April 18, 2011

Mr. Charles J. Temus
Project Manager
AREVA Federal Services, LLC
1102 Broadway Plaza, Suite 300
Tacoma, WA 98402-3526

SUBJECT: CERTIFICATE OF COMPLIANCE NO. 9341 FOR THE MODEL NO. BRR PACKAGE

Dear Mr. Temus:

As requested by your application dated June 4, 2010, as supplemented December 16, 2010, enclosed is Certificate of Compliance No. 9341, Revision No. 1, for the Model No. BRR package. The staff's Safety Evaluation Report is also enclosed.

AREVA Federal Services, LLC, is registered as user of the package under the general license provisions of 10 CFR 71.17. 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.

If you have any questions regarding this certificate, please contact me or Chris Staab of my staff at (301) 492-3321.

Sincerely,

/RA/

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

Docket No. 71-9341
TAC No. L24451

Enclosures: 1. Certificate of Compliance No. 9341, Rev. No. 1
2. Safety Evaluation Report

cc w/encls.: R. Boyle, Department of Transportation
J. Shuler, Department of Energy

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OFC:	SFST	E	SFST		SFST		SFST		SFST		SFST	
NAME:	CStaab		JVera		DTarantino		KGambone		JSolis		MDeBose	
DATE:	1/19/2011		2/1/2011		1/21/2011		1/20/2011		1/21/2011		1/20/2011	
OFC:	SFST		SFST		SFST		SFST		SFST		SFST	
NAME:	DPstrak		MRahimi		NGarcia-Santos		MWaters					
DATE:	3/29/2011		3/15/2011		3/17/2011		4/18/2011					

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Safety Evaluation Report
Model No. BRR Package
Docket No. 71-9341
Certificate of Compliance No. 9341
Revision 1

SUMMARY

By application dated June 4, 2010, as supplemented December 16, 2010, AREVA Federal Services, LLC (AREVA) submitted an application to the U.S. Nuclear Regulatory Commission for an amendment to Certificate of Compliance (CoC) for the BEA Research Reactor (BRR) package.

The amendment proposes to reduce the cooling time from 930 days to 120 days for MITR-II fuel elements. This results in a design change to the MITR-II fuel basket, which increases the thermal decay heat from 30W to 150W and only allows 8 MITR-II fuel elements, not 11.

The staff has concluded the package meets the requirements of 10 CFR Part 71 by using the guidance in NUREG-1609, "Standard Review Plan for Transportation Packages for Radioactive Material," and guidance in NUREG-1617, "Standard Review Plan for Transportation Packages for Spent Nuclear Fuel."

References

AREVA Federal Services LLC, application dated June 4, 2010.

Supplement dated December 16, 2010.

1.0 GENERAL INFORMATION

The applicant requests to reconfigure the MITR-II fuel basket to accommodate increased radiation source terms as well as the decay heat of the fuels to be shipped. The proposed revision to the MITR-II fuel basket eliminates the 3 center fuel elements and allows space for only 8 elements with reduced cooling times, as shown in the Safety Analysis Report (SAR) technical Drawing No. 1910-01-03-SAR.

2.0 STRUCTURAL AND MATERIALS EVALUATION

The structural change in the proposed amendment is a revised fuel basket for the MITR-II fuel elements. The number of elements that the new basket can carry is 8 (previously 11). The new basket weighs 560 lbs (267.6 kg) when empty (previously 290 lbs (131.5 kg)).

2.1 Structural Design

The MITR-II basket consists of a cylindrical weldment supported by a 14-inch diameter pedestal. Twenty-nine (29) stainless steel flat plates of variable thicknesses are machined and stacked to create eight (8) diamond shaped fuel cavities. Fuel cavities are arranged symmetrically about the center axis of the basket. The top plate of the weldment is machined to prevent the loading of fuel into the central cavity of the basket. The bottom plate of the weldment provides support for the fuel and allows for drainage of water from the fuel cavities.

Drawing No. 1910-01-03-SAR of the application provides structural details for the basket design. The revised MITR-II fuel basket is 53.45 in (135.8 cm) long and 15.63 in (39 cm) in diameter, as the previous version.

