January 30, 2014

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, D.C. 20590

SUBJECT: REQUEST FOR ADDITIONAL INFORMATION FOR REVALIDATION OF MODEL NO. TN-BGC1 (FRENCH COMPETENT AUTHORITY CERTIFICATE OF APPROVAL NO. F/313/B(U)F-96 REV. JBB)

Dear Mr. Boyle:

This letter is in response to your letter, dated November 19, 2013, in which you requested our assistance in evaluating the Model No. TN-BGC1 package authorized by French Competent Authority Certificate of Approval No. F/313/B(U)F-96, Rev. Jbb.

To assist with our review, the U.S. Nuclear Regulatory Commission (NRC) staff needs the information identified in the enclosure to this letter. This information is required to determine if the Model No. TN-BGC1 package meets the IAEA TS-R-1 requirements. We request that you provide the information within thirty days. If you are unable to provide a response within thirty days, our review will be delayed.

Please reference Docket No. 71-3034 and TAC No. L24858 in future correspondence related to this revalidation action. If you have any questions regarding this matter, feel free to contact me at (301) 287-9225.

Sincerely,

/RA/

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

Docket No. 71-3034
TAC No. L24858

Enclosure: Request for Additional Information

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Request for Additional Information
Docket No. 71-3034
Competent Authority Certificate No. F/313/B(U)F-96, Rev. Jbb
Model No. TN-BGC1 Package

By application dated November 19, 2013, the Department of Transportation requested revalidation of the Model No. TN-BGC1 package (French Competent Authority Certificate F/313/B(U)F-96, Rev. Jbb). This request for additional information (RAI) identifies information needed by staff in connection with its review of the application.

Each individual RAI describes information needed by the NRC staff for it to complete its review of the application to determine whether the applicant has demonstrated compliance with IAEA regulatory requirements.

Criticality Review

RAI 1
Identify the source of the reprocessed uranium; e.g., power reactor fuel assemblies, U-Mo fuel assemblies, as well as the anticipated fission products, uranium isotopes; e.g., uranium-234 and uranium-236, and plutonium isotopes in the content.

In Section No. 3, "Criticality Study," of ANNEXE 11 of the application letter dated November 19, 2013, the applicant states that one of the intended contents is unirradiated reprocessed uranium. Paragraph 246 of TS-R-1 explicitly identifies the permissible quantities of plutonium, fission products, and uranium-236 which define uranium as unirradiated. The isotopic composition of reprocessed uranium can vary widely depending upon its source, and the TS-R-1 regulations for reprocessed uranium are very restrictive with regard to isotopes. Therefore, the applicant needs to provide specific information on both the source of the reprocessed uranium and the isotopic composition for this type of contents.

The staff needs this information to proceed with its review to determine if the TN-BGC 1package with content 11 meets the requirements of para. 246 and 673 of TS-R-1 (2009 edition).

RAI 2
Provide code benchmarking information and results for the computer codes, APLLO2 and MORET 4, and demonstrate that the TN BGC-1 package with content 11 meets the regulatory requirements of TS-R-1, para. 677, 678, 681 and 682.

The applicant states in the safety analysis report that the APLLO2 and MORET 4 computer codes were used in the criticality safety analyses of the TN-BGC1 package. However, the applicant provided no benchmarking information for these codes. The applicant needs to provide information on the benchmarking of these codes, the resulting bias and bias uncertainties, corresponding corrections to the calculated k_{eff} values, and consequently the limit on the allowable ^{235}U contents and the Criticality Safety Index for each package.

The staff needs this information to proceed with its review per the requirements of requirements of TS-R-1 (2009 edition), para. 677, 678, 681 and 682.

RAI 3

For content 11b:

1. Clarify if 15 kg rather 19.5 kg of uranium-235 (^{235}U) is the intended payload limit of content 11b;
2. Demonstrate criticality safety of the package that contains proposed hydrogenous materials;
3. Demonstrate that a 3.3 cm neutron poison resin layer would remain uniformly attached to the inner wall after the package thermal test of TS-R-1 para. 728(a);
4. Demonstrate criticality safety of the package assuming complete loss of neutron poison resin under hypothetical accident conditions (HAC); i.e., accident conditions of transport (ACT) if the assumed remaining 3.3 cm layer cannot be assured ;
5. Recalculate the Criticality Safety Index with $k_{eff} \leq 0.95$;
6. Correct Table 9 on page 23 of Chapter No. 8 to ensure that the payload quantities are consistent with the table presented in ANNEXE 11 of the application for contents 11c, 11f, and 11h.

The applicant requests authorization to transport 19.5 kg of ^{235}U for content 11b. The safety analysis report, however, analyzed criticality safety for a package containing 15 kg of ^{235}U for this content. The applicant needs to clarify the desired content limit and provide analyses to demonstrate the package meets the criticality safety requirements of TS-R-1 for that limit. The staff's own analyses show that k_{eff} for a TN-BGC1 package with 19.5 kg of ^{235}U will exceed 0.95 for a single package under normal conditions of transport as well as a package under HAC (ACT).

The applicant requests authorization of use of hydrogenous materials, such as polyurethane, polyethylene, and PVC as packaging materials. The safety analysis report, however, does not include an evaluation of the impact these types of materials have on criticality safety. The applicant needs to provide criticality safety analyses for packages that use hydrogenous materials, such as polyurethane foam and polyethylene sheet, as part of the packaging materials.

