

December 15, 2006

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

SUBJECT: REVISION 43 OF CERTIFICATE OF COMPLIANCE NO. 9225 FOR THE
MODEL NO. NAC-LWT PACKAGE

Dear Mr. Patko:

As requested by your letter dated May 26, 2006, as supplemented August 18 and 22, and October 12, 2006, enclosed is Certificate of Compliance No. 9225, Revision No. 43, for the Model No. NAC-LWT package. You requested additional contents of segmented Tritium-Producing Burnable Absorber Rods (TPBARs) as segments and segmentation debris contained in a welded stainless steel waste container and shipped in the TPBAR basket. 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 or Kim Hardin of my staff at (301) 415-8500.

Sincerely,

/RA/

Robert A. Nelson, Chief
Licensing Branch
Division of Spent Fuel Storage and Transportation
Office of Nuclear Material Safety
and Safeguards

Docket No. 71-9225

TAC No. L24005

Enclosures: 1. Certificate of Compliance
No. 9225, Rev. No. 43
2. Safety Evaluation Report
3. Registered Users

cc w/encl 1 and 2: R. Boyle, Department of Transportation
J. Shuler, Department of Energy
RAMCERTS
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. 43

TABLE OF CONTENTS

SUMMARY	3
REFERENCES	3
1.0 GENERAL INFORMATION	3
2.0 STRUCTURAL	5
3.0 THERMAL	7
4.0 CONTAINMENT	7
5.0 SHIELDING	9
6.0 CRITICALITY	11
7.0 OPERATING PROCEDURES	11
8.0 ACCEPTANCE TESTS AND MAINTENANCE PROGRAM	11
CONDITIONS	11
CONCLUSION	12

SAFETY EVALUATION REPORT

Docket No. 71-9225
Model No. NAC-LWT Package
Certificate of Compliance No. 9225
Revision No. 43

SUMMARY

By application dated May 26, 2006, as supplemented August 18 and 22, and October 12, 2006, NAC International (NAC) requested that the Nuclear Regulatory Commission (NRC) approve a revision to Certificate of Compliance (CoC) No. 9225 for the Model No. NAC-LWT package. NAC requested that the package be authorized for the transport of up to 55 equivalent Tritium-Producing Burnable Absorber Rods (TPBARs) as segments and segmentation debris from post-irradiation examination (PIE) contained in a welded stainless steel waste container and shipped in the TPBAR basket.

EVALUATION

The submittal was evaluated against the regulatory standards in 10 CFR Part 71, including the general standards for all packages, and performance standards under normal conditions of transport (NCT) and hypothetical accident conditions (HAC). Staff reviewed the application using the guidance in NUREG-1617, "Standard Review Plan for Transportation Packages for Spent Nuclear Fuel," NUREG-1609, "Standard Review Plan for Transportation Packages for Radioactive Material," and its supplement "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 concludes that the design has been adequately described and evaluated and meets the requirements of 10 CFR Part 71.

REFERENCES

NAC International, application dated May 26, 2006.

NAC International, supplements dated August 18 and 22, and October 12, 2006.

1.0 GENERAL INFORMATION

1.1 Package Description

The Model No. NAC-LWT package with TPBARs is shipped by truck, within an ISO container, or by railcar, as a Type B(M)F-96 package, as defined in 10 CFR 71.4. NAC requested that the package be authorized for the transport of up to 55 equivalent TPBARs as segments and segmentation debris from post-irradiation examination (PIE)

contained in a welded stainless steel waste container and shipped in the TPBAR basket.

Other details of the revision request are described below:

This amendment request includes the addition of the previously inadvertently omitted TPBAR consolidation canister top insert as part of the approved shipping assembly and special measures implemented for the prevention and control of the spread of tritium contamination.

A testing requirement for sealed canister designs prior to underwater application was also added to the "Acceptance tests and Maintenance Program" in Chapter 8 of the Safety Analysis Report (SAR). Chapter 7, "Package Operations," of the SAR was also revised to describe the procedures for wet and dry loading of the TPBAR waste container into a NAC-LWT cask and to include dry unloading of the TPBAR waste container from a NAC-LWT cask. A procedure addition to Chapter 7 regarding action to be taken if tritium absorption and potential weeping is determined was also added.

