

Request for Additional Information  
Docket No. 71-3088  
Model No. CASTOR THTR/AVR Package

By letter dated March 11, 2015, the Department of Transportation (DOT) submitted a request for review of the German Certificate of Approval No. D/4214/B(U)F-96 (Rev. 10) for the CASTOR THTR/AVR package and make a recommendation concerning the revalidation of the package for import and export use.

By letter dated January 11, 2017, the U.S. Nuclear Regulatory Commission staff (NRC staff or staff) provided a safety evaluation report (Docket No. 71-3088, CAC No. A33010) recommending revalidation with the following conditions:

- Condition No. 1: Packages must be transported as exclusive use.
- Condition No. 2: The pre-shipment leakage test at  $10^{-7}$  ref  $\text{cm}^3/\text{sec}$  (air) must include the cask body as well as the seal regions.

By letter date June 3, 2021, the Department of Transportation requested the evaluation of the U.S. Department of Energy (DOE) request that the pre-shipment leakage test condition be removed from DOT's Competent Authority Certificate (USA/0808/B(U)F-96) for the CASTOR THTR/AVR package.

This request for additional information (RAI) identifies information needed by the U.S. Nuclear Regulatory Commission staff in connection with its review of the DOT request in compliance with the International Atomic Energy Agency (IAEA), "Regulations for the Safe Transport of Radioactive Material," TS-R-1, 2012 Edition.

## **MATERIALS EVALUATION**

- 1- Identify the materials and fabrication methods used for manufacturing the four containment boundary components (i.e., cask body, secondary lid, blind flange, protection cap) of the reserve cask that received leakage rate testing and the corresponding four containment boundary components of the loaded consignment casks that are not subjected to leakage rate testing. The staff requests that this information include the following data:
  - (i) The specific types of materials used for constructing the four containment boundary components that received a leakage rate test for the reserve cask and the corresponding four components for the consignment casks. The staff notes that, for several components, the cask design has more than one option for material type. The staff seeks to understand the specific materials option chosen for the reserve and consignment casks.
  - (ii) The containment material fabrication methods and material specifications (e.g., requirements of national or international standards). If certain components were not fabricated according to a national or international standard, then please provide a description of the elemental composition, material processing

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techniques, material properties, and test criteria for the casks' structural components.

If there are any differences between the four containment boundary components of the reserve cask that received leakage rate testing and the corresponding four components of the consignment casks with respect to items (i) and (ii) above, then identify the specific differences between the components of the reserve cask and the corresponding components of the consignment casks with respect to material types, fabrication methods, and material fabrication standards, as applicable.

For any differences identified in the paragraph above, provide a justification as to why the containment boundary components for the consignment casks may be considered to be functionally equivalent to those of the reserve cask in their ability to perform as a leak tight barrier to the migration of gaseous radionuclides from inside containment to the outside environment.

For its review, the NRC staff considers whether there is adequate confidence that the above four containment boundary components for the consignment casks are functionally equivalent to those for the reserve cask with respect to performing as a leak tight barrier to the release of gaseous radionuclides from inside the containment. As part of this assessment, the NRC staff considers whether the intrinsic material properties of these 4 components in the consignment casks, absent any flaws that could form a leak path, are the same as (or sufficiently similar to) the intrinsic properties of the reserve cask structural materials, with respect to the ability of the materials to function as a leak tight barrier that prevents the migration of gaseous radionuclides from inside the containment to the outside environment.

In its review of the technical documentation submitted by GNS for this application, the NRC staff noted that GNS included just the following statement explaining why the above four components of the consignment casks may be considered to be functionally equivalent to those of the reserve cask in their ability to perform as a leak tight barrier:

“The reserve serial cask was manufactured and tested in the same way as the loaded casks of CASTOR THTR/AVR and can consequently be considered as representative.”

The NRC staff reviewed this statement and determined that it is not adequate to support a technical determination that the above four containment boundary components for the consignment casks may be considered to be functionally equivalent to those for the reserve cask in the ability to perform as a leak tight barrier. The reason that the staff considers this statement to be insufficient in this regard is because it does not provide the level of detail needed for the staff to make a technical determination that the consignment cask components would be capable of preventing the migration of gaseous species through the containment boundary. Accordingly, the information above regarding the materials and associated fabrication methods used for manufacturing the above four components of the reserve cask and consignment casks is requested.

This information is necessary to determine compliance with Paragraphs 659(a) and 659(b)(ii) of IAEA SSR-6.

- 2- Provide the following information regarding the nondestructive examinations that were performed for acceptance of the newly fabricated structural containment boundary components of the consignment casks:
- (a) Identify the methods of nondestructive examination (e.g., radiographic testing method, ultrasonic testing method, liquid (dye) penetrant method, visual examination methods, etc.) that were performed for acceptance of the newly fabricated structural containment boundary components.
  - (b) Describe the national or international standards or alternative criteria applicable to the performance of these examinations.
  - (c) Describe the methods and acceptance standards used for the evaluation of the examination results, and the results of the examinations.
  - (d) Address how these examinations and examination results are adequate for ensuring the absence of flaws that may form a leak path through the containment boundary in newly fabricated material.

