport 300 TPBARS in a consolidated canister and up to 55 TPBARs or TPBAR segments in a waste container.

NAC International (NAC) has requested an approval for an Amendment to the existing CoC No. 9225, Revision 51, to incorporate transporting up to 25 TPBARs in a PWR/BWR rod transport canister (in a 5x5 rod insert), and an approval to modify the 5x5 rod insert for the PWR/BWR transport canister for a larger tube that will allow transport of larger than a single lattice position PWR guide tube or BWR water rod. The existing Safety Analysis Report (SAR), and NAC License Drawings were revised to reflect inclusion of the additional contents, and submitted for NRC staff review.

2.0 STRUCTURAL REVIEW

The staff reviewed the application to revise the Model No. NAC-LWT package structural design and evaluation to assess whether the package will remain within the allowable values or criteria for normal conditions of transport (NCT) and hypothetical accident conditions (HAC) as required in 10 CFR Part 71. This application was also reviewed to determine whether the package fulfills the acceptance criteria listed in Section 2 (Structural Review) of NUREG-1609, “Standard Review Plan for Transportation Packages for Radioactive Material,” and its Supplement 2,

"Standard Review Plan for Transportation Packages for Irradiated Tritium-Producing Burnable Absorber Rods (TPBARs)."

2.1 Structural Review Description

The applicant has presented a structural evaluation of the NAC-LWT cask system for the shipment of up to 25 individual TPBARs in the PWR/BWR Rod Transport Canister, the PWR insert, and the TPBAR basket under NCT and HAC. The TPBAR basket contents are: 1) PWR insert; 2) PWR/BWR rod transport canister; 3) Internal spacer and rod insert; and 4) TPBARs.

The structural review was focused on verifying that the new total weight of (1,901 lbs) TPBARs rods including the fuel rods insert, transport canister and PWR basket spacer used for structural evaluations provides adequate safety margin and is bounded by the current CoC. Also, the staff verified that the PWR/BWR modified transport canister geometry requirements such as length, diameter, etc., were either bounded by previous evaluations or adequate new analysis were provided.

2.2 Materials Evaluation

The changes proposed include a new shipping configuration for 25 TPBARs shipped in a PWR/BWR Rod Transport Canister fitted with a 5x5 rod insert and a modification of the design of the 5x5 rod insert by replacing four rod inserts with an oversized nonfuel-bearing component and up to 21 fuel rods.

The evaluation focused on a review of the previously approved NAC-LWT package and the specific material modifications requested. The objectives of this material review are to ensure adequate material properties exist.

The application was reviewed for material properties of all components of the NAC-LWT package involved with the proposed new shipping configuration and design modification followed by a review of the specific material changes proposed. No new determination on the adequacy of previously approved material properties was made without justification or if not directly applicable to the proposed shipping configuration and design modification submitted.

NAC-LWT Containment Boundary Materials

The NAC-LWT cask provides the containment boundary for the payload and also acts as an environmental barrier. The NAC-LWT shipping cask containment boundary consists of the following: a bottom plate, an inner diameter shell, an upper ring forging, and the closure lid. The bottom plate is 4-inches thick, Type 304 stainless steel (SS) forging containing a lead disk enclosed by a Type 304 SS end cover. The inner diameter shell is Type XM-19 high strength SS and provides the diametrical boundary for the payload cavity. The Type 304 SS upper ring forging is machined for accepting the 11.3-inch thick, Type 304 SS closure lid and includes penetrations to the cask payload cavity for vent/fill/drain valves. In addition, lifting/handling trunnions are welded to the forging. The closure lid forging is machined to recess into the upper ring forging when installed and is secured by twelve Grade 660, high-alloy steel, 1-inch bolts. Machining provides a series of steps to prevent radiation streaming.

NAC-LWT Containment Boundary Seal Materials

Two leaktight configurations (ANSI N14.5) are used for the NAC-LWT. The first, or standard configuration, is achieved by the use of a metallic O-ring seated in a groove machined on the underside of the closure lid and alternate vent/drain port covers provided with Viton containment O-rings. The second configuration is achieved by the use of a metallic O-ring seated in a groove machined on the underside of the closure lid and alternate B vent/drain port covers provided with metal seals. To allow for testing and to verify proper sealing, a second O-ring is designed for the containment boundary O-ring and the alternate B drain/vent port O-rings. Both boundary seal and testing O-rings contact against the machined surface of the upper ring forging to complete the sealing of the cask.