The Alternate B port cover closure bolt torque and tolerance changes from 280 +/-10 in-lbs to 285 +/-15 in-lbs, which corresponds to a maximum bolt preload of 5,340 pounds. This change was also incorporated into Chapter 7 of the SAR.

The unclassified U.S. Department of Energy (DOE) reference documents have been updated with this revision and moved to the Chapter 1 Appendices in full page format.

Minor editorial changes were made throughout the SAR without changing the technical content.

1.2 Packaging Drawings

No new license drawings are included in this submittal. Fourteen updated license drawings were included in this submittal. The revised drawings included:

Drawing 315-40-01, Rev. 6	Legal Weight Truck Transport Cask Assembly, Safety Analysis Report
Drawing 315-40-02, Rev. 19	Legal Weight Truck Transport Cask Assembly, Safety Analysis Report
Drawing 315-40-048, Rev. 2	Legal Weight Truck Transport Cask Assembly, 42 MTR Element, Safety Analysis Report
Drawing 315-40-052, Rev. 2	Legal Weight Truck Transport Cask Assembly, 28 MTR Element, Safety Analysis Report

Drawing 315-40-079, Rev. 2	Legal Weight Truck Transport Cask Assembly, TRIGA Fuel
Drawing 315-40-084, Rev. 3	Legal Weight Truck Transport Cask Assembly, 140 TRIGA Elements
Drawing 315-40-094, Rev. 3	Legal Weight Truck Transport Cask Assembly, 35 MTR Elements
Drawing 315-40-104, Rev. 2	Legal Weight Truck Transport Cask Assembly, PWR Transport Canister
Drawing 315-40-111, Rev. 1	Legal Weight Truck Transport Cask Assembly, DIDO Fuel
Drawing 315-40-124, Rev. 1	Transport Cask Assembly, General Atomics IFM, LWT Cask
Drawing 315-40-125, Rev. 3	Transport Cask Assembly, Framatome/EPRI, LWT Cask
Drawing 315-40-127, Rev. 2	Spacer Assembly, TPBAR Shipment LWT Cask
Drawing 315-40-128, Rev. 2	Legal Weight Truck Transport Cask Assy, TPBAR Shipment, Safety Analysis Report
Drawing 315-40-133, Rev. 1	Transport Cask Assembly, PULSTAR Shipment, LWT Cask

License drawing 315-40-128 has been revised to add Assembly 98, TPBAR Waste Shipment. Other drawing changes eliminate conflicting information regarding the requirement for installation and use of tamper-indicating devices on the NAC-LWT cask assembly and to facilitate the use of alternate B port covers on all LWT units with the 285 ± 15 in-lbs torque requirement for the closure bolts. Drawing updates also include the elimination of nonessential technical information (i.e., manufacturers' names, catalog, and part numbers, etc., for ball-lock pins and metal cup seals). The deleted information has no safety significance and was not used in the evaluation of the package to demonstrate compliance with the requirements of 10 CFR Part 71. All the affected components are procured under NAC's Quality Assurance Program based on the assigned Quality Category in accordance with NAC's graded quality approach.

1.3 Contents

This package has previously been evaluated and authorized for shipment of up to 300 intact TPBARs (of which two can be damaged) with the following characteristics:

Parameter	TPBAR
Maximum Number of TPBARs per Consolidation Canister	300
Number of Consolidation Canisters per Cask	1
Rod Clad Material	Stainless Steel
Rod Length, in	153.04
Rod Diameter, in	0.381
Maximum Rod Heat Load, W	2.31
Maximum Cask Heat Load, kW	0.693
Maximum Tritium Content per Rod, gram	1.2
Maximum Activity per Cask, Ci	3.84×10^6
Consolidation Canister Plus TPBAR Weight, pounds	1,000
Maximum Event Failed Tritium Release (Ci/rod)	<55

