

July 18, 2008

Mr. Richard W. Boyle
Chief, Radioactive Materials Branch
Office of Hazardous Materials
Technology
U.S. Department of Transportation
1200 New Jersey Ave., S.E.
Washington, DC 20590

SUBJECT: RAVALIDATION OF CERTIFICATE NO. D/4342/B(U)F-96 FOR THE TN 7-2
PACKAGE

Dear Mr. Boyle:

This is in response to your letter dated March 12, 2008, requesting our review of the Model No. TN 7-2 package, authorized by German Certificate of Approval No. D/4342/B(U)F-96 (Rev. 5). To support the review you provided various documents, including Nuclear Cargo + Services GmbH Report NCS 0313, Rev. 5, "Safety Analysis Report for the Transport Cask TN 7-2 Loaded with Irradiated MTR-Fuel Assemblies." By supplement dated March 12, 2008, you provided German Certificate of Approval No. D/4342/B(U)F-96 (Rev. 6), including information regarding the updated certificate. By supplement dated June 4, 2008, you provided German Certificate of Approval No. D/4342/B(U)F-96 (Rev. 7), including information regarding the updated certificate.

Based upon our review of the statements and representations contained in the application, as supplemented, and for the reasons described in the enclosed Safety Evaluation Report, we recommend revalidation of the certificate (Revisions 5, 6, and 7). Note that the Safety Evaluation Report describes our review of the round fuel described in Item 1 of Allowable Contents of the German Certificate of Approval. We are continuing our review of the box-type fuel described in Item 2 of Allowable Contents of the German Certificate of Approval, and will provide the results of that review separately.

If you have any questions regarding this matter, please contact me or Ms. Nancy Osgood of my staff at 301-492-3300.

Sincerely,

/RA/

Eric J. Benner, Chief
Licensing Branch
Division of Spent Fuel Storage and Transportation
Office of Nuclear Material Safety
and Safeguards

Docket No. 71-3025
TAC No. L24161
Enclosure: Safety Evaluation Report

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Based upon our review of the statements and representations contained in the application, as supplemented, and for the reasons described in the enclosed Safety Evaluation Report, we recommend revalidation of the certificate (Revisions 5, 6, and 7). Note that the Safety Evaluation Report describes our review of the round fuel described in Item 1 of Allowable Contents of the German Certificate of Approval. We are continuing our review of the box-type fuel described in Item 2 of Allowable Contents of the German Certificate of Approval, and will provide the results of that review separately.

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Filename: G:/SFST/OSGOOD/3025-TN7-2.doc

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DATE	7/17/08		7/18/08		7/18/08		7/17/08		7/18/08		7/17/08	7/18/08

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SAFETY EVALUATION REPORT
Model No. TN 7-2 Package
Docket No. 71-3025
German Certificate of Approval D/4342/B(U)F-96 (Revisions 5, 6 and 7)

SUMMARY

By application dated December 5, 2007, the U.S. Department of Transportation (DOT) requested review and recommendation regarding revalidation of German Certificate of Approval No. D/4342/B(U)F-96 (Rev. 5). DOT provided the following documents:

- Nuclear Cargo + Services GmbH Report NCS 0313, Rev. 5, "Safety Analysis Report for the Transport Cask TN 7-2 Loaded with Irradiated MTR-Fuel Assemblies."
- German Federal Agency for Material Research and Testing (BAM) Document III.3/21081 (1st Supplement), "Expert review for a Type B(U) Package design of Type TN 7-2 for Fissile Radioactive Materials."
- Packaging Engineering Drawings.

By supplement dated March 12, 2008, DOT provided an updated German Certificate of Approval No. D/4342/B(U)F-96 (Rev. 6), and technical information regarding the revised certificate.

By supplement dated June 4, 2008, DOT provided an updated German Certificate of Approval No. D/4243/B(U)F-96 (Rev. 7), and technical information regarding the revised certificate.

The application, as supplemented, was reviewed to determine if the package design meets the requirements of the International Atomic Energy Agency (IAEA) "Regulations for the Safe Transport of Radioactive Material," TS-R-1, (1996 Edition). Based upon our review of the statements and representations contained in the application, as supplemented, and for the reasons described in the enclosed Safety Evaluation Report, we recommend revalidation of the certificate. Note that the Safety Evaluation Report describes our review of the round fuel described in Item 1 of Allowable Contents of the German Certificate of Approval. We are continuing our review of the box-type fuel described in Item 2 of Allowable Contents of the German Certificate of Approval, and will provide the results of that review separately.

EVALUATION

1.0 GENERAL INFORMATION

The staff previously recommended DOT revalidation of the German Certificate of Approval for this package design (see letters dated September 1, 1995, August 3, 1998, February 4, 1999, and July 25, 2000). The application dated December 5, 2007, forwarded an updated German Certificate (Rev. 7) that included updated fuel specifications and updated packaging drawings.