The metal port cover seal containment configuration is required to be utilized for all TPBAR contents and may be used for other contents. The standard, Viton O-ring containment configuration is not authorized for TPBAR contents.

Shielding Materials

An annulus between the inner diameter shell and the Type XM-19 SS outer structural shell exists to enclose a 5.75-inch thick poured lead gamma shield. A solution of borated ethylene glycol/demineralized water/potassium tetraborate is used as a neutron shield in addition to the poured lead gamma shield. This mixture is contained in a 5-inch thick, Type 304 SS tank. The neutron shield tank assembly includes a Type 304 SS expansion tank to allow the thermal expansion and contraction of the neutron shield solution without loss of shielding or overstressing of the shield tank structure. A siphon tube is responsible for the connection between shield and expansion tanks.

Impact Limiters Materials

Aluminum honeycomb impact limiters are attached (four places) to each end of the cask to absorb kinetic energy developed during a cask drop, and limit the consequences of normal operations and hypothetical accident events. Additionally, thermal insulation is provided by the impact limiters, which protects the lid seals during the hypothetical fire accident condition.

Coolant Materials

There are no coolants utilized within the package other than the normal transportation atmosphere of air or helium, depending on content conditions. The cask is passively cooled due to its relatively low maximum heat loading of 2.5 kilowatts (kW).

TPBAR Materials Overview

TPBARs are used to generate and retain tritium. When irradiated in a commercial nuclear reactor, the TPBARs lithium-aluminate pellets absorb neutrons to produce helium and tritium. NAC states that TPBARs are similar in size and nuclear characteristics to standard commercial PWR, SS-clad burnable absorber rods. The exterior of the TPBAR is a Type 316 SS-clad tube 0.381-inch in diameter.

The internal components of a typical TPBAR include a plenum spacer tube (getter tube), a spring clip or a plenum (compression) spring, pellet stack assemblies (pencils), and a bottom spacer tube. The pencil consists of a Zircaloy-4 alloy (corrosion resistance and low thermal neutron cross section) liner around which Lithium Aluminate absorber pellets are stacked and confined in a Zircaloy-4 Tritium Getter tube plated with Nickel on both the inner and outer diameters. Aluminide (for providing corrosion and oxidation resistance) is then coated onto the outer diameter Nickel plate concluding with a layer of SS-clad.

TPBAR Shipping Configuration:

NAC is currently authorized to transport 300 TPBARs in a Consolidation Canister and up to 55 TPBARs or TPBAR segments in a Waste Container. NAC requests to ship up to 25 TPBARs (two prefailed max) in a PWR/BWR Rod Transport Canister fitted with a 5x5 rod insert.

The PWR/BWR Rod Transport Canister assembly consists of the following: an internal spacer, 5x5 rod insert, canister weldment, and a lid and base. All components of the canister assembly are fabricated from Type 304 SS. The PWR insert, aluminum alloy 6061, houses the PWR/BWR Rod Transport Canister assembly which allows for correct positioning and insertion into the alternative TPBAR basket assembly. The alternative TPBAR basket assembly utilizes a shorter (6.5-inch vs. 7-inch long) bottom spacer for an improved fit within the NAC-LWT shipping cask. The PWR insert is not designed as a structural component. The TPBAR basket body, aluminum alloy 6061-T651, is constructed of four machined segments that are held together with aluminum bands at five locations along the axial length of the basket, as well as the top and bottom fittings, which are bolted to the aluminum basket.

The TPBARs do not contain fissile material and the maximum decay heat shall not exceed 0.058 kW for 25 TPBARs.

Rod Insert Modification:

Overview:

NAC requested to modify the design of the 5x5 rod insert by replacing four rod insert tubes with an oversized (single larger diameter) tube for securing a nonfuel-bearing component (CE guide tube or BWR water rod) and up to 21 fuel rods in the remaining inserts.

