January 11, 2017

Mr. Richard W. Boyle, Chief
Radioactive Materials/R&D Branch
Division of Engineering and Research
Office of Hazardous Materials Technology
U.S. Department of Transportation
1200 New Jersey Ave., S.E.
Washington, D.C. 20590

SUBJECT: REVALIDATION OF THE GERMAN CERTIFICATE OF APPROVAL NO. D/4214/B(U)F-96 FOR THE MODEL NO. CASTOR THTR/AVR PACKAGE

Dear Mr. Boyle:

This is in response to your letter dated March 11, 2015, requesting our assistance in evaluating the Model No. CASTOR THTR/AVR package, authorized by the German Certificate of Approval No. D/4214/B(U)F-96, Revision 10. On July 22 and November 22, 2016, you provided the additional information requested on June 29, 2015, to complete our detailed technical review.

Based upon our review, the statements and representations contained in the Safety Analysis Report for Packaging Transport and Storage Cask CASTOR® THTR/AVR, as listed in reports GNB B 135/2004, Rev. 4, Part I-Design; GNB B 063/2004, Rev. 1, Part II-Construction; GNB B 136/2004, Rev. 4, Part III-Operation; and the Technical Note E 2006/0168, Rev. 0, dated April 27, May 16 and May 4, 2006, respectively; and for the reasons stated in the enclosed Safety Evaluation Report, we recommend revalidation of the German Certificate of Approval No. D/4214/B(U)F-96, Revision 10, 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 cm^3/sec (air) must include the cask body as well as the seal regions.

If you have any questions regarding this matter, please contact Pierre Saverot of my staff at (301) 415-7505.

Sincerely,

/RA/

John McKirgan, Chief
Spent Fuel Licensing Branch
Division of Spent Fuel Management
Office of Nuclear Material Safety
and Safeguards

Docket No. 71-3088
CAC No. A33010

Enclosure: Safety Evaluation Report

Mr. Richard W. Boyle, Chief
Radioactive Materials/R&D Branch
Division of Engineering and Research
Office of Hazardous Materials Technology
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SAFETY EVALUATION REPORT
Model No. CASTOR THTR/AVR
German Certificate of Approval No D/4214/B(U)F-96, Revision 10.
Docket No. 71-3088

By letter dated March 11, 2015, the U.S. Department of Transportation (DOT) requested that the Nuclear Regulatory Commission (NRC) staff review the Model No. CASTOR THTR/AVR package, as authorized by the German Certificate of Approval No. D/4214/B(U)F-96, Revision 10, to provide a recommendation concerning the revalidation of the certificate for import and export use.

DOT provided the documentation for this application in the following reports: Part I - Design - Report GNB B 135/2004, Rev. 4; Part II - Construction - Report GNB B 063/2004, Rev. 1; Part III - Operation - Report GNB B 136/2004, Rev. 4; "Complement to the Criticality Safety Report Type B(U)F Package Transport and Storage Cask CASTOR® THTR/AVR", Technical Note E 2006/0168, Rev. 0; "Evaluation of the amendments of the 17th and 18th European Agreement concerning the International Carriage of Dangerous Goods by Road Amendment Decrees with regard to their relevance to the safety analysis report upon which the approval is based", Technical Note E 2007/0018, Rev. 0; Report: GNB B 332/2003, Rev. 0 (Document UI-11) and Technical Note E 2006/0168, Rev. 0. On July 22 and November 22, 2016, DOT provided the responses to a request for additional information (RAI) dated June 29, 2015.

The staff evaluated the Model No. CASTOR THTR/AVR package against the standards in the International Atomic Energy Agency (IAEA), "Regulations for the Safe Transport of Radioactive Material," Safety Standards Series No. TS-R-1, 2009 edition.

Based upon the statements and representations contained in the application and the responses to the RAIs, the staff recommends that DOT revalidate the German Certificate of Approval No. D/4214/B(U)F-96, Revision 10, 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 cm^3/sec (air) must include the cask body as well as the seal regions.

1.0 GENERAL INFORMATION

The Model No. CASTOR THTR/AVR package is a dual use package, designed for both transportation and storage purposes. Only the package's ability to meet transportation regulations according to TS-R-1 2009 was reviewed.

