



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

SAFETY EVALUATION REPORT
Docket No. 71-9341
Model No. BEA Research Reactor
Certificate of Compliance No. 9341

SUMMARY

By application dated January 9, 2019 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML19016A143) Orano Federal Services (the applicant) requested a one-time authorization for a shipment using the Model No. BEA Research Reactor (BRR) package to transport spent fuel elements from the Rhode Island Nuclear Science Center (RINSC) reactor having a burnup calculated to be in excess of the amount approved in the transportation package's Certificate of Compliance (CoC). The RINSC fuel elements are not currently authorized contents in CoC No. 9341, Revision 7 (ADAMS Accession No. ML19038A094).

A one-time letter authorization has been granted to authorize these shipments based on the statements and representations in the application. The staff agrees that the change does not affect the ability of the package to meet the requirements of Title 10 of the *Code of Federal Regulations* (CFR) Part 71.

EVALUATION

The applicant requested a one-time authorization for a single shipment of the BRR package containing spent fuel elements originating from the RINSC having a burnup calculated to be in excess of the amount approved in the transportation package's CoC. The staff reviewed and evaluated the fuel parameters in the application and determined that the request does not affect the ability of the package to meet the requirements of 10 CFR Part 71. The following sections summarize the staff's evaluation.

1.0 GENERAL INFORMATION

1.1 Packaging

The BRR package body is a right circular cylinder 77.1 inches long and 38 inches in diameter. It comprises inner and outer shells that is connected by a thick lower end casting. The shells and lower end casting are made of American Society for Testing and Materials Type 304 stainless steel with an encased lead shield. The cast-in-place lead shielding fills the annulus between the shells. Together, with the removable 11.2-inch thick shield plug under the closure lid, the package body assembly constitutes the payload cavity, which has a diameter of 16 inches and a length of 54 inches. The principal components of the BRR are: a lead-shielded package body, a separate, removable upper shield plug, a bolted closure lid, upper and lower impact limiters containing polyurethane foam, and various payload baskets specifically designed for each type of fuel being transported.

The package is primarily a welded structure using Type 304 austenitic stainless steel. There are no changes in the design of the package body or the payload container.

The applicant will transport the fuel elements in the currently licensed square fuel basket (Assembly A5 on drawing 1910-01-03-SAR, "BRR Package Fuel Baskets [safety analysis

report] SAR Drawing.” Revision 6, referenced in CoC, Revision 7) during transport. The following sections include the evaluation of the changes to the packaging to accommodate the proposed contents in this letter authorization request.

1.2 Contents

Revision 7 of the CoC, the transportation package’s active certificate at the time that this application was submitted, permits a maximum burnup of 52.5 MWd for each RINSC fuel element. RINSC fuel currently licensed for shipment in the BRR package is 19.75% enriched U_3Si_2 , with a maximum fuel loading of 275 grams U-235 a minimum cooling time of 120 days, and a maximum burnup of 52.5 MWd. The single payload, which is the subject of this request differs from the currently licensed payload only in burnup and cooling time. The subject RINSC fuel payload has a maximum burnup of 52.61 MWd and a minimum cooling time of 589 days.

The applicant proposes using the BRR to ship currently authorized RINSC fuel elements with burnup exceeding what is currently approved in the transportation package’s active CoC, Revision 7. Additional fuel parameters are summarized in Table 1.7 of the CoC, Revision 7 and in greater detail in the BRR CoC, Revision 5 application (ADAMS Accession No. ML15188A086) and the applications associated SER (ADAMS Accession No. ML16204A306), with the only exception being the burnup, which exceeds what is assessed in the referenced application and SER.

The RINSC fuel elements proposed by this application are not currently authorized for shipment in the BRR package as approved in CoC No. 9341, Revision 7. As such, the analyses performed for this letter authorization derive their bases from the analyses performed as part of the CoC, Revision 5, of the BRR approval, as well as the information provided in the subject application of this letter authorization.

2.0 STRUCTURAL EVALUATION

There were no changes that affected the package’s structural evaluation.

3.0 THERMAL EVALUATION

There were no changes that affected the package’s thermal evaluation.

4.0 CONTAINMENT EVALUATION

There were no changes that affected the package’s containment evaluation.

5.0 SHIELDING EVALUATION

The applicant requested a one-time authorization for an exclusive use shipment of spent fuel elements from the RINSC reactor in the BRR package. The spent fuel elements for this one-time authorization have a burnup calculated to be in excess of the amount approved in the BRR package’s CoC. The objective of this review is to verify that the BRR package loaded with the contents describe in this request meets the external radiation requirements of 10 CFR Part 71 under normal conditions of transport and hypothetical accident conditions.

5.1 Description of the Contents and Assumptions

The applicant states that the spent fuel elements from the RINSC reactor are approved for transport in the BRR package, which is capable of transporting up to eight RINSC spent fuel

elements. The RINSC identified five spent fuel elements that have a burnup in excess of the certificate of compliance limit of 52.5 MWd, with a maximum burnup of 52.61 MWd and a minimum cooling time of 589 days.