5x5 Rod Insert Design Modification:

A total of 25 rod inserts are welded together to form a 5x5 matrix/lattice designed to hold fuel rods for transportation. Each rod insert (pin tube) is fabricated from Type 304 SS with an 11/16-inch outside diameter and 0.028-inch wall thickness.

The 5x5 lattice design is modified by replacing four pin tubes with an oversized water rod tube of Type 304 SS with a 1-7/16-inch outside diameter and 0.049-inch wall thickness. NAC states that the presence of the BWR water rod reduces the inertial loading due to the contents, as well as employs a larger cross-section for the BWR water rod as compared to four smaller tubes containing fuel rods. The alternative configuration reduces fuel-bearing capacity to a maximum of 21 fuel rods.

Materials Conclusion:

The staff finds that no new material type(s) were introduced for this revision. Unless otherwise noted in this SER, all material properties used in the package are acceptable.

The staff has reviewed the application. Based on the statements and representations contained in the FSAR and the conditions given in the Certificate of Compliance, the staff concludes that the NAC-LWT Package, Model No. 9225, meets the requirements of 10 CFR Part 71.

2.3 Structural Evaluation

The SAR Section 2.10.14 presented the structural evaluation of the NAC-LWT cask system for two TPBAR content conditions: up to 300 production TPBARs loaded into an open (i.e., unsealed) consolidation canister; and up to 55 segmented TPBARs loaded into a welded closed waste container.

Although the analysis provided in Section 2.10.14 used a slightly lower content weight than the TPBARs in the PWR/BWR Rod Transport Canister configuration, the applied content load is comparable as conservative accelerations were used. As such, the evaluation of TPBARs in the PWR/BWR Rod Transport Canister uses the results of Section 2.10.14, appropriately scaled to account for any increase in total applied content load.

NCT for Cask Body and TPBARs in the PWR/BWR Rod Transport Canister:

The applicant has provided the cask body structural evaluation for NCT for the shipment of TPBARs in the PWW/BWR Rod Transport Canister, the PWR insert, and the TPBAR basket. SAR Section 2.10.14 provided the critical stress intensity results of the NAC-LWT cask system for two TPBAR content conditions: up to 300 production TPBARs loaded into an open (i.e., unsealed) consolidation canister; and up to 55 segmented TPBARs loaded into a welded closed waste container. The Section 2.10.14 analysis used a three-dimensional half-symmetry model of the LWT cask body developed using ANSYS. A detailed description of the implemented finite element model was as shown in Section 2.10.14.1.2. Both the pressure and component temperatures considered in Section 2.10.14 bound the TPBARs in the PWR/BWR Rod Transport Canister configuration.

For the side drop, the cask was loaded by both the contents weight and the weight of the cask body surrounding the cask cavity. The weight of the cask body surrounding the cavity is 34,400 lbs, which includes the lead for shielding, the inner and outer shells, as well as portions of the top and bottom forgings. The evaluation in Section 2.10.14 uses a cask content weight of 1800 lbs, which is 101 lbs less than the TPBAR in the PWR/BWR Rod Transport Canister content weight of 1901 lbs. The normal conditions evaluation of Section 2.10.14 uses a conservative inertial load of 25 g for the side drop, which is 0.7 g greater than the required inertial load of 24.3 g (Table 2.6.7-34). Section 2.10.14 provides the minimum margins of safety for each stress category for 1-foot drop conditions. For the analysis of the TPBARs in the PWR/BWR Rod Transport Canister configuration, the stress-intensity results of critical sections, listed in Section 2.10.14, were scaled by the ratio of the content weight and cask body weight surrounding the

cavity, using an appropriate scale factor. NRC staff has reviewed this analysis, and concur with the approach and finds the results acceptable.