The package is a smooth surfaced, cylindrical package with two bolted lids made primarily of ductile cast iron (GGG-40) capped by two impact limiters made primarily of spruce. The package with impact limiters has a length of 3.906 meters, outer diameter of 2.09 meters, and weighing 32,030 kg. The impact limiters are placed over the lids which prevent tampering with

the closure of the package. The trunnions are blocked from usage, once the impact limiters are put on the package, by both bolts and the impact limiters themselves.

The containment system consists of the cask body, the primary lid with the inner metallic seal and outer elastomeric seal, the test port sealing screw with a metal seal, the evacuation hole protection cap with a metal seal, the secondary lid with inner metallic seal and outer elastomeric seal, the protection cap with a metal seal, and the threaded pressure switch with a metal gasket. No valves or pressure relief devices are incorporated into the package design.

2.0 STRUCTURAL AND MATERIALS EVALUATION

2.1 Structural Evaluation

The structural evaluation of the Model No. CASTOR THTR/AVR package against the TS-R-1 2009 requirements is described below.

The trunnions were evaluated using finite element analysis and were shown to be able to withstand lifting loads that included dynamic effects. The trunnions are bolted on the main body of the cask, and their failure will not impair the package's ability to meet regulations. The package was evaluated for dynamic loads observed during normal transportation, as well as by specialized equipment that would lift the cask and place it on the conveyance. The dynamic loads used in the evaluation included physical test data. Bolt torque (pretension) was calculated and specified on the plans. The applicant evaluated thermally induced stresses in the cask body and bolts for normal conditions of transport (NCT) and hypothetical accident conditions (HAC -fire) by way of a finite element analysis (ANSYS). The internal pressure of the package was shown to not exceed 153 kPa (absolute) while the package overall was shown to withstand 700 kPa.

For NCT, side drop orientations of 0^{o} and 45^{o} as well as end drops were performed on an essentially unyielding surface. Finite element analysis (ANSYS) and Excel were used in the evaluation of the impact limiters and the cask body. It was assumed that the impact limiters would have to absorb all impact energy (unyielding surface assumption).

HAC package performance was demonstrated via a combination of analytical and experimental techniques. Excel was used to determine the impact limiter performance for the 9 m drop test for several package orientations. Decelerations observed during HAC for orientations other than those determined experimentally (end drop, side drop and at 45^{o}) were calculated using the computer code DROP. The DROP software was benchmarked using full size package drop data for packages that were similar to the Model No. CASTOR THTR/AVR package. The applicant assumed that the impact limiters would absorb all impact energy (unyielding surface assumption), as assumed for NCT. The slap down scenario was modeled using LS-DYNA and was found to be the most severe drop orientation with respect to deceleration loads. The highest calculated g-load was seen to occur at 4^{o} with a value of 188 g noted. Decelerations obtained from Excel and DROP were then applied to the package in a quasi-static manner. Physical testing included dropping the package a distance of 9 meters at -40^{o} C ambient temperature.

The 1 m drop test onto a bar was modeled in ANSYS where the side wall of the package experienced strains that were less than 1%. Plastic strains observed by other package components were significantly below their plastic limits. The applicant examined the sequence of accident scenarios (9 m drop followed by puncture drop and 500 kg plate drop) followed by the water immersion test (ANSYS analysis) and demonstrated adequate package performance.

2.2 Materials Evaluation

A materials review for revalidation of German Certificate of Approval D/4214/B(U)F-96, Rev. 10, for the Model No. CASTOR THTR/AVR transportation package was conducted to ensure compliance with safety requirements 613, 615, 618, 642, 651(c), 664 and 676 in IAEA Safety Requirements Document No. TS-R-1, "Regulations for the Safe Transport of Radioactive Material," 2009. The evaluation included verifying materials compatibility, ability of the materials to perform without degradation, any potential generation of gases or corrosive atmospheres from radiolysis and ability of the materials to meet the temperature requirements. The review was performed based on a compilation of documents, including reports GNB B 135/2004, Rev. 4, GNB B 063/2004, Rev. 1, GNB B 136/2004, Rev. 4, and references therein.

