July 22, 2008

Mr. Richard Boyle, Chief
Radioactive Materials Branch
Office of Hazardous Materials
Technology
U.S. Department of Transportation
400 Seventh Street, S.W.
Washington, DC 20590

SUBJECT: REVALIDATION OF THE MODEL NO. GNS-16 PACKAGE, GERMAN PACKAGE DESIGN CERTIFICATE NO. D/4326/B(U)F-85, REV. 5

Dear Mr. Boyle:

This refers to your request dated March 21, 2008, for a recommendation concerning the revalidation of the Model No. GNS-16 Package, German Package Design Certificate No. D/4326/B(U)F-85, Rev. 5. Based on email correspondence with the Department of Transportation (Conroy) and Washington Savannah River Company (Dunsmuir), the Nuclear Regulatory Commission (NRC) confirmed the request to validate the following contents under Loading Variant 1 of the revised certificate:

- The shipping canister with 40 special fuel plates may only be loaded in the central position of the basket FR 2/33. A loading with a shipping canister is only permissible with box shaped MTR FAs and MTR SFAs with a low enrichment level. In this case, only control MTR SFAs with 17 fuel plates is permissible.

The NRC has previously recommended revalidation of the German Package Design Certificate for the Model No. GNS-16 by letters dated July 17, 1998; January 6, May 7, and July 12, 1999; May 15, 2001; and May 2, 2002. Based on our review, including these previous reviews, the statements and representations contained in the application, and for the reasons stated in the enclosed Safety Evaluation Report, we recommend revalidation of German Package Design Certificate No. D/4326/B(U), Rev. 5, dated December 20, 2007, limited to contents described above.

If you have any questions regarding this matter, you may contact me at (301) 492-3321.

Sincerely,

/RA/

Chris Staab, Project Manager
Licensing Branch
Division of Spent Fuel Storage and Transportation
Office of Nuclear Material Safety
and Safeguards

Docket No. 71-3044
TAC No. L24202

Enclosure: Safety Evaluation Report

cc: J. Chamberlin, Department of Energy
M. Dunsmuir, Washington Savannah River Company
M. Lambert, Transport Logistics International, Inc.

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SAFETY EVALUATION REPORT
Docket No. 71-3044
Model No. GNS-16 Package
German Package Design Certificate No. D/4326/B(U)F-85
Revision 5

SUMMARY

The Department of Transportation (DOT) requested NRC's recommendation concerning the revalidation of the Model No. GNS-16 Package, German Package Design Certificate No. D/4326/B(U)F-85, Rev. 5. Based on email correspondence with the Department of Transportation (Conroy) and Washington Savannah River Company (Dunsmuir), NRC confirmed the request to validate the following contents under Loading Variant 1 of the revised certificate: The shipping canister with 40 special fuel plates may only be loaded in the central position of the basket FR 2/33. A loading with a shipping canister is only permissible with box shaped MTR FAs and MTR SFAs with a low enrichment level. In this case, only control MTR SFAs with 17 fuel plates is permissible. Based on the statements and representations in the application, as supplemented, and the conditions listed below, the NRC has concluded that the package meets IAEA requirements.

1.0 General Information

The GNS-16 package has been previously reviewed and recommended for revalidation by the NRC for the following contents: a) Box-type MTR fuel in a 2/33 basket; b) rod-shaped TRIGA fuel; c) TRIGA fuel in a FR 2/15 basket with a BEL-B2 loading unit; d) box-type MTR fuel with up to 500 cm^2 of through clad corrosion damage; e) bowed TRIGA fuel in a FR 2/15 basket with either a BEL-C or BEL-D loading unit; f) Loading with box-type MTR-FE and MTR-SFE; and g) Loading with TRIGA-FE and TRIGA-SFE. The previous recommendations for revalidation of the German Package Design Certificate for the Model No. GNS-16 were contained in letters dated July 17, 1998; January 6, May 7, July 12, 1999; and May 15, 2001; and May 2, 2002.

The scope of this review included the loading of loose fuel plates in a canister with no change to the basket design. The fuel plates are uranium-aluminum alloy fuel with aluminum cladding. The nuclear fuel is high-enriched uranium (HEU) to 90 wt% U-235. The meat is 0.6 cm thick with 0.45 cm cladding for a total plate thickness of 1.5 cm. The maximum outer dimensions of the plate are 7.075 x 5.0 cm. The range of width and height of the fuel zone are 4.0 – 4.5 cm and 3.3 - 4.5 cm respectively.

2.0 Structural Analysis

The structural performance of the GNS-16 for Box-type MTR fuel in a 2/33 basket, for Normal Conditions of Transport and Hypothetical Accident Conditions, has been previously reviewed by NRC and a recommendation was made to revalidate the German Package Design Certificate.

The inclusion of a shipping canister with 40 special fuel plates as described in loading variant one does not impact the structural performance of the package and is bounded by the previous analysis and recommendations.