HAC for Cask Body with TPBARs and the PWR/BWR Rod Transport Canister:

The applicant provided the cask body structural evaluation for hypothetical accident conditions as follows:

Free Drop (30-Foot): Section 2.10.14 provided the cask body structural evaluation for the 30-foot drop accident conditions of transport for the shipment of TPBARs in the PWR/BWR Rod Transport Canister, the PWR insert, and the TPBAR basket. Section 2.10.14 provided the critical stress intensity results of the NAC-LWT cask system for two TPBAR content conditions: up to 300 production TPBARs loaded into an open (i.e., unsealed) consolidation canister; and up to 55 segmented TPBARs loaded into a welded closed waste container. The Section 2.10.14 analysis used a three-dimensional half-symmetry model of the LWT cask body developed using ANSYS. A detailed description of the implemented finite element model was shown in Section 2.10.14.1.2. Both the pressure and component temperatures considered in Section 2.10.14 bound the TPBARs in the PWR/BWR Rod Transport Canister configuration.

SAR Section 2.10.14.2.1 provided the results of the critical section stresses for the 30-foot drop accident conditions. As listed in Section 2.10.14.2.1, the minimum margins of safety resulted from the 30-foot side drop condition. The evaluation of Section 2.10.14 used a cask content weight of 1800 lbs, which is 101 lbs less than the TPBAR in the PWR/BWR Rod Transport Canister content weight of 1901 lbs. The accident conditions evaluation of Section 2.10.14 uses a conservative inertial load of 60 g for side drop, which is 10.3 g greater than the required inertial load of 49.7 g (Table 2.6.7-34). As a result, the 30-foot drop evaluation of Section 2.10.14.2 used a content inertial load of 108,000 lb (1800 lbs x 60 g). Assuming a conservative acceleration of 55 g for the side drop inertial load, the contents inertial load for the TPBARs in the PWR/BWR Rod Transport Canister was calculated as 104,555 lbs (1901 lbs x 55 g). The total applied contents load for the critical stresses of Section 2.10.14.2.1 was greater than that for the TPBARs in the PWR/BWR Rod Transport Canister. Therefore, it was concluded that the NAC-LWT cask is structurally adequate for the shipment of TPBARs in the PWR/BWR Rod Transport Canister under the 30-foot drop accident conditions of transport. NRC staff has reviewed this analysis and concur with the approach and find the results as acceptable.

Fire Accident:

The pressure and component temperatures for the TPBARs in the PWR/BWR Rod Transport Canister for the fire accident conditions were bounded by the fire accident evaluation of the NAC-LWT cask body with TPBARs in a consolidation canister in Section 2.10.14.2.2. Therefore, based on the results of Section 2.10.14.2.2, presented in Table 2.10.14-27 and Table 2.10.14-28, the NAC-LWT cask is structurally adequate for the shipment of TPBARs in the PWR/BWR Rod Transport Canister under fire accident conditions.

Inner Shell Buckling:

SAR Section 2.10.6 presented a buckling evaluation of the cask inner shell per ASME Code Case N-284 for the design basis cask configuration. The evaluation presented in Section 2.10.6 bounds the TPBAR contents (up to 25 TPBARs in a rod holder in the PWR/BWR Rod Transport Canister) based on the following:

The maximum weight of the TPBAR contents (up to 25 TPBARs in a rod holder) in the PWR/BWR Rod Transport Canister of 1901 lbs was enveloped by the weight of the design basis contents, which would reduce the compressive stresses in the cask shells due to less inertia loading for the drop conditions. The cask internal pressure for the TPBAR contents (up to 25 TPBARs in a rod holder in the PWR/BWR Rod Transport Canister) was significantly higher than the cask internal pressure for the design basis contents. The increase in the pressure would increase the tensile stresses in the shell that would result in stiffening of the inner shell and, consequently, in reducing the compressive stresses associated with buckling.

The interaction summary presented in Table 2.10.6-10, associated with the design basis weight and the design basis pressure, was bounding for the TPBAR content (up to 25 TPBARs in a rod holder in the PWR/BWR Rod Transport Canister) conditions. Therefore, it is concluded that the cask inner shell will not buckle with the TPBAR contents (up to 25 TPBARs in a rod holder in the PWR/BWR Rod Transport Canister) in the NAC-LWT cask.

2.4 Conclusion

Chapter 2 of the existing SAR was verified by the staff to ensure that the new total weight of revised TPBAR payload including the fuel rod inserts, transport canister, and the PWR basket spacer, provides an adequate safety margin under the applicable regulatory requirements. NRC staff also verified that the proposed modification to the PWR/BWR transport canister either meets the geometry requirements such as length, diameter, etc., of previous LWR rod evaluations, or the applicant has provided new analysis to demonstrate the adequacy of the new design.