The package contents include undamaged spherical spent fuel elements (AVR-FE) containing thorium in a graphite matrix and encapsulated in a fuel-free graphite shell, or undamaged hafnium and boron-containing absorber materials and graphite elements (BTE contents). The elements are then loaded into a separate canister inside the package containment cavity. These canisters are fabricated from corrosion-resistant stainless steel and coated with a zinc-silicate paint to mitigate corrosion. The inner surfaces of the cask are also coated with a zinc-silicate coating. The surfaces of the basket for the fuel element canisters are also coated with corrosion-mitigating paint. The package contents are vacuum-dried following loading, and the containment cavity is backfilled with an inert gas (GNB B 093/97, Operating Instructions Document). The staff finds that these design and operational requirements for loading are adequate for protecting the contents from inadvertent chemical reactions during transport, and preventing degradation of the contents during transport that could result in fuel reconfiguration.

The applicant defined the material properties for all cask containment subcomponents in the report GNB B 135/2004 at a design temperature of 75 °C, including the cask body, the primary and secondary lids and the protective plate. The applicant stated that the design temperature is adequate as it results in lower tensile yield stresses than the corresponding values at -40°C. The staff reviewed the mechanical properties of cask materials and finds the applicant's conclusion acceptable.

The primary lid is fabricated of three alternate materials (spheroidal graphite cast iron GGG-40, low-temperature carbon steel St 52-3 or ferritic steel TStE 355). Both the secondary lid and protection plate are fabricated of ferritic steel (Fe 510 D1 or TStE 355). The applicant's approach for demonstrating that these materials provide adequate performance at low temperature (-40 °C) was to demonstrate that maximum stresses during a 9-m side drop remain below 70% of the yield strength (St 52-3, TStE355 and Fe 510 D1 materials) or below 50% of the yield strength (GGG-40 material) (GNB B 082/2000, BAM GGR-007). The staff reviewed these analyses and concludes that their proposed approach is acceptable and that separate fracture mechanical evaluations are not required for these cask components. The staff also reviewed the material specification, which states that primary and secondary lid bolts are notch impact tested at -40°C (WB 46).

The monolithic cask body is fabricated of spheroidal graphite cast iron (GGG-40). The staff verified the mechanical property values used in the Finite Element Model document for the 9-m side drop (GNB B 173/2003), which was used to define cask locations of maximum stresses and calculate corresponding first principal stresses at maximum acceleration. The applicant followed a licensing approach consistent with guidelines from the German Competent Authority (BAM GGR-007), in which a fracture mechanics evaluation was performed at cask locations where the first principal stress was calculated to be greater than half the tensile yield stress at

-40°C. During this evaluation, the applicant chose to conservatively disregard any heat generated by the contents.

The applicant defined a critical stress intensity factor (K_{IC} = 50 MPa·m$^{1/2}$) for the spheroidal graphite cast iron GGG-40. The staff requested additional information on methods and test sampling for defining this value to provide reasonable assurance of its adequacy for both dynamic and quasi-static strain conditions. The applicant referenced two sets of experiments in its justification. In the first set of studies, a total of 11 samples were cut from cast test specimens and characterized. The pearlite content varied up to ~20 %, with a fracture strain varying up to 21 %. The static yield strength of these samples was determined at 20°C, which produced average values exceeding the minimum guaranteed values required by the fabrication specifications for the package (Material Data Sheets WS 0.7040-12, Rev. 1; WS 0.7040-04 Rev. 2; WS 0.7040-07 Rev. 4).

The applicant stated that four of these samples were tested at - 40°C, which resulted in dynamic stress intensity factors (K_{ID}) exceeding the applicant's proposed K_{IC}, for pearlite contents ranging from approximately 7 to 20%. In the second set of experiments, six samples with mechanical properties near the minimum requirements of the material data sheets were characterized at - 40°C, resulting in K_{ID} well exceeding the applicant's K_{IC}. The applicant clarified that strain rates used for testing were consistent with those observed during a 9-m drop tests, as well as those defined in the BAM GGR-007 guidelines. In order to assure that the as-fabricated material properties are consistent with the supporting testing, specimens are taken from three different locations in the cask, per fabrication specification WB 38 Rev A, which are characterized for chemical composition and microstructure (nodule graphite shape and size; ferrite content; pearlite content) and mechanical properties (tensile strength, yield strength). The applicant clarified that these results are documented in the fabrication records. Based on this review, the staff finds that the applicant adequately justified a K_{IC} for the fracture-mechanical evaluation of the spheroidal graphite cast iron cask body, as the supporting testing is consistent with the maximum allowable pearlite content (20%) in the material, per the fabrication specifications for the package (Material Data Sheets WS 0.7040-12, Rev. 1; WS 0.7040-04 Rev. 2; WS 0.7040-07 Rev. 4).