The applicant states that the package's square fuel basket will be used in the transport of the proposed RINSC fuel payload. Based on the BRR package side dose rates, as detailed in Table 5.4-2 of the application, the external radiation levels generated by the currently approved RINSC spent fuel elements contents are bounded by the approved loose plate box contents. The package surface side maximum dose rate for the currently approved RINSC fuel contents is 3.8 mrem/hr, while the total package side surface dose rate for the loose plate box contents is 39.2 mrem/hr. Based on the maximum dose rate at various locations described in the application, the package side is the limiting location for the dose rates. Also, the applicant evaluated the proposed content against the radiation level limits for exclusive use transport. According to 10 CFR 71.47, the package surface dose rate limit is 200 mrem/hr for exclusive use transport. The higher 1,000 mrem/hr limit is not applicable because the shipment will use an open vehicle without an enclosure around the package. The dose rate limit applies at the outer surface of the heat shield, and the outer surface of the impact limiters.

The applicant used NUREG/CR-6716, "*Recommendations on Fuel Parameters for Standard Technical Specifications for Spent Fuel Storage Casks*", in its evaluation of the package with the proposed, slightly higher burnup, RINSC spent fuel element contents instead of performing new shielding analyses. Particularly, the applicant used the trends in neutron and gamma dose rates with burnups identified in NUREG/CR-6716 to estimate the impact on the package dose rates with RINSC spent fuel elements with the higher burnups in the request. These trends are that the neutron dose rates will increase approximately as the burnup to the power of four, while gamma dose rates will increase nearly linearly with burnup.

Based on the currently approved RINSC fuel contents burnup limit of 52.5 MWd and the proposed RINSC fuel contents burnup of 52.61 MWd, the applicant estimated that the neutron dose rates will increase by a factor of 1.0084, while the gamma dose rates will increase by a factor 1.0021; the applicant conservatively did not credit the proposed contents' cooling time being longer than the minimum allowed in the certificate of compliance. Applying these factors to the dose rates calculated in the application for the currently approved RINSC spent fuel element contents does not result in a significant increase in the package side surface dose rate (increase of less than 0.1 mrem/hr). It is demonstrated in Section 2.7.1.5 of the application, *Fuel Basket Stress Analysis* that the baskets remain intact after a drop event, and therefore the baskets may be modeled as undamaged for both normal conditions of transport and hypothetical accident conditions.

5.2 Staff evaluation

The staff reviewed the description of the proposed RINSC reactor spent fuel element for this one-time shipment authorization and the parameters for the RINSC fuel currently approved for shipment in the BRR package. The staff also performed source term calculations based on the information provided by the applicant. The staff used TRITON depletion code, which is part of SCALE 6.1 computer code to develop a source term model using the burnup, enrichment and cooling times for the proposed RINSC fuel. Although, the applicant based their neutron and gamma dose rate evaluation on NUREG/CR-6716, the staff notes that this NUREG is written for commercial spent nuclear fuel storage, not transport of research reactor spent nuclear fuel, which has different fuel material and different geometric configuration. Thus, the staff performed confirmatory analysis, calculating the source terms for both the approved RINSC

spent fuel element contents and the proposed RINSC spent fuel contents and using the relative difference in the source terms to estimate the relative difference in package dose rates for the contents (proposed vs. approved).

The staff's analysis considered both the burnup and the cooling times described for the proposed contents along with the enrichment of 19.75 wt% of U-235. The staff's confirmatory analysis demonstrated that the surface dose rates will be less than 3.8 mrem/hr at the package side. This reduction in dose rates at the package side is mainly because the proposed contents have four times longer cooling times (589 days) than the approved contents (120 days), which results in decay of the source term that exceeds the increase in the source term from the slightly increased burnup. Also, while the staff has questions about the applicant's use of NUREG/CR-6716 in its evaluation and its applicability to the RINSC fuel, the staff's analysis confirms that the results of the applicant's evaluation are, in this instance, conservative. Therefore, the staff finds that the package with the proposed contents for this one-time shipment will not exceed the radiation level limits established in 10 CFR 71.47 and in 10 CFR 71.51 and meets the external radiation requirements in 10 CFR Part 71.

6.0 CRITICALITY SAFETY EVALUATION

There were no changes that affected the package's criticality evaluation.

7.0 PACKAGE OPERATIONS

There were no changes that affected the package's operations.

8.0 ACCEPTANCE TESTS AND MAINTENANCE PROGRAM REVIEW

There were no changes that affected the package's acceptance tests or maintenance program.

9.0 CONDITIONS

CoC No. 9341 has been amended by letter to authorize one shipment of the BRR package containing RINSC fuel elements exceeding a burnup of 52.5 MWd. No additional conditions apply beyond those stated in CoC No. 9341, Revision 7. All other conditions of CoC No. 9341, Revision 7, shall remain the same. This authorization expires on May 31, 2020.

CONCLUSION

CoC No. 9341 has been amended by letter to authorize shipment of one BRR package containing RINSC fuel elements with a maximum burnup of 52.61 MWd. This authorization expires on May 31, 2020.

Based on the statements and representations in the application, and with the conditions listed above, the staff agrees that this change does not affect the ability of the package to meet the requirements of 10 CFR Part 71.

Issued in reference to Certificate of Compliance No. BRR, Revision No. 7.