

**CERTIFICATE OF COMPLIANCE
FOR RADIOACTIVE MATERIAL PACKAGES**

CERTIFICATE NUMBER	REVISION NUMBER	DOCKET NUMBER	PACKAGE IDENTIFICATION NUMBER	PAGE	PAGES
5086	13	71-5086	USA/5086/B(U)F	1	OF 2

2 PREAMBLE

- a This certificate is issued to certify that the package (packaging and contents) described in Item 5 below meets the applicable safety standards set forth in Title 10, Code of Federal Regulations, Part 71, "Packaging and Transportation of Radioactive Material."
- b This certificate does not relieve the consignor from compliance with any requirement of the regulations of the U.S. Department of Transportation or other applicable regulatory agencies, including the government of any country through or into which the package will be transported.

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

- a ISSUED TO (*Name and Address*)
Babcock & Wilcox Nuclear Operations
Group, Inc.
P.O. Box 785
Lynchburg, VA 24505-0785
- b TITLE AND IDENTIFICATION OF REPORT OR APPLICATION
BWXT Nuclear Products Division application
dated December 23, 2003, as supplemented

4 CONDITIONS

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

5.

(a) Packaging

- (1) Model No.: UNC-2600
- (2) Description

The inner container is an 11-gauge steel box with inside dimensions of 2-5/8" high x 7" wide x 96" long. The inner container is supported in a 22-1/2" ID by 102-1/2" long, 14-gauge steel drum by an insertable cage formed by nine 21-1/2" diameter by 3/8" thick steel plates, spaced approximately 12" apart, with a channel formed through the center of the plates by angle irons. The outer container closure is made with a 14-gauge drum lid with 12-gauge bolt locking ring with drop forged lugs, one of which is threaded, having a 5/8" diameter bolt.

- (3) Drawings

The packaging is constructed in accordance with Thomas Gutman Consultant Drawing No. B-2600-2, Sheets 1 through 6, Rev. 3.

(b) Contents

- (1) Type and form of material

Unirradiated, uranium-zirconium, fuel elements. The uranium may be enriched to any degree, up to 100%, in the U-235 isotope.

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- (2) Maximum quantity of material per package

375 grams of U-235 per package as clad fuel element. The net weight of the contents shall not exceed 265 pounds.

- (3) Contents are limited to one A₂ quantity based on the actual isotopic values for all constituent nuclides of the loaded contents.

(c) Criticality Safety Index (CSI). 100

6. In addition to the requirements of Subpart G of 10 CFR Part 71:

- (a) The package must be prepared for shipment and operated in accordance with Chapter 7 of the application dated October 16, 2009, with the exception that the CSI must be in accordance with Condition No. 5(c).
- (b) The package must be maintained in accordance with Chapter 8 of the application dated October 16, 2009, with the exception that welding repairs are not authorized.

7. The package authorized by this certificate is hereby approved for use under the general license provisions of 10 CFR 71.17.
8. The fabrication of new packages is not authorized after April 1, 1999.
9. Expiration date: November 30, 2014.

REFERENCES

BWXT Nuclear Products Division application dated December 23, 2003.
Supplements dated: May 30, 2008; January 29 and October 16, 2009.

FOR THE U.S. NUCLEAR REGULATORY COMMISSION



Jennifer Davis, Acting Chief
Licensing Branch
Division of Spent Fuel Storage and Transportation
Office of Nuclear Material Safety
and Safeguards

Date: November 24, 2009.



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

SAFETY EVALUATION REPORT
Docket No. 71-5086
Model No. UNC-2600 Package
Certificate of Compliance No. 5086
Revision No. 13

SUMMARY

By application dated May 30, 2008, BWX Technologies, Inc. (BWXT) requested the transfer of the Certificate of Compliance (CoC) No. 5086 for the Model No. UNC-2600 package to Babcock & Wilcox Nuclear Operations Group, Inc. (B&W NOG) in parallel to the transfer of control of Special Nuclear Materials License No. SNM-42. In connection with the staff's review of the CoC transfer request, the staff identified that the Model No. UNC-2600 package was one of those for which results of a shallow angle drop testing could invalidate the basis for approval of the transportation package. The staff sent a Request for Additional Information (RAI) on the drop testing issue on October 28, 2008.

By application dated January 29, 2009, B&W NOG requested renewal of the CoC and provided a response to staff's RAI dated October 28, 2008. By letter dated October 16, 2009, B&W NOG supplemented its application and provided a response to staff's RAI dated March 13, 2009. The certificate has been issued to B&W NOG and renewed for a five year term expiring on November 30, 2014.