1.1 Packaging

The Model No. TN 7-2 is a stainless steel and lead-shielded cask designed for the transport of irradiated research reactor fuel. The cask body is approximately 3136 mm in length and 1030 mm in diameter, with a lead shield thickness of 185 mm. The package's overall length, with

impact limiters, is 3926 mm. The maximum weight of the package, including a maximum content weight of 3550 kg, is 24,270 kg. The fuel is transported within two types of fuel baskets, one for round (i.e., cylindrical) and one for box-shaped fuel assemblies.

The packaging is shown in the drawings included in the German Certificate: Figure 1, Drawing No. 090-069-01, Rev. 0, (Figures 1, 2 and 3, and the cask assembly drawing 105-050-04, Rev. 0).

1.2 Contents

The package is designed for the transport of irradiated research reactor fuel. The contents are described in the German Certificate of Approval under "allowable contents." Details with respect to fuel specifications are provided in Attachment 1, Table 1 (for round fuel assemblies), and Attachment 1, Tables 2 and 3 (for box-shaped fuel assemblies). The package is also designed for capsules containing fuel plates for the Siemens-Argonaut-Reaktor, however, these contents were not included for technical review.

2.0 STRUCTURAL

There were no changes to the packaging or the authorized contents that would significantly affect the structural evaluation previously performed for this package design (see staff Safety Evaluation Report dated July 25, 2000). As stated in the Safety Analysis Report, the minor changes made in the fuel baskets designs were evaluated and found to not affect their structural performance. The types of fuel assemblies, the packaging (cask, impact limiters, and fuel baskets), weights, and materials of construction were essentially the same as previously evaluated.

3.0 THERMAL

There were no changes that affect the thermal evaluation previously performed for this package design. The changes in fuel specification and basket designs are minor in nature and would not significantly increase the decay heat or change the heat transfer properties of the package.

4.0 CONTAINMENT

There were no changes that affect the containment evaluation previously performed for this package design. The minor changes in fuel specifications would not significantly affect the containment provided by the package.

5.0 SHIELDING

There were no changes that affect the shielding review previously performed for this package design. The slight increase in fissile content and changes in the fuel specifications are minor in nature and would not affect the external radiation levels. As stated in previous Safety Evaluation Reports, neutron and gamma dose rates are measured prior to each shipment to ensure that the package meets the external radiation standards.

6.0 CRITICALITY

6.1 Description of Changes

Revision 7 of the German Certificate of Approval is documented in Revision 7 of the certificate. In Revision 1 the applicant removed content No. 2 (the ESSOR-FA) from the certificate. In Revisions 2 through 4 the applicant adapted the certificate from the 1985 IAEA regulations to the 2005 IAEA regulations and prolonged the validity of the certificate (i.e., renewed the certificate). In Revision 5 the applicant revised the mass of the R2 fuel assemblies (box type) and in Revision 6 the certificate included more precise fuel specifications. In addition to the round (DIDO or FRJ-2/HIFAR) fuel, it is noted by the staff that Revision 6 allows the transport of box-shaped fuel (type R2 and type HFR) as well as capsules with fuel plates. In Revision 7, the applicant increased the maximum enrichment of the LEU fuel assemblies for the round (DIDO or FRJ-2/HIFAR) fuel. The staff acknowledges that other types of fuel are approved to be shipped with Revision 7 of the Certificate. These are box type and capsules with fuel plates. The current staff review addresses the round (DIDO or FRJ-2/HIFAR) fuel assemblies. The box-type fuel assemblies will be addressed separately. The content described as Siemens-Argonaut-Reaktor fuel plates in capsules, is not included in the NRC review scope.

6.2 Fissile Contents

Revision 7 of the Certificate of Approval allows for transport of multiple types of irradiated research reactor fuel assemblies. These are round (DIDO or FRJ-2/HIFAR) and box (R2 and HFR) shaped MTR-fuel assemblies and fuel plates of the type "Siemens-Argonaut-Reaktor," loaded into capsules. This Safety Evaluation Report documents staff review of Revision 7 of the German Certificate of Approval for the round (DIDO or FRJ-2/HIFAR) type MTR-fuel assemblies.

The fuel assemblies consist of 4 concentric fuel cylinders and a surrounding aluminum cylinder fixed with head and foot parts. The fuel consists of U-Al-alloy, UAl_x-Al-dispersion, U₃O₈-Al-dispersion, or U₃Si₂-Al-dispersion each with a cladding made of aluminum or an aluminum alloy. The fuel assemblies are cut and only the central part which contains the whole fuel is transported. The fuel cylinders are fixed asymmetric with a clip or symmetric with combs.

There will be a maximum of 4 insert baskets stacked axially in the cask with a maximum of 15 assemblies per basket.

Corroded fuel assemblies are acceptable for shipment only if the surface corrosion on the aluminum fuel cladding does not exceed 211 cm² per package.

The maximum U-235 enrichment for High Enriched Uranium (HEU) fuel is 94%. The maximum amount of U-235 per fuel assembly for this enrichment is 173.0g. The maximum U-235 enrichment for Low Enriched Uranium (LEU) fuel is 20.0%. The maximum amount of U-235 per fuel assembly for this enrichment is 204.0g.

The fuel must meet the requirements in Table 1 of Revision 7 of the German Certificate of Approval.