The requested revision adds the authorized transport of up to 55 equivalent TPBARs as segments and segmentation debris from PIE contained in a welded stainless steel waste container and shipped in the TPBAR basket with the following characteristics:

Parameter/Description	Value
Maximum Number of TPBAR Segments and Debris per Waste Container, equivalent number of TPBARs	55
Number of Waste Containers per Cask	1
Waste Container Material	316L Stainless Steel
Maximum Tritium Content per TPBAR equivalent, gram	1.2
Maximum Activity per Cask, Ci	6.66×10^5
Maximum Heat Load per Waste Container, watts	127
Maximum Loaded Waste Container Weight, pounds	700
Minimum Cooling Time, days	90

2.0 STRUCTURAL

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 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 2 (Structural Review) of NUREG-1617, "Standard Review Plan for Transportation Packages for Spent Nuclear Fuel," NUREG-1609, "Standard Review Plan for Transportation Packages for Radioactive Material," and its supplement "Standard Review Plan for Transportation Packages for Irradiated Tritium-Producing Burnable Absorber Rods (TPBARs)."

2.1 Structural Review Description

Structural analyses of the TPBAR basket for 1-foot side and end drops are performed using classical hand calculations. The analyzed weight of the loaded TPBAR consolidation canister previously approved is 1,000 pounds, which bounds the loaded weight of the TPBAR waste container and extension of 700 pounds. Therefore, the analyses provided for the consolidation canister are bounding. Additionally, the heat load of the TPBAR waste container, 0.127 kW, is bounded by the previously approved TPBAR consolidation canister, 0.693 kW.

As is the case for the previously approved TPBAR consolidation canister, the welded, Type 316L stainless steel waste container is considered a nonstructural component only used for handling the TPBAR segments and debris during cask loading and unloading operations. Therefore, for purposes of the basket structural analyses, the canister and container are both considered to fail and to not protect the contents from damage.

This revision request includes a change in the tolerance for the Alternate B port cover closure bolt torque and tolerance from 280 +/-10 in-lbs to 285 +/-15 in-lbs, which corresponds to a maximum bolt preload of 5,340 pounds. The required calculated bolt torque previously evaluated and approved was 267 in-lbs. The difference in the margins of safety from those previously evaluated were approximately 9%. Implementation of the recommended torque value of 285 +/-15 in-lbs for the Alternate B port cover closure bolts will facilitate the use of torque wrenches calibrated with a +/-4% accuracy. This change is an operational enhancement affecting future TPBAR shipments.

2.2 Material Properties

CoC No. 9225 allows the shipment of up to 300 TPBAR rods, including up to 2 breached rods. The current revision allows the shipment of up to 55 rod equivalents of rod segments, debris, and metallurgical mounts in a sealed austenitic stainless steel container. The sealed container would function only as a transfer container and have no containment functions.

In the original SAR for the transport of the 300 TPBAR rods, the effects of radiation on all the other materials in the system including the seals was analyzed. As stated in the SER no adverse effects were noted.

It was also assumed in the original SAR that all the rods were breached for the purpose of analyzing hydrogen interactions with other materials. No adverse interactions were noted. This evaluation considered this hydrogen interaction with other components due to the potential hydrogen release from cut rod segments in excess of the hydrogen released by diffusion through the cladding of intact rods. Since the original analyses

assumed complete release of hydrogen from even the intact rods, the release of hydrogen in the original analysis bounds the release of hydrogen expected in the present request.

As a result, there are no new material issues raised in this amendment, and the conclusion in the SER for the original TPBAR amendment, that there are no materials safety issues, remains valid.

Based on the information presented in this revision request, staff concludes that there are no new material issues raised, and the conclusion in the SER for the original TPBAR amendment evaluation, that there are no materials safety issues, remains valid. The staff agrees that the changes do not affect the ability of the package to meet the requirements of 10 CFR Part 71.

2.3 Conclusions

Based on the analyses presented in the NAC-LWT Revision No. 43 SAR submittal, staff concludes that the transport of up to 55 equivalent TPBARs as segments and segmentation debris from PIE contained in a welded stainless steel waste container and shipped in the TPBAR basket will provide adequate margins of safety during NCT and HAC and is bounded by the previously approved TPBAR analyses. The staff agrees that the changes do not affect the ability of the package to meet the structural integrity requirements of 10 CFR Part 71.