Based on the above discussion, the staff concurs with the applicant's request as there is no new situation that might affect the structural integrity of the payload during the shipment. There is reasonable assurance that the package will meet the structural adequacy requirements of 10 CFR Part 71.

3.0 THERMAL REVIEW

The staff reviewed the application to revise the Model No. NAC-LWT package thermal design and evaluation to assess whether the package temperatures will remain within their allowable values or criteria for NCT and HAC as required in 10 CFR Part 71. This application was also reviewed to determine whether the package fulfills the acceptance criteria listed in Section 3 (Thermal Review) of NUREG-1609, "Standard Review Plan for Transportation Packages for Radioactive Material," and its Supplement 2, "Standard Review Plan for Transportation Packages for Irradiated Tritium-Producing Burnable Absorber Rods (TPBARs)."

3.1 Thermal Review Description

This amendment request involves the following changes:

- include up to 25 TPBARs in a PWR/BWR Rod Transport Canister utilizing a 5x5 rod insert, and

- allow the use of an alternate design of the 5x5 rod insert for the PWR/BWR Rod Transport Canister to accommodate an oversize non-fuel bearing component (e.g., CE guide tube or BWR water rod) and up to 21 fuel rods.

3.2 Thermal Evaluation

The maximum heat load for each TPBAR is 2.31 watts, so for 25 TPBARs arranged in a 5x5 rod insert the maximum heat load for the insert would be 2.31 x 25, or approximately 58 watts. The maximum heat load that has been approved for the transport of 300 TPBARs is 693 watts as documented in Table 1.2-8, "Typical Production TPBAR Characteristics." Therefore, the proposed change for the inclusion of the 5x5 rod insert has a heat loading over ten times less than the currently approved heat loading for TPBARs, which are placed in a consolidation canister within the NAC-LWT transportation cask.

For NCT, the applicant performed a comparative analysis of the 5x5 insert to the thermal evaluation of the 300 TPBARs in the TPBAR basket (SAR Section 3.4.1.12) and to the thermal evaluation of high burnup PWR or BWR rods in a rod holder (SAR Section 3.4.1.7). For this comparison the applicant assumed that the 5x5 insert had a total heat load of 100 watts rather than the previously mentioned limit of 58 watts for added conservatism. Ultimately, the applicant determined that the 5x5 insert, had temperatures that were bounded by the aforementioned comparisons to previously approved analyses and concluded that its components were bounded by these results of the 300 TPBARs as shown in Table 3.4-16 "Maximum Component Temperatures for TPBAR Shipment-Normal Conditions of Transport." Based on the difference in heat load between this amendment and the previously approved 300 TPBARs, the staff concluded that this was acceptable.

For the HAC fire, since the proposed 5x5 rod insert has less heat load than the previously approved 300 TPBARs, the staff agrees that the 5x5 rod insert will also be acceptable because the internal temperatures will be lower.

3.3 Conclusion

Based on the comparative arguments presented in the application, the staff affirms the applicant's position that all the material temperature limits have been met and that there has been no increase to previously calculated temperatures or pressures as a result of this amendment. Therefore, this amendment meets the requirements of 10 CFR Part 71.

4.0 CONTAINMENT EVALUATION

The staff reviewed the application to revise the Model No. NAC-LWT package to verify that the package containment design has been described and evaluated under NCT and HAC as

required in 10 CFR Part 71. This application was also reviewed to determine whether the package fulfills the acceptance criteria listed in Section 4 (Containment Review) of NUREG-1609, "Standard Review Plan for Transportation Packages for Radioactive Material," and its Supplement 2, "Standard Review Plan for Transportation Packages for Irradiated Tritium-Producing Burnable Absorber Rods (TPBARs)."

4.1 Containment Review Description

Under the previously approved amendments of the NAC-LWT all TPBAR shipments shall be made in a cask design and tested to the leaktight criteria of ANSI 14.5-1997.