The staff reviewed the applicant's fracture mechanics evaluation at various cask-body locations (GNB B 079/2004), which defined a maximum permissible flaw size per the required minimum detection limit for the non-destructive testing (PV 10-01 Rev. 04 E). The applicant calculated a maximum allowable stress per the maximum permissible flaw size, which assumed a constant stress across the flaw (per Reference 17 in GNB 251B/205). Using quasi-static 3D Finite Element calculations, the applicant defined cask locations of maximum stresses and calculated corresponding first principal stresses during a 9-m drop at a conservative maximum acceleration of 200 g. The fracture mechanical evaluation assumed a linear drop of stress from the surface of the cask to the flaw tip, and calculated a corresponding stress intensity factor K_I = 34.5 MPa·m$^{1/2}$ at the crack tip. The application, therefore, concluded that the maximum stress intensity factor (K_I) during a 9-ft drop is below the justified critical stress intensity factor (K_{IC}). The staff finds that the applicant's assumptions are adequate and that the fracture mechanical evaluation and stress evaluations demonstrate adequate performance of the cask body at low temperatures (- 40°C) per IAEA requirements.

2.3 Conclusion

Based on the review of the statements and representations contained in the application, as supplemented, the staff agrees that the Model No. CASTOR THTR/AVR package meets the standards in IAEA Safety Standards Series No. TS-R-1, 2009 edition.

3.0 THERMAL EVALUATION

3.1 Thermal Design

The Model No. CASTOR THTR/AVR package content includes two Arbeitsgemeinschaft Versuchsreaktor (AVR) fuel element canisters.

The thermal material properties of the package components, contents, and fill gases (a mix of helium and argon) are provided in Tables 4 through 8 of the thermal section of the application.

The maximum decay heat for the contents of the package is 141 W, although the analysis in the application was for 179 W and 228 W. The 228 W analyzed decay heat in the application was for contents not requested in this revalidation. The 179 W analyzed decay heat in the application was for the content requested in this revalidation, therefore it is conservative.

3.2 Thermal Evaluation

The NCT and HAC thermal analyses were generated using 2D axisymmetric and radial models developed with the ANSYS computational code. The staff confirmed the materials used in the package have a minimum allowable service temperature that is less than or equal to -40°C (-40°F). The NCT thermal analyses at 38°C (100°F) ambient temperature showed that component temperatures are below the allowable values. The maximum package surface temperature of the protective hood, without solar insolation, is 39°C (102.2°F). Although the surface temperature does not exceed the exclusive use temperature limit of 85°C (185°F), the package will be transported by exclusive use due to external radiation levels.

The maximum normal operating pressure is 153 kPa absolute (22.2 psi). The package cavity pressure if the AVR fuel element canisters leak into the cavity was also calculated which reduces the cavity pressure to 136 kPa absolute (19.7 psi). The package is designed for a gauge pressure of 700 kPa (101.5 psi) which exceeds the MNOP.

The HAC thermal analysis model was the same as the NCT thermal analysis model except the protective hood and impact limiters which were conservatively not included due to the preceding mechanical loads. The staff finds that this is a conservative assumption which provides more heat input from the regulatory thermal test into the package.

The HAC thermal analysis showed that component temperatures are below the allowable values. Figures 14 and 15 of the thermal section of the application show the temperature vs. time profiles during and after the HAC-fire for the major package components and contents.

During HAC, the maximum pressure is 183 kPa absolute (26.5 psi). The package cavity pressure if the AVR fuel element canisters leak into the cavity was also calculated which reduces the cavity pressure to 156 kPa absolute (22.6 psi). The package design pressure exceeds the HAC maximum pressure.

Thermal stresses caused by constrained interfaces among package components during NCT and during and after HAC was discussed in a request for additional information (RAI) response. A finite element model was created using the ANSYS computational code and temperature fields were applied representing NCT and HAC conditions. The results of the analysis showed that the cask equivalent plastic strain, the secondary lid equivalent stress, and secondary lid bolt average equivalent and tensile stresses were below admissible limits for NCT and HAC.

Staff recommends the following condition be included in the Department of Transportation (DOT) certificate:

Condition No.1: Packages must be transported as exclusive use.