2.2 Structural Compliance with Regulations

The MITR-II basket is one of four baskets for use with the BRR package. It weighs 640 lb (297 kg), fully loaded. The MURR basket weighs 770 lb (349 kg) and is the heaviest basket for this package. Therefore the MITR-II's structural effects are not bounding on the package for Normal Conditions of Transport (NCT) or Hypothetical Accident Conditions (HAC) since the dynamic loads are smaller than the heaviest basket.

Staff determined that the new, heavier design of the MITR-II basket is structurally more robust than the previous design and therefore more resistant to structural effects than the MITR-II basket design previously approved for Normal Conditions of Transport (NCT) or Hypothetical Accident Conditions (HAC).

The only structural concern with the basket, buckling of the lower pedestal under a 30-foot drop condition, was evaluated by the applicant using the method of American Society of Mechanical Engineers (ASME) Code Case N284-2. The applicant used the fully loaded basket weight (which includes the lower pedestal's self weight) and acceleration of 120 g (nearly 150% of the highest test result in half-scale tests performed on Certification Test Units) in the buckling analysis for a conservative result. Staff verified the calculations and finds the approach and results acceptable.

2.3 Materials Evaluation

The proposed amendment permits the substitution of a 3/8-inch thick plate of American Society for Testing and Materials (ASTM) A240 304 stainless steel with A276 304 stainless steel on Drawing No. 1910-01-03-SAR. The staff finds this change acceptable as both standards require the same minimum mechanical properties for the materials and have nearly identical compositions.

One material was added to licensing drawing 1910-01-03-SAR, sheet 1, list of materials for Item 7 to be fabricated from pipe (0.25 wall thickness) under specification ASTM A312, GR TP304. This material was added to existing material specification ASTM A240, Type 304. The added material properties were reviewed for its intended end use and against the existing material specification. Both materials are essentially similar in chemistry and upon review of the ASME code both are listed under the same group number in Section IID. The staff considers the added material specification to be acceptable.

The applicant states that the seals mentioned in Table 3.1-1 refer to the containment elastomer seals used to seal the package and were updated from "seals" to "elastomeric seals" terminology throughout. Thermal analysis shows the bounding temperature of the closure seal, vent port sealing washer, and drain port sealing washer. Also, Section 2.12.7 has been revised to include an analysis of Rainier Rubber butyl compound R-0405-70 test data and a conservative determination of the acceptable long-term (one year) NCT temperature. In addition, Section 7.1.2 has been revised to allow only new (unused) elastomer O-rings and sealing washers. Section 7.4 (pre-shipment leakage rate testing using the pressure rise

technique) is invalid for new O-rings and has been deleted. As a result, reference [4] of Chapter 7 is no longer required and has been removed. Lastly, the applicant verified that the polyurethane elastomer used in the impact limiters would not be affected by the decay heat of the package contents.

The staff finds that the terminology change seeks to define the general seal material type only and not the intended function of the seal. Installation and testing of new (unused) elastomer O-rings and sealing washers are permanently incorporated within the procedures for loading the package prior to all shipments. The current specified pre-shipment helium leakage rate tests are not new tests and were always offered as an option to the deleted pressure rise pre-shipment leakage rate test previously described in ~~of~~ Section 7.4. The staff considers the actions incorporated by the applicant as a result of request for additional information to be acceptable.

The staff considers the actions incorporated by the applicant as a result of request for additional information to be acceptable and the overall materials and structural evaluation to meet 10 CFR Part 71 requirements.

3.0 THERMAL EVALUATION

The staff reviewed the proposed BRR transportation package amendment to verify that the thermal performance of the package has been adequately evaluated for the tests specified under NCT and HAC and that the package design satisfies the thermal requirements of 10 CFR Part 71. The amendment was reviewed to determine whether the package fulfills the acceptance criteria listed in Section 3 of NUREG-1617, "Standard Review Plan for Transportation Packages for Spent Nuclear Fuel," as well as associated Interim Staff Guidance (ISG) documents.