4.2 Containment Evaluation

Leaktightness is assured by metal seals and use of the Alternate B port covers to withstand the higher design pressure (i.e., 300 psig, with a hydrostatic pressure test to 450 psig) associated with the shipment of TPBARs. Since the previously approved 300 TPBAR content bounds the 5x5 insert of TPBARs for gas release and the cask is continuing to meet the leaktight criteria, the staff finds this amendment meets the requirements of 10 CFR Part 71.

4.3 Conclusion

Based on the statements and representations in the application, staff agrees that the applicant has shown that the use of the NAC-LWT meets the containment requirements of 10 CFR Part 71 for this revision.

5.0 SHIELDING REVIEW

The staff reviewed the application to revise the Model No. NAC-LWT package to verify that the shielding design has been described and evaluated under NCT and HAC, as required in 10 CFR Part 71. This application was also reviewed to determine whether the package fulfills the acceptance criteria listed in Section 5 (Shielding Review) of NUREG-1609, "Standard Review Plan for Transportation Packages for Radioactive Material," and its Supplement 2, "Standard Review Plan for Transportation Packages for Irradiated Tritium-Producing Burnable Absorber Rods (TPBARs)."

5.1 Shielding Review Description

The applicant provided the model configurations for and results of the shielding analyses in Chapter 5 of the application. The SAS2H module of the SCALE 5.0 computer code system was employed in the fuel assembly depletion/source term generation analyses, and the MCNP5 code was employed for dose rate calculations.

5.2 Shielding Evaluation

Chapter 5 of the revised SAR provides shielding safety analyses for the TPBAR and 21 fuel rods plus one oversize nonfuel-bearing CE guide tube or water rod package. Up to 300 TPBARs may be loaded in the 5x5 PWR or BWR rod insert. Up to 25 TPBARs may be loaded in each hole of the 5x5 PWR or BWR rod insert. For the package of the oversize nonfuel-bearing CE guide tube or water rod, the center hole of the 5x5 PWR or BWR rod insert will be enlarged to accommodate the oversize component. The enlarged center hole will take up the space of three neighboring holes. The remaining

21 holes will be available for loading of PWR or BWR fuel rods for the matching rod inert. Licensing Drawing 315-40-98 shows the actual configuration of the oversize nonfuel-bearing CE guide tube and water rod insert.

The applicant calculated the dose rates at the surface, 1 meter from the surface, and 2 meters from the surface of the cask using MCNP5, a 3-D transport theory-based Monte Carlo method code. The applicant simplified the source term distribution in the model by omitting the fuel rod lattice details in the fuel rod insert.

The applicant described the MCNP model for the NAC-LWT TPBAR and 21 fuel rods plus one oversize nonfuel-bearing CE guide tube or water rod package for transportation. The applicant assumed that in an HAC event the neutron shield together with the shell was lost and radial, top, and bottom gaps were developed on the gamma shield due to lead slump. The impact limiters also were assumed to be lost during accident.

The applicant evaluated the dose rates of the NAC-LWT TPBAR transportation packages under the above assumptions. Table 5.3.13-5 presents the dose rates of the package under NCT and HAC. The max dose rate is 82.3 mrem/hr on the radial surface and 8.4 mrem/hr at 2 meters from the surface of the truck under normal condition of transport. The maximum dose rate is 253 mrem/hr under HAC.

The staff evaluated the applicant's calculations on the gamma and neutron source terms for the NAC-LWT TPBAR and 21 fuel rods plus one oversize nonfuel-bearing CE control rod guide tube or water rod package. The staff also reviewed the ORIGEN-S and MCNP input files for the source term and shielding analyses. Based on its evaluation, the staff concludes that the TPBAR and 21 fuel rods plus one oversize nonfuel-bearing CE guide tube or water rod package continues to meet the regulatory requirements of 10 CFR 71.47.

5.3 Conclusion

Based on the review, the staff concludes that the package design has been adequately evaluated for radiation shielding and meets the requirements set forth in 10 CFR Part 71. This Safety Evaluation Report (SER) provides the staff's evaluation of this design revision. The details of the evaluations and regulatory findings are provided in the various chapters of this SER.