Since the four containment boundary components of the reserve cask that were leakage tested satisfied the ANSI criteria for leak tightness, it is reasonable to assume that these reserve cask components did not have any flaws that could form a leak path. For the containment boundary components of the consignment casks that are not leakage tested, the staff must consider whether there is adequate confidence that there are no such flaws that could form a leak path for the release of radioactive gasses.

As part of its basis for this determination, the staff must consider whether there is adequate confidence that there are no flaws that originated during fabrication of the consignment cask structural containment boundary components that could be a leak path.

In its review of the technical documentation submitted by GNS for this application, the NRC staff noted that GNS included just the following statement explaining why the above four structural containment boundary components of the consignment casks may be considered to be functionally equivalent to those for the reserve cask in their ability to perform as a leak tight barrier:

“The reserve serial cask was manufactured and tested in the same way as the loaded casks of CASTOR THTR/AVR and can consequently be considered as representative.”

The NRC staff reviewed this statement and determined that it is not adequate to support a technical determination that there is adequate confidence that the structural containment boundary materials for the consignment casks are free of fabrication flaws that could form a leak path through the containment boundary. The reason that the staff considers this statement to be insufficient in this regard is because it does not provide any information regarding the nondestructive examinations, examination acceptance standards, and examination results for consignment casks' structural containment boundary materials. This examination information is needed to provide evidence that the structural containment boundary materials for the consignment casks are free of flaws that could form a leak path. Accordingly, the information above regarding the

nondestructive examinations performed for acceptance of the structural containment boundary components of the consignment casks is requested.

This information is necessary to determine compliance with Paragraphs 659(a) and 659(b)(ii) of IAEA SSR-6.

- 3- Address, as specified below, whether the structural containment boundary components of the consignment casks are susceptible to aging between the time of manufacture and the time of shipment that may degrade the containment function, and address any periodic and/or pre-shipment inspections that may be credited for detecting such aging effects:
- (a) Provide a conservative estimate of the amount of time that will have elapsed between the time of manufacture of the consignment casks and the estimated time when the consignment casks will be shipped. Please include in this response an estimate of the amount of elapsed time prior to shipment when the consignment casks will have been loaded with radioactive contents.
  - (b) Describe the environment in which the consignment casks have been stored between the time of fabrication and time of shipment (e.g., climate-controlled, outdoors, or other type of environment).
  - (c) Address whether there are any aging mechanisms that could have the potential to degrade the containment function of the consignment casks during the elapsed times reported in response to part (a) above based on structural containment boundary materials, environmental conditions, and loading conditions prior to shipment.
  - (d) Describe any inspections (e.g., visual examinations and/or other types of nondestructive exams) of the consignment casks performed during storage and immediately prior to shipment that may be credited for detecting aging effects that may potentially degrade containment function.

Even if there are no fabrication-related flaws that could be a leak path, the staff must consider whether there is the potential for any significant aging to occur in the consignment casks' structural containment boundary components between the time of fabrication and the time of shipment, where the aging mechanisms could potentially form a new leak path(s) in the containment boundary. Specifically, if there are sufficiently adverse environmental and/or loading conditions, then certain material aging mechanisms may have the potential to reduce containment wall thickness, form new flaws in the containment boundary, cause the growth of small preexisting subcritical flaws in the containment boundary, and/or reduce the structural tolerance of small preexisting subcritical flaws in the containment boundary.

This information is needed because the proposed elimination of the pre-shipment leakage rate test condition completely eliminates any direct evidence that the consignment casks' structural containment boundary components are capable of functioning as a leak tight barrier prior to shipment. Accordingly, the information above regarding the aging of the consignment casks' structural containment boundary components is requested.

This information is necessary to determine compliance with Paragraphs 659(a) and 659(b)(ii) of IAEA SSR-6.

## **CONTAINMENT EVALUATION**

- 1- Confirm that the value calculated for the reference air leakage rate of  $1.7 \times 10^{-4}$  ref·cm<sup>3</sup>/s in Section 5.4 "Reference air leakage rates" on Page 16/21 of GNS B 325/2018, Rev. 2, "Containment Analysis for the Type B(U)F Package Transport and Storage Cask CASTOR® THTR/AVR", is calculated for normal conditions of transport (NCT) and that the leakage rate calculated for NCT is limiting.

Upon review of the reference mentioned above, it was not clear to the staff whether the reference air leakage rate referred to above was calculated for NCT.

This information is necessary to determine compliance with Paras 501 (b), 503 (c), and 659 (a) and (b) (ii) of SSR-6.

- 2- Provide a detailed description of the pressure monitoring system used to monitor the sealing system on the CASTOR® THTR/AVR Storage Cask.

The staff was not able to locate a detailed description of the pressure monitoring system for the sealing system of the CASTOR® THTR/AVR cask in the documentation provided to the staff for review.

Given the importance of the performance of the cask sealing system in assessing containment integrity prior to the shipment of the CASTOR® THTR/AVR cask system, a description of this system should be provided.

This information is necessary to determine compliance with Paras 501 (b) and (c) of SSR-6.