The principal changes in the proposed amendment involve a revision to the minimum cooling time of the MITR-II fuel elements from 930 days to 120 days. This change results in an increase to the thermal decay heat from 30 to 150 watts per fuel element or 1200 watts total heat load per package. A change was also implemented to the MITR-II fuel basket to accommodate the increased decay heat. A dry loading scenario was also added in Chapter 7 (Package Operations) to enhance the utility of the package. The thermal evaluation for the BRR package is still based on the MURR fuel elements and the MITR-II since these fuel elements result in the maximum decay heat load per package. The peak packaging component temperatures for the MITR-II payload are similar to those achieved with the MURR payload since the total decay heat is similar for both packages (1200 and 1264 watts, respectively).

Maximum component temperatures during NCT are presented in Table 3.3-2 of the SAR. All temperatures remain below the allowable limits with adequate margin. The applicant considered the MURR payload to perform the HAC evaluation, since it has the maximum heat load and will bound the other packages, including the modified MITR-II basket. Table 3.4-1 of the SAR presents the maximum component temperatures during HAC. All predicted temperatures are below allowable limits with significant margin. Table 3.1-1 of the SAR presents a summary of the maximum pressures predicted under NCT and HAC. The BRR package design pressure is 25 psig. The applicant calculated a maximum normal operating pressure of 5.6 based on the NCT predicted temperatures. A maximum bounding pressure of 10 psig is set by the applicant for this package during NCT. The predicted pressure during HAC is 8.8 psig, which corresponds to the MURR payload. As a result of these changes, all predicted temperatures and pressures are below allowable limits during NCT and HAC with

adequate margin of safety. The staff reviewed the changes described in the amendment and the revised analyses and assumptions and finds the amendment acceptable.

The staff has reviewed the package design, construction, and preparations for shipment and concludes that the package material and component temperatures will not extend beyond the specified allowable limits during normal conditions of transport consistent with the tests specified in 10 CFR 71.71. The staff has reviewed the package design, construction, and preparations for shipment and concludes that the package material and component temperatures will not exceed the specified allowable short time limits during HAC consistent with the tests specified in 10 CFR 71.73.

4.0 CONTAINMENT EVALUATION

There are no nuclear safety changes to the containment section of the SAR.

5.0 SHIELDING EVALUATION

The objective of this review is to verify that the BRR transportation package design meets the requirements of 10 CFR Part 71 under NCT and HAC.

The applicant requests to reconfigure the MITR-II fuel basket to accommodate increased radiation source terms as well as the decay heat of the fuels to be shipped. The proposed revision to the MITR-II fuel basket eliminates the 3 center fuel elements and allows space for only 8 elements with reduced cooling times, as shown in SAR technical Drawing No. 1910-01-03-SAR.

The applicant analyzed the radiation shielding of the new basket configuration design. Section 5.3.1 of the SAR provides the model specifications for the applicant's shielding evaluation. All relevant design features of the BRR package were modeled in three-dimensions in MCNP, as shown in Figure 5.3-1 of the SAR. The key dimensions relevant to the MCNP model are summarized in Table 5.3-1 of the SAR and are obtained from Section 1.3.3 of the SAR.

The change made to the package design affects only the MITR-II fuel basket. The removal of the three center fuel elements from the allowable contents of the package design compensates for the increase in source terms of a single element so that the total source term and dose rates of the package remain essentially the same. The maximum NCT and HAC dose rates are reported in Table 5.1-1 of the SAR. The fuel type associated with each dose rate is provided in the same table.

The staff reviewed the package design changes presented in the proposed SAR revision. The staff reviewed the dose rates reported by the applicant in Table 5.1-1 of the SAR. Based on the statements and representations contained in the SAR and the conditions given in the Certificate of Compliance, the staff concludes that the BRR transportation package continues to meet the regulatory requirements of 10 CFR Part 71. The staff used guidance in Section 6 of NUREG-1617, "Standard Review Plan for Transportation Packages for Spent Nuclear Fuel," to determine that regulatory requirements are satisfied.

6.0 CRITICALITY EVALUATION

The objective of this review is to verify the BRR transportation package design meets the criticality safety requirements of 10 CFR Part 71.

The applicant requests to reconfigure the MITR-II fuel basket to accommodate increased radiation source terms as well as the decay heat of the fuels to be shipped. The proposed revision to the MITR-II fuel basket eliminates the three center fuel elements and allows space for only eight elements with reduced cooling times, as shown in SAR technical Drawing No. 1910-01-03-SAR.