6.0 CRITICALITY SAFETY REVIEW

The staff reviewed the application to revise the Model No. NAC-LWT package to verify that the criticality design has been described and evaluated under NCT and HAC, as required in 10 CFR Part 71. This application was also reviewed to determine whether the package fulfills the acceptance criteria listed in Section 6 (Criticality Review) of NUREG-1609, "Standard Review Plan for Transportation Packages for Radioactive Material," and its Supplement 2, "Standard Review Plan for Transportation Packages for Irradiated Tritium-Producing Burnable Absorber Rods (TPBARs)."

6.1 Criticality Review Description

The applicant provided in Chapter 6 the model configurations for and results of the criticality safety analyses. For criticality, there was no need for a repeated analysis

because the previously approved contents of 25 BWR or PWR rods package bounds the 21 fuel rods plus one oversize nonfuel-bearing CE guide tube or water rod content. The Criticality Safety Index is determined as 0.

6.2 Criticality Safety Evaluation

For the TPBAR content, there is no adverse safety implication to the criticality safety because the package contains no fissile materials. The criticality safety evaluation for the 21 fuel rods plus one oversize nonfuel-bearing CE guide tube or water rod package is bounded by the previously approved 25 PWR or BWR fuel rods content because the new package contains fewer fuel rods and hence less fissile material in the package. In addition, there is less moderation, and, therefore, lower k_{eff} because the cask system is under-moderated and the guide tube further displaces water.

6.3 Conclusion

The staff reviewed the amendment requests and evaluated the information provided. Based on its review, the staff finds that the applicant has demonstrated, and the staff agrees, that the 21 fuel rods plus one oversize nonfuel-bearing CE control rod guide tube or water rod package continue to meet the criticality safety requirements of 10 CFR Part 71.

7.0 PACKAGE OPERATIONS

Chapter 7 of the SAR provides procedures for package loading, unloading, and preparation of the empty package for transport. Sections 7.1.8, 7.1.9, and 7.1.11 of Chapter 7 provide operating procedures for loading the TPBAR and the 21 fuel rods plus one oversize nonfuel-bearing CE guide tube or water rod packages. Section 7.2.5 of Chapter 7 provides operating procedures for unloading the TPBAR package and Section 7.2.6 provides operating procedures for unloading the PWR/BWR rods and oversize nonfuel-bearing guide tube or water rod package.

The staff reviewed the Operating Procedures in Chapter 7 of the SAR to verify that the package will be operated in a manner that is consistent with its design evaluation. On the basis of its evaluation, the staff concludes that the combination of the engineered safety features and the operating procedures provide adequate measures and reasonable assurance for safe operation of the proposed revision for TPBARs and the 21 fuel rods plus one oversize nonfuel-bearing CE guide tube or water rod in accordance with 10 CFR Part 71. Further, the CoC is conditioned such that the package must be prepared for shipment and operated in accordance with the Operating Procedures specified in Chapter 7 of the Safety Analysis Report.

8.0 ACCEPTANCE TESTS AND MAINTENANCE PROGRAM

The staff reviewed the revisions to Chapter 8 of the application to verify that the revised acceptance tests for the packaging meet the requirements of 10 CFR Part 71.

To support this revision request, Sections 8.1-1 through 8.1-11 and Sections 8.2-1 through 8.2-4 of the SAR were revised to describe the requirements for acceptance testing and maintenance of the leaktight containment boundary.

Based on the statements and representations in the application, the staff concludes that the revised acceptance tests for the packaging meet the requirements of 10 CFR Part 71. Further,

the CoC is conditioned to specify that each package must meet the Acceptance Tests and Maintenance Program of Chapter 8 of the application.

CONDITIONS

The CoC has been revised as follows:

Condition Nos. 5(a)(3)(ii):

Twenty drawings were revised.

Condition No. 5(b)(2)(ix) and 5(b)(2)(x):

Details on the fuel rod insert were added.

Condition No. 5(b)(2)(xiii):

Details on the Rod Transport Canister and the heat load were added.

Condition No. 18:

Allows the use of Revision 50 of this certificate for one year.

CONCLUSION

Based on the statements and representations in the application, as supplemented, and the conditions listed above, the staff concludes that the Model No. NAC-LWT package design has been adequately described and evaluated and that these 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. 51,
on September 24, 2009.