3.0 THERMAL

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. The thermal analyses (heat load and maximum normal operating pressure) of this application were not changed and were bounded by the previously approved 300 TPBARs in the consolidation canister SAR.

Based on the review of the application, the staff found reasonable assurance that the applicant has demonstrated that the evaluation of the NAC-LWT package with up to 55 equivalent TPBARs as segments and segmentation debris from PIE contained in a welded stainless steel waste container and shipped in the TPBAR basket is bounded by previously approved contents under NCT and HAC. The staff agrees that the changes do not affect the ability of the package to meet the thermal requirements of 10 CFR Part 71.

4.0 CONTAINMENT

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-1617, "Standard Review Plan for Transportation Packages for Spent Nuclear Fuel," NUREG-1609, "Standard Review Plan for Transportation Packages for Radioactive Material," and its supplement "Standard Review Plan for Transportation Packages for Irradiated Tritium-Producing Burnable Absorber Rods (TPBARs)."

4.1 Containment System Design

The containment boundary of the NAC-LWT package consists of a 4.0-inch-thick bottom plate, a 0.75-inch-thick, 13.375 inches inner diameter shell, an upper ring forging, and an 11.3-inch-thick closure lid. 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 containment boundary 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-rings. This boundary does not change with this revision.

This revision request adds 55 segmented TPBARs and debris to the authorized contents with a maximum total weight of 700 pounds. Additionally, the maximum tritium content per waste container is 1.2 grams, and the maximum heat load per waste container from all the segmented TPBARs is 0.127 kW.

The waste container is not a containment boundary and is used for handling convenience of the segmented TPBARs.

4.2 Containment System Evaluation

The staff noted that no pressure evaluation of the waste container was performed, but rather the container was assumed to fail during normal transport conditions. An evaluation of the containment boundary was performed for pressurization effects and presence of a combustible mixture. The applicant demonstrated that the pressurization effect for the 55 segmented TPBARs was bounded by the currently approved evaluation of a shipment of 300 TPBARs which were conservatively assumed to fail during NCT. The applicant calculated a maximum containment pressure of 50 psig from the 55 segmented TPBARs compared to 289 psig from the postulated failure of the 300 intact TPBARs. Additionally, the combustibility analysis conservatively demonstrated that for the 55 segmented TPBARs, the tritium released (3.1% by volume) is below the flammability limit of hydrogen in air.

A permeation evaluation for the tritium gas released from the 55 segmented rods was performed for the seals since they are relatively thin compared to the cask wall thickness. Evaluations were performed for NCT and HAC using seal temperatures that were conservative based on analyses of LWT casks containing significantly higher heat loads (1.05 kW for NCT and 2.5 kW for HAC) compared to a heat load of only 0.127 kW for the 55 segmented TPBARs. These analyses demonstrated that the tritium released was below the regulatory limit of $10E-6$ A₂/hr for NCT and 1 A₂/week for HAC. One A₂ of tritium is 1100 Ci.

The containment boundary is leak tested to the ANSI N14.5 -1997 leak tight criteria; therefore, no content (other than tritium permeation) is assumed to be released during shipment and no radiological evaluation needs to be performed.

Additionally, the applicant committed, in the operating procedures, to notify the NRC of the necessity of reoccurring decontamination of an empty NAC-LWT which would be an indication of excessive tritium absorption and subsequent release after the cask is opened.

4.3 Conclusion

Based on the statements and representations in the application, staff agrees that the applicant has shown that shipping 55 segmented TPBARs in the Model No. NAC-LWT meets the containment requirements of 10 CFR Part 71.

5.0 SHIELDING

The applicant provided a shielding evaluation for the package containing the segmented TPBARs in Chapter 5 of the application. The staff reviewed the application to revise the Model No. NAC-LWT package to verify that the package 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-1617, "Standard Review Plan for Transportation Packages for Spent Nuclear Fuel," NUREG-1609, "Standard Review Plan for Transportation Packages for Radioactive Material," and its supplement "Standard Review Plan for Transportation Packages for Irradiated Tritium-Producing Burnable Absorber Rods (TPBARs)."