The applicant performed analyses for a single package as well as arrays of packages under conditions of 10 CFR 71.55(b), (d), and (e), and 10 CFR 71.59(a)(1) and (2). The results of these analyses are presented in Section 6.4 through 6.6 of the SAR. The SAR contains tables that show the calculated k-effectives and their corresponding standard deviation. The upper subcritical limit (USL) for the BRR (package or package array) is determined by the applicant to be 0.9209. The package is considered to be subcritical if k_{safe} (k_s) is less than the USL. The computed k_{safe} is equated as $k_s = k_{eff} + 2\sigma < USL$. The reactivity for each fuel type and the USL are found in Table 6.1.1 of the SAR. The Criticality Safety Index of the new package design is 0.

The staff reviewed these tables and found that the most reactive cases are clearly identified and are demonstrated to be less than the USL. The staff performed a confirmatory analysis of the applicant's revised MCNP criticality model of the MITR-II fuel configuration. The staff verified parameters such as material composition, density, geometry, and accuracy of the input file and then ran the input file to verify the applicant's results. The revision 3 change in MITR-II fuel basket configuration results in a reduction of k_{eff}. The staff found the final estimated k_{eff} to be 0.56162 +/- 0.00094 when fully reflected with water as for a HAC. The staff notes that the maximum enrichment specification of the MURR, MITR-II, and ATR fuels has been increased from 93% maximum to 93 ± 1 wt.% U-235 in Chapter 1. The criticality analysis uses 94% in the model which bounds the actual fuel enrichment.

The staff reviewed the criticality safety analysis provided in the SAR. The staff has concluded the package meets the requirements of 10 CFR Part 71 by using the guidance in NUREG-1609, "Standard Review Plan for Transportation Packages for Radioactive Material," and guidance in NUREG-1617, "Standard Review Plan for Transportation Packages for Spent Nuclear Fuel." Based on the statements and representations contained in the SAR, the staff concludes that the BRR transportation package continues to meet the criticality safety requirements of 10 CFR Part 71.

7.0 PACKAGE OPERATIONS

The amendment request for the BEA Research Reactor Package includes the addition of a dry loading scenario to the package operations, describing the actions to take in chronological order to perform dry loading of the cask.

The staff reviewed and evaluated the proposed procedure. The operating procedure provides reasonable assurance that the user will correctly load and unload the cask following these procedures and the ALARA principal has been followed in the design of the package operations.

Section 7.1.2 of the SAR has been revised to allow only new (unused) elastomer O-rings and sealing washers. Section 7.4 of the SAR (pre-shipment leakage rate testing using the pressure rise technique) is invalid for the new O-rings and has been deleted. The staff concludes that the BRR package continues to meet the requirements of 10 CFR Part 71.

CONDITIONS

The following conditions in CoC No. 9341 were revised:

- Condition 5.(a)(3) was revised to specify new drawings for the MITR-II basket to allow only 8 fuel elements, not 11.

- Condition 5.(b)(1) was revised to reduce the minimum cooling time to 120 days for MITR-II fuel elements, increase the maximum decay heat to 150 Watts for each MITR-II fuel element, increase the maximum enrichment to 94.0 wt. % for MURR, MITR-II, and ATR fuel, provide clarification for table parameters pertaining to pre-irradiated fuel, specify maximum U-235 per fuel plate for MURR, MITR-II, and ATR fuel for clarity, clarify each TRIGA fuel element fuel matrix is uranium mixed with zirconium hydride, clarify that Zr and U-235 specified masses are a maximum for TRIGA fuel types, and provide the maximum U-235 enrichment and maximum H/Zr atom ratio for TRIGA fuel types for clarity.

- Condition 5.(b)(2) was revised to only allow 8 MITR-II elements per package.

CONCLUSION

Based on the statements and representations contained in the application, as supplemented, and the conditions listed above, the staff concludes that the Model No. BRR package meets the requirements of 10 CFR Part 71.

Issued with Certificate of Compliance No. 9341, Revision No. 1,
on April 18, 2011.