3.0 Thermal

The maximum heat load for a shipping canister with 40 special fuel plates is 0.2 watt compared to the maximum 40 watts for an MTR fuel assembly. The package has previously been recommended for revalidation with a total heat load of 1,320 watts. The package, with a shipping canister with 40 special fuel plates, is less than the maximum heat load and is bounded by the previous analysis and recommendations.

4.0 Containment

The shipping canister with 40 special fuel plates has a significantly lower activity compared to the box-type MTR fuel which has been previously approved. The containment analysis is bounded by the previous analysis for box-type MTR fuel which has previously been recommended for revalidation.

5.0 Shielding

The source term is bounded by the analysis made with the design-basis assembly. At all gamma energies, the source term is less than that of the box-shaped MTR fuel element. Neutron emission is lower than that of the MTR fuel assembly as well. The shielding analysis presented in USA/0551/B(U)F-85 applies to this application.

6.0 Criticality

The applicant utilized the 44-group ENDF-V cross-section libraries. Criticality analysis was done with the CSAS25 sequence using KENO Va to calculate k_{eff}. The software, cross-section libraries, and methods are acceptable for the analysis of 32 MTR fuel elements and one spent fuel canister containing 40 plate-type fuel elements.

The fuel plates consist of a uranium-aluminum alloy fuel clad with aluminum metal. The dimensions and weight of the fuel plates are significantly less than that of the box-shaped MTR fuel assembly. The three types of fuel plates, UP-382/3, UP-SE-8 and UP-SE-9 are segregated and stacked 10 per cartridge, except for the single cartridge housing all 20 UP-382/3 fuel plates. The two cartridges holding 10 fuel plates are also packed with 5 non-fuel dummy plates consisting entirely of $AlMg_3$. A total of 10 non-fuel dummy plates will be used. These dummy plates are conservatively ignored in the criticality analysis and replaced with pure water. These cartridges are then placed into a canister. The position of the fuel appears to be maintained with the use of aluminum spacers. The canister is authorized to be placed only in the central basket location, number 17. The total heavy-metal mass of all 40 plates is 30 g.

The applicant's criticality analysis was conducted with an explicit representation of the fuel plate canister loaded in the central position (number 17) in the FR 2/33 fuel basket. The three cartridges are stacked together in a linear configuration with spacers above and below the cartridges. The location of the fuel is axially centered. The cadmium seal is not included in the criticality analysis.

The staff performed confirmatory analysis using 238-group ENDF-V cross-section libraries. Staff criticality analysis used the CSAS26 sequence (KENO VI) to determine the reactivity of the spent fuel canister.

The staff's own analysis was conducted with the same canister geometry. Using the maximum allowed U-235 content with the minimum meat volume, a bounding U-235 density (g/cm3) was determined. The meat alloy is specified as UAl_x. Specific material data, such as aluminum/uranium ratio or density, on the meat alloy was missing at the time of the analysis. As a result, the staff used U-235 density derived from the specified UP-SE-8/9 maximum per plate content as a starting point. A total uranium density was determined assuming 90 wt% U-235 enrichment. The fuel was modeled as a mixture of only uranium and aluminum. The density of each metal was considered separately to determine an approximate mixture density. Staff assumptions resulted in a final meat alloy that is 62 wt% uranium; this material composition is used in all staff analyses. Information obtained later showed the meat to be less than 30 wt% uranium, confirming that the staff's material assumption is conservative. The bounding mixture density was applied to the maximum meat volume. This results in the staff analysis conservatively assuming the presence of more fissile material than is allowed in each fuel plate. In addition, the staff conducted the analysis using the highest fuel mass of the UP-SE-8 (1.0 g per fuel plate) and loaded each cartridge with fuel plates of identical bounding characteristics. 40 plates are the maximum that will be loaded for transport. Staff assumed that voids inside the cartridge were uniformly spaced among the fuel elements and between top/bottom plates and cartridge walls. All empty space within the canister was flooded with un-borated water and no basket reactivity control was considered.

The staff did not consider it necessary to run a full cask analysis. A criticality calculation of an infinite array of canisters with no reactivity controls showed the k_∞ of the fuel-plate canister to be 0.41. This is significantly less than the k_{eff} of a cask loaded with 33 design-basis box-shaped MTR fuel elements. This confirms that the reactivity of the proposed canister and 40 fuel plates are less than the existing bounding design-basis contents. Staff analysis confirms that the package meets the criticality requirements for normal conditions of transport and hypothetical accident conditions.

Conditions

The NRC recommends revalidation of the German Package Design Certificate for the following conditions:

Loading Variant One:

- The shipping canister with 40 special fuel plates may only be loaded in the central position of the basket FR 2/33. A loading with a shipping canister is only permissible with box shaped MTR FAs and MTR SFAs with a low enrichment level. In this case, only control MTR SFAs with 17 fuel plates is permissible.

Conclusion

Based on the statements and representations contained in the application the staff concludes that the Model No. GNS-16 package design meets IAEA requirements.

Issued with letter to R. Boyle, Department of Transportation,
on 7/22/2008.