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, boiling water reactor fuel, and 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 up to 55 segmented TPBARs and associated debris 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 and the subsequent activation source terms were described in report TTQP-1-111, Rev. 5 included with the application, and used a cool time of 30 days for production TPBARs and 90 days for the segmented post-irradiation examination TPBARs.

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 NCT and HAC. In the MCNP analysis, a peaking factor of 1.15 was applied over the entire TPBAR length to bound the actual discharge irradiation profile.

The calculated dose rates were based on a payload of 300 TPBARs with a 30 day cool time. For this analysis, since the source term of the 55 segmented TPBARs cooled for at least 90 days is significantly smaller than the analyzed 300 TPBARs case, the segmented TPBARs are bounded by the original analysis. The dose rates of the segmented TPBARs will be far below the regulatory limits for NCT and HAC as indicated by the previous analysis.

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 300 TPBARs, which is bounding for the 55 segmented TPBARs cask loading. 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 NCT. 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.

6.0 CRITICALITY

There is no impact on criticality safety for this amendment.

7.0 PACKAGE OPERATIONS

The staff reviewed Chapter 7 of the SAR in the application to revise the Model No. NAC-LWT package to verify that it meets the requirements of 10 CFR Part 71 and is adequate to assure the package will be operated in a manner consistent with its evaluation for approval.

The chapter includes the procedures for package loading, unloading, and preparation of the empty package for transport. To support this revision request, Section 7.1.9 and 7.1.11 of the SAR was revised to include the procedure for the wet loading and dry loading, respectively, of the TPBAR waste container into a NAC-LWT cask. Section 7.2.5 was revised to include dry unloading of the TPBAR waste container from the NAC-LWT cask in a dry unloading facility. Requirements for the use and sensitivity of a tritium monitoring system are included in Section 7.2.5. Section 7.2.5 has also been revised by adding a note to Step 23 in the Procedure for Dry Unloading of TPBAR Contents to address NAC action in case of potential tritium absorption and subsequent weeping by the cask internals. Sections 7.1, 7.1.1, 7.1.10, 7.2.1, 7.2.2, 7.2.3, and 7.3 were revised to incorporate the torque value change for the Alternate B port cover closure bolts.

Based on the statements and representations in the application, the staff concludes that the package operations meet the requirements of 10 CFR Part 71 and that they are adequate to assure the package will be operated in a manner consistent with its evaluation for approval. Further, the CoC is conditioned to specify that the package must be prepared for shipment and operated in accordance with the Operating Procedures in Chapter 7 of the application.

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 8.1.3.3.1 and 8.1.3.3.2 of the SAR was revised to incorporate the torque value change for the Alternate B port cover closure bolts.

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

In addition to the packaging drawings (Condition No. 5(a)(3)(i) and 5(a)(3)(ii)) listed in Section 1.2 and the authorized contents listed in Section 1.3 of this SER (Condition No. 5(b)(1)(xv)), the CoC has been revised as follows:

Condition No. 5(a)(2):

The TPBAR segments and segmentation debris were added to the description of the Model No. NAC-LWT.

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

“300 TPBARs” was corrected to read “Up to 300 TPBARs.”

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

Details on the maximum quantity of segmented TPBARs per package were added.

Condition No. 8:

Revised to reflect the change in the Alternate B port cover closure bolt torque and tolerance

Condition No. 10(c):

The word “TPBAR” was changed to “TPBAR contents” for clarification to the contents for the 1.0 atm helium backfill requirement. The words “individual PWR and BWR rods” were added for clarification.

Condition No. 12:

The word “TPBAR” was changed to “TPBAR contents” for clarification in the requirements for a personnel barrier.

Condition No. 14:

The word “TPBAR” was changed to “TPBAR contents” for clarification in shipment requirements. Also the drawing revision number was updated to Rev. 2.

Condition No. 19:

Allows the use of Revision 42 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. 43,
on December 15, 2006.