The package surface temperature during NCT is 39°C (102.2°F). While the package surface temperature does not exceed the exclusive use temperature limit of 85°C (185°F), the applicant stated the package must be shipped as exclusive use due to external radiation levels.

3.3 Conclusion

Based on the statements and representations in the application, the staff finds that the thermal evaluation has been adequately described, and the thermal performance of the package meets the requirements of the International Atomic Energy Agency (IAEA) Safety Requirements, No. TS-R-1.

4.0 CONTAINMENT EVALUATION

4.1 Containment Approach

The applicant specified that a pre-transport leak test of 10^{-7} ref cm^3/sec (air) would limit releases to less than 10^{-6} A_2/hr for NCT and one A_2 in one week for HAC. No further leakage tests were described. The applicant demonstrated by calculation that the design pressure of 100 psig significantly exceeds the Maximum Normal Operating Pressure (MNOP) of 7.6 psig. The applicant adopted the ANSI N14.5 definition of leaktight for the containment design criteria under NCT and HAC; because a leaktight package precludes significant releases of radioactive material, no further release calculations are normally required to demonstrate that a release less than 10^{-6} A_2/hr under NCT, or less than one A_2/week under HAC, occurs.

4.2 Containment Evaluation

The applicant stated that the containment system is to be leak tested for acceptance to 10^{-7} ref cm^3/sec (air), in accordance with the ANSI N14.5 definition of leaktight; therefore, detailed containment calculations that include release fractions were no longer necessary. The NRC staff finds this assertion to be flawed in that the ANSI N14.5 definition of leaktight requires that the full containment boundary be tested at fabrication, which was not done. The lid region does satisfy the leak tight criteria in that the metallic seals are tested to 10^{-7} ref cm^3/sec (air) for the pre-shipment leak test; however, the package body has no equivalent test performed to demonstrate it is leaktight.

In its RAI response, the applicant cited significant information related to manufacturing control, quality assurance, and operational experience to include continuous pressure monitoring between containment barriers to demonstrate the entire containment boundary is leaktight. While this information provides some assurance that the full containment boundary provides an effective means of confining radioactive material, it still does not demonstrate that the entire boundary was leaktight at the time of fabrication or shipment. Further, pressure monitoring is not an acceptable means to demonstrate leaktightness, as defined by ANSI N14.5, as the sensitivity of such monitoring has not been demonstrated to be equivalent to a leak rate of 10^{-7} ref cm^3/sec (air).

The applicant did however perform calculations with leak rates (~10^{-5} ref cm^3/sec (air)) that exceeded the leaktight definition of 10^{-7} ref cm^3/sec (air) and demonstrated that, for both NCT and HAC, the regulatory limits for activity release were satisfactorily met. Staff reviewed these calculations and found them acceptable as they were consistent with staff guidance and the requirements of ANSI N14.5.

As noted above, these calculations are not required provided that the entire containment boundary is demonstrated to be leaktight; however, since the conditions specified by ANSI N14.5 were not met, these calculations would be necessary to demonstrate regulatory compliance and package safety. The deficiency with this approach however is that there is no correlation between the assumed leakage rate of ~10^{-5} ref cm^3/sec (air) and the potential leak in the cask body base material, (e.g., the cask body could have a leak rate of 10^{-4} ref cm^3/sec (air) which cannot be detected by pressure monitoring).

As such, staff recommends the following condition be included in the Department of Transportation (DOT) certificate:

Condition No. 2: The pre-shipment leakage test at 10^{-7} ref cm^3/sec (air) must include the cask body as well as the seal regions.

4.3 Conclusion

Based on the review of the statements and representations in the application, the staff concludes that the CASTOR THT/AVR containment design has been adequately described and evaluated and that the package design meets the containment requirements of TS-R-1.

5.0 SHIELDING EVALUATION

5.1 Shielding Approach

For ground transport of radioactive materials, the provisions of paragraphs 559 to 572, 650 to 671, 673 to 679, and 681 to 683 in IAEA TS-R-1 apply. Paragraphs 569, 651 and 657 specify, in part, that the maximum dose rates shall not exceed 10 mSv/hr (1000 mrem/hr) at any point on the surface of the package; 2 mSv/hr (200 mrem/hr) at any point on the external surface of the vehicle; 0.1 mSv/hr (10 mrem/hr) at any point 2 m from the outer surface of the vehicle; 10 mSv/hr at any point 1 m from the surface of the package under accident conditions of transport; and the increase in the maximum dose rate as a result of compression/deformation is less than 20%.