EVALUATION

The certificate holder has been changed from BWXT to B&W NOG. B&W NOG has accepted responsibility for the completeness and accuracy of the statements and representations of the previous certificate holder, BWXT. B&W NOG will be responsible for maintenance of the certificate and Safety Analysis Report of the package design in accordance with the requirements of 10 CFR 71.91(c). B&W NOG has indicated that the records for this design will be maintained at the same location where the records have been maintained by BWXT, in Lynchburg, Virginia.

On October 28, 2008, the staff requested the applicant to (i) evaluate whether a 9-meter (30 foot) drop test at a shallow angle orientation could result in lid separation and (ii) examine, if the analysis results in lid separation, the effect of such lid separation on the ability of the package to meet the requirements of 10 CFR 71.55(b) & (e) and 10 CFR 71.59(a)(2). The original licensing basis for the package that was tested assumed that the lid would remain attached to the drum. Separation of the lid from the package could adversely affect the criticality evaluation required to meet 10 CFR 71.55(b) & (e), and also affect the assessment of an array of damaged packages, as required by 10 CFR 71.59(a)(2). Thus, the results of the shallow angle drop testing could invalidate the basis for approval of the package.

in its response dated January 29, 2009, the applicant stated that the 9-meter shallow angle drop test would likely result in the separation of the lid from the package and proposed to (i) restrict the payload to 375 grams of U-235 per package and (ii) limit the maximum number of packages per shipment to 2 by increasing the Criticality Safety Index (CSI) value to 50.

Staff reviewed the applicant's proposed limitations to confirm compliance with the requirements of 10 CFR Part 71. Staff reviewed the applicant's submittal, "UNC 2600 Safety Analysis Report for Packaging Application for License USA/5086/B(U)F," (SAR) dated January 29, 2009, and the subsequent submittal, "UNC 2600 Safety Analysis Report for Packaging Application for License USA/5086/B(U)F," dated October 16, 2009. Staff also reviewed the analyses documenting the package's performance in the normal and hypothetical accident conditions, which were previously relied upon in classifying the package as Type B(U)F, in CoC No. USA/5086/B(U)F, Revision 8, dated February 14, 1994. Staff finds that the SAR dated December 23, 2003, as supplemented, provides the basis for finding that the Model No. UNC-2600 package has been adequately described and evaluated against the normal conditions of transport, as specified in 10 CFR 71.71. The results of the 9-meter shallow angle drop test do not change the ability of the package to meet these normal conditions of transportation.

Staff reviewed the SAR dated December 23, 2003, as supplemented, to evaluate the performance of the package under hypothetical accident conditions of transport. The applicant chose to limit the contents of the package to ensure the hypothetical accident conditions requirements of 10 CFR Part 71 would be met, given the fact that the lid is likely to separate during a shallow angle 9-meter drop test. Staff reviewed the criticality, containment and shielding analyses to evaluate the applicant's assumptions, e.g., "no credit is taken for the ability of the package to protect the contents during transport" and the proposed contents limitations.

The staff reviewed the applicant's statements, regarding lid separation and proposed contents limitations, and representations. The staff also performed independent criticality analyses for the package under hypothetical accident conditions. Based on the results of the staff's independent analyses and its review, the staff finds that the Model No. UNC-2600 package with a payload up to 375 grams of U-235 meets the criticality safety requirements of 10 CFR Part 71 because it contains less than the minimum critical mass of 780 grams of U-235 in an optimally water moderated and reflected U-235 sphere.

The applicant requested approval of a Criticality Safety Index (CSI) of 50 but did not perform an evaluation of the package with the assumed lid separation, in a 2N array, as required by 10 CFR 71.59(a)(2). The applicant asserts that the minimum critical mass is about 820 grams of U-235 based on its referenced publication and that the fissile material in an array of two packages, 750 grams of U-235, is less than the minimum critical mass to determine a CSI value of 50.

The staff performed its independent analyses for the minimum critical mass of homogenous U-235 + H₂O system and found that the minimum critical mass for 100% enriched U-235 is 780 grams rather than 820 grams as indicated by the applicant. This result is consistent with the data published in ANSI/ANS 8.1 and other publications, e.g., R. Q. Wright, et al., "Calculation of the Minimum Critical Mass of Fissile Nuclides," Nuclear Science and Engineering:158, 203-209, (2008). In addition, the staff's independent calculation shows that the k_{eff} value of 2 damaged packages (a total mass of 750 grams of U-235 homogenized and fully reflected with water) is 0.9980 ± 0.0020 . With consideration of statistical uncertainties, this system is in essence

critical. Based on NUREG-1609, "Standard Review Plan for Transportation Packages for Radioactive Material," a Δk_{eff} of 0.05 should be used as a criticality safety margin in order to account for the uncertainties in the calculation of the multiplication factor K_{eff} for a package or array of packages. Therefore, an array of two damaged packages does not meet the criticality safety requirements of 10 CFR 71.59 and the applicant's proposed CSI of 50 is not acceptable. For this reason, the staff considers that a CSI value of 100 is appropriate. Thus, the staff sets a CSI of 100 to authorize only exclusive use shipments with one package per shipment.