In its criticality safety analyses, the applicant assumed that there was a 3.3 cm neutron poison resin layer attached to the inner shell wall of the packaging after the package has endured a fire as described in TS-R-1 para. 728(a). The applicant needs to demonstrate this assumption is valid or redo the criticality safety analyses with an assumption that can be validated.

The staff also notes that a k_{eff} greater than 0.95 had been used as the acceptance criterion for criticality safety. This is not consistent with guidance in the 2008 edition of TS-G-1.1, para. VI.38. The applicant needs to demonstrate criticality safety for a single package as well as an array of packages under normal conditions of transport as defined in Para. 719 through 724 and HAC (ACT) as defined in Para. 726 through 733 of the 2009 edition of TS-R-1 using an acceptance criterion of $k_{eff} \leq 0.95$ per the guidance in the 2008 edition of TS-G-1.1, para. VI.38.

In addition, correct Table 9 in page 23 of Chapter No. 8 of the SAR to ensure that the payload limits are consistent with the table presented in ANNEXE 11 the of the application. There is no quantity limit in Table 9 for content 11c, 11f, and 11h.

The staff needs this information to proceed with its review to determine if the TN-BGC 1package with content 11 meets the requirements of para. 673 of TS-R-1 (2009 edition).

RAI 4
Provide the criticality safety analyses applicable to content 11f or identify its replacement.

Section 4.11.1.4 of Chapter No. 8 of the SAR states CEA/SEC/T No. 89-18 dated 20 January 1989 demonstrates sub-criticality of the TN-BGC1 with content 11f. However, CEA/SEC/T No. 89-18 cannot be located within the submittal.

The staff needs this information to proceed with its review per the requirements of para. 671 of TS-R-1 (2009 edition).

Shielding Review

RAI 1
Justify why there is no shielding safety analysis if the content has significant quantities of gamma or neutron emitting isotopes (see above Criticality Review RAI 1).

From the application, one of the intended contents is unirradiated reprocessed uranium. Since reprocessed fuel typically contains gamma and neutron emitting isotopes, the applicant needs to justify why there is no shielding safety analysis for the package if the unirradiated reprocessed uranium has significant quantities of gamma or neutron emitting isotopes.

The staff needs this information to proceed with its review to determine if the TN-BGC 1package with content 11 meets the requirements of para. 569 and 657 of TS-R-1 (2009 edition).

Materials Review

RAI 1
Clarify the maximum mass of PVC and polyurethane for non-air transport.

A restrictive list of polymeric materials, namely polyurethane, polyethylene, and polyvinyl chloride (PVC), is specified in the French Certificate of Approval for sub-contents 11a, 11b, and 11c. For non-air transport, the certificate states that the maximum mass of polyethylene for sub-contents 11a, 11b, and 11c is limited to 500 g. However, no defined limitation for the mass of PVC or polyurethane in the package is specified.

The staff needs this information to proceed with its review per para. 613,TS-R-1 (2009 Edition).

RAI 2
Provide an analysis for the production of inflammable gases due to radiolysis and thermolysis of the polyethylene in the primary containment. The analysis should include a justification for the gas formation rates and the thermal decomposition thresholds considered.

A gas release analysis for uranium bearing contents is provided in Chapter 9 (§3.3.1) for a bounding content consisting of 45 kg of uranium enriched to 100% in ^{235}U, which exceeds the enrichment of contents 11a, 11b, and 11c. The applicant assumed a maximum polymer mass of 500 g and a maximum temperature of 144°C reached during HAC (ACT). However, the analysis uses a radiolytic efficiency for PVC which is much lower than that of polyethylene. The service temperature of polyethylene is also lower than that of PVC or polyurethane.

The staff needs this information to proceed with its review per para. 506, TS-R-1 (2009 Edition).

RAI 3
Clarify if the uranium-zirconium alloy is to be shipped as powder. If it is to be shipped as powder, provide details on the minimum particle size and additional controls to avoid flammability or pyrophoricity hazards. Provide details on inert gas purity, initial water content of powder, and procedures for loading and inerting the material.

The French Certificate of Authorization states inerting conditions for the container, secondary containment, and the TN-BGC1 cavity, with a leakage rate below $1.33x10^{-5}$ Pa m^3s^{-1}. However, these conditions are insufficient to eliminate the potential for a pyrophoric reaction. Additional controls are required.

The staff needs this information to proceed with its review per para. 506, TS-R-1 (2009 Edition).

RAI 4
Clarify the maximum temperatures reached by the PVC and polyurethane in Content No. 11, and for polyurethane in Content No. 26. If the temperatures exceed 144°C, provide a valid gas generation analysis due to thermolysis/radiolysis of the covers.

The SAR analysis (Ch. 9, §3.3) assumes 144°C as the bounding temperature for the outside of the primary containment during HAC (ACT). A thermal evaluation was provided (Chapter No. 5, §7.23 and §8.3.3) assuming that PVC or polyurethane containers are used as covers for the primary container of an 80W content (Family 1 as defined in Chapter No. 5, §4). However, the SAR does not reference the covers being used for contents in Family 3 (i.e., zero power, Contents No. 11 and No. 26). In addition, the cover temperatures for a bounding Family 3 content are not provided.

The staff needs this information to proceed with its review per para. 506, TS-R-1 (2009 Edition).