5.2 Shielding Evaluation

The applicant performed a shielding safety evaluation for the package with solid, spent THTR and AVR fuel. The fuel elements consist of HEU particles dispersed throughout a spherical graphite matrix. Under HAC, the package is assumed to retain the geometric shape and dimensions. The applicant calculated the maximum expected dose rate to be well within the limits set in Paragraph 569.

The applicant is specifically requesting to ship a maximum of 2320 fuel elements (FE) or operating elements (BTE) in the package. The THTR and AVR FEs are largely comprised of graphite, 99.751% by weight, with fission products and heavy elements comprising the balance. The applicant provided source activity and spectrum information given their burnup and cooling time assumptions.

To address any reconfiguration, the entire package cavity is filled with homogenized fuel material, representing a total payload of 3110 FE. The applicant conservatively assumes all of the source material consists of the most restrictive element, AVR FE Type 3, of which only 590 may be loaded per TLB. The applicant used MCNP to determine the location of maximum dose rates at the package surface, and at points 1 m and 2 m from the surface of the transport vehicle. The applicant's results were within the limits set in IAEA TS-R-1.

Staff performed an independent analysis using SCALE 6.1. Staff assumed the entire package cavity was filled with a homogenized mixture of fuel material, with a source rate scaled to the most restrictive FE type. Staff also investigated the impact of self-shielding on the external dose rate by varying the density of the source material while conservatively maintaining the same source strength. Staff evaluated the dose rate on the surface of the package, and at distances of both 1 m and 2 m from the top, bottom and sides. Staff did not investigate the source term and used the spectrum and source information provided by the applicant.

Staff's results were in reasonable agreement with those of the applicant given the different tally locations. The staff chose points at which to measure the external dose rates that were more conservative than those of the applicant. Staff calculated dose rates to be within the limits set in paragraphs 569 and 657 of IAEA TS-R-1.

5.3 Conclusion

Based on its review and confirmatory analysis, the staff has reasonable assurance that the CASTOR design meets the shielding safety requirements of IAEA TS-R-1.

6.0 CRITICALITY EVALUATION

The applicant performed a criticality safety evaluation for the package to ship spherical AVR fuel elements or BTE operating elements. The AVR FEs are 60mm in diameter with a 5mm thick graphite shell and consist of a graphite matrix with uranium and thorium fuels enriched up to 93 wt% HEU. The BTE are the same diameter absorber spheres composed of graphite elements containing hafnium and boron, or graphite only spheres. The absorber spheres are conservatively ignored in the evaluation. All AVR FEs are modeled as fresh in the evaluation, with no burnup credit taken.

The evaluation contained an analysis of the loaded CASTOR THTR/AVR package HAC conditions in a triangular pitch array, with a nominal loading of 1,900 AVR FEs and BTE per package, as well as a higher package loading of 2,486 AVR FEs. Maximum reactivity of these arrays was found to be subcritical for optimal internal and interstitial moderation.

Staff performed an independent analysis using SCALE 6.1 with a similar configuration and confirmed that the k_{eff} for the maximum reactivity case is substantially subcritical. Staff also performed calculations for the single unit case and found it to be bounded by the maximum reactivity case.

For the HAC case, the applicant modeled the nominal and overloaded CASTOR THTR/AVR packages (1,900 and 2,468 AVR FEs and BTEs, respectively) and found both to be subcritical.

The application also justified that an infinite array of packages is subcritical, and corresponds to the CSI of 0.0.

6.1 Conclusion

Based upon the staff's review and confirmatory analyses, the staff has reasonable assurance that the CASTOR design meets the criticality safety requirements of IAEA TS-R-1.

CONCLUSION

Based on the review of the statements and representations contained in the application, as supplemented by the RAI responses dated July 22 and November 22, 2016, and for the reasons stated in this safety evaluation report, the staff agrees that the Model No. CASTOR THTR/AVR package, authorized by the German Certificate of Approval No. D/4214/B(U)F-96, Revision 10, meets the requirements of IAEA Safety Standard Series No. TS-R-1, 2009.

The staff recommends revalidation of the package with the conditions stated in the safety evaluation report.

Issued with letter to R. Boyle, Department of Transportation,
on January 11, 2017.