As a Type B(U)F package previously approved by NRC without the designation "-85" in the identification number of the CoC, no new fabrication of this package is authorized after April 1, 1999, per 10 CFR 71.19(b)(1). As specified in 10 CFR 71.19(b), this package may be used under the general license of 10 CFR 71.17.

As specified in 10 CFR 71.19(d)(1), the staff is authorized to approve modifications to the design or authorized contents if the changes are not significant with respect to the design, operating characteristics, or safe performance of the containment system when the package is subjected to the tests specified in 10 CFR 71.71 and 71.73. The applicant makes no change to the design or operating characteristics of the package. By limiting the contents to one A_2 quantity, i.e., by ensuring that no more than one A_2 quantity can be released in one week, the package is in compliance with 10 CFR 71.51(a)(2). On the basis of the above, the staff finds that containment requirements are met for the package with its limited contents, when subjected to the tests specified in 10 CFR 71.73.

Staff reviewed the application, as supplemented to confirm that the package complies with the shielding requirements of 10 CFR Part 71. The authorized contents of the package are limited to unirradiated uranium, which primarily emits alpha and beta radiation. Staff agrees that the limited contents of the package, without any shielding, will not exceed the limitations in 10 CFR 71.51(a)(2), 10 millisieverts per hour at 1-meter, when subjected to the tests specified in 10 CFR 71.73. Based on the statements and representations in the application, as supplemented, the staff concludes that the package meets the external radiation requirements in 10 CFR Part 71.

Staff reviewed the operating and maintenance instructions for the Model No. UNC-2600. In the supplement dated October 16, 2009, the applicant has appropriately limited the package contents to less than 375 grams U-235, and no more than the A_2 value, in Chapter 7, Section 7.1, step 3. The applicant must ensure that the appropriate sum of the fraction calculation is used to determine the correct A_2 value for the specific mixture of radionuclides in each fuel element. Staff noted that the incorrect CSI is listed in Section 7.0, but has conditioned the certificate to specify that the CSI is equal to 100. The applicant indicated that oak wood spacers are used at the ends of the box to prevent movement of the contents during transport and protect the fuel element from shifting.

In Chapter 8, Section 8.1, the applicant has clearly identified that no new fabrication is authorized. Staff noted that the verification that "all welds are visually acceptable" (for packages procured before October 9, 1992) did not include the AWS procedure for weld inspection, e.g., "as a minimum, all welds are visually examined per AWS 1.6 (1999)." Staff has conditioned the certificate to specify that the package can no longer be used if it necessitates repair or replacement of welds on the existing packages.

Based on the statements and representations of the application, as supplemented, staff concludes that the operating and maintenance instructions for the packaging meet the requirements of 10 CFR Part 71.

The following revisions to the certificate have been made:

Item No. 3(a) was modified to include the name of Babcock & Wilcox Nuclear Operations Group as certificate holder.

Condition No. 5(b)(2) was modified to limit the quantity of material to 375 grams U-235 per package.

Condition No. 5(b)(3) was added to limit the contents to one A_2 quantity for all constituent nuclides

Condition No. 5(c) of the certificate was revised to include the new Criticality Safety Index. The CSI has been assigned as 100, to limit the authorization to only one package per shipment, and to ensure that exclusive use controls are in place for each conveyance.

Condition No. 6(a) was modified to specify that the package must be prepared for shipment and operated in accordance with Chapter 7 of the supplement, dated October 16, 2009, with the exception that the CSI must be in accordance with Condition No. 5(c).

Condition No. 6(b) was modified to specify that the package must be maintained in accordance with Chapter 8 of the supplement, dated October 16, 2009, with the exception that welding repairs are not authorized.

Condition No. 7 was modified to clarify that the package is approved for use under the general license provisions of 10 CFR 71.17. This change is due to a revision in the numbering of the sections in 10 CFR Part 71 that became effective on October 1, 2004 (69 FR 3698). This condition was renumbered to correct a typographical error from Revision No. 12 of the certificate.

Condition No. 8 was added to require that all fabrications of this packaging must have been completed by April 1, 1999.

Condition No. 9 was added, in lieu of the previous Condition No. 8 in Revision No. 12 of the certificate, to change the expiration date of the certificate to November 30, 2014.

The October 16, 2009, UNC-2600 Safety Analysis Report for Packaging has been included to the reference section.

CONCLUSION

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

The certificate has been renewed for a five year term that expires on November 30, 2014.

Issued with Certificate of Compliance No. 5086, Revision No. 13,
on November 24 , 2009.