6.3 Criticality Evaluation

The staff reviewed the criticality evaluation referenced in Revision 7 of the Certificate of Approval. This is Annex 20 of the Safety Analysis Report. The staff notes that this is the same analysis reviewed by the staff, as documented in the staff Safety Evaluation Report dated July 25, 2000.

Table 1 of Revision 7 of the certificate contains the approved fuel parameters. The staff reviewed these values against the analysis in Annex 20 of the Safety Analysis Report and the staff's previous approval (see staff Safety Evaluation Report dated July 25, 2000). The staff found that most of these values are bounded by the previous approvals. Some values were not specified in previous revision of the Certificate of Approval or the staff's SER. The staff verified that these were within the bounds of the criticality analysis. There are two parameters that were not previously reviewed and were not within bounds of the analysis.

In Revision 7 of the Certificate, the applicant divides the fuel into two types: low enriched uranium (LEU) and high enriched uranium (HEU). The applicant has two separate enrichments and mass limits for U-235 for each of these categorizations. LEU fuel is fuel that has a maximum enrichment of 20.0% and a maximum U-235 mass of 204.0g per assembly. HEU fuel has a maximum enrichment of 94% and a maximum U-235 mass of 173.0g per assembly.

The HEU fuel is bounded by the analysis in Annex 20 of the Safety Analysis Report. This analysis is based on 94% enriched fuel with a maximum mass of fissile material of 203g and was previously reviewed and approved by the staff for this amount as documented in staff Safety Evaluation Report dated July 25, 2000.

The addition of a separate LEU fuel limit is new. However previous approval of the TN 7-2 allowed an enrichment range of 19.5% up to 94% with a maximum mass of 203g for the entire range. The criticality analysis in Annex 20 of the Safety Analysis Report states a sensitivity study was performed that shows that the 94% enriched case of 203g U-235 is more bounding than the 19.5% with the same U-235 mass. Although the applicant does not have an analysis for the 20.0% with 204.0g per assembly, the staff finds that an analysis would produce results that are also bounded by the higher enrichment analysis. Therefore the staff finds this acceptable.

The staff notes that approving shipping contents without a supporting analysis is a practice typically not condoned by the staff. In this case, the staff is reasonably confident that the proposed shipping contents are bounded by the higher enrichment analysis. In addition the k-eff calculated for these packages is very low, on the order of 0.73, therefore giving the staff additional confidence that no safety limits will be exceeded with this change. However, the staff notes here that in future submittals the practice of not performing an analysis for the limiting contents will not be accepted. Although the applicant demonstrates that the 94% enriched fuel bounds the 19.5%, the difference cited in k-infinity for the two configurations is not substantial enough to give the staff confidence that 94% enrichment is bounding for all lower enrichments. In addition the staff does not have much information about this sensitivity study to determine if optimum moderation conditions were established to ensure that the 94% enrichment case is indeed bounding of all lower enrichments.

The other deviation from the criticality analysis is in the maximum fuel thickness. Revision 7 of the German Certificate of Approval has a value of 0.96mm listed whereas the criticality analysis in Annex 20 of the Safety Analysis Report assumes this value is 0.66mm. In emails submitted

with supplement dated March 12, 2008, between the German certificate holder (Nuclear Cargo + Service GmbH) and the U.S. Department of Energy, Savannah River Site, the increased value to 0.96mm is to account for the possibility of single grains sticking out. Areas of larger thickness would be compensated by areas of smaller thickness as the fuel mass limits remain the same. The areas of large grain thickness is said to be far less than 10% over the center for the fuel meat length. For 90% of the fuel meat length or more, the meat thickness does not exceed 0.75mm. This is also outside the analysis but it is explained that per engineering judgment, increasing the fuel meat thickness from 0.66 to 0.75mm is more than compensated for by the conservatism employed in the analysis. The staff generally agrees with this assessment and notes that the k-eff for these analyses are very low (approximately 0.73) and that the uncertainty due to this change would not cause the TN 7-2 to exceed any regulatory limits and therefore finds this acceptable. The staff does note that in future revisions to this certificate, reducing margins would be cause for the staff to revisit these conclusions.

6.4 Conclusions

Based on the statements and representations contained in the application, the staff concludes that the Model No. TN 7-2 package containing the round fuel meets the criticality requirements of IAEA Safety Series No. TS-R-1, 2005 edition. The staff recommends revalidation of the Certificate of Approval D/4342/B(U)F-96, Revisions 5, 6, and 7 for the round (DIDO or FRJ-2/HIFAR) fuel assemblies. Recommendations regarding the box-shaped fuel will be provided separately.

SUMMARY

Based on the statements and representations contained in the application, as supplement, the staff concludes that the Model No. TN 7-2 package meets the requirements of IAEA TS-R-1 (1996 Edition), and recommends revalidation of German Certificate of Approval No. D/4342/B(U)F-96 (Revisions 5, 6 and 7) for the round fuel assemblies as described in Item 1 of Allowable Contents of the German Certificate of Approval. We are continuing our review of the box-type fuel described in Item 2 of Allowable Contents of the German Certificate of Approval, and will provide the results of that review separately.

Issued with Ltr. to R. Boyle
dated July 18, 2008.