January 12, 2009

James M. Shuler
Manager, Packaging Certification Program
Safety Management and Operations
Office of Environmental Management
Department of Energy
Washington, DC 20585

SUBJECT: REQUEST FOR ADDITIONAL INFORMATION FOR REVIEW OF THE CERTIFICATE OF COMPLIANCE NO. 9315, REVISION 9

Dear Dr. Shuler:

By letter dated October 11, 2007, as supplemented March 11 and 25 and September 28, 2008, the Department of Energy (DOE) submitted a revised application in accordance with 10 CFR Part 71 for an amendment to Certificate of Compliance (CoC) No. 9315 for the Model No. ES-3100 package to request various changes.

The U. S. Nuclear Regulatory Commission (NRC) staff reviewed the information provided and requested additional information (RAI) by letter dated April 28, 2008, as supplemented July 14, 2008. DOE responded to the RAIs by letter dated September 8, 2008. On October 14, 2008, a telephone call was held with DOE to discuss the RAI responses and to let the applicant know that there will be a second round of RAIs. Staff discussed some of the RAIs and presented a portion of the questions by letter dated November 25, 2008.

In connection with our review, we need the information identified in the enclosure to this letter. Additional information requested by this letter should be submitted in the form of revised Safety Analysis Report pages. To assist us in scheduling staff review of your response, we request that you provide this information by February 8, 2009. If you are unable to provide a response by that date, our review may be delayed. Staff also stresses that responses should be very clearly and concisely written to provide the information necessary to make a safety determination.

Please reference Docket No. 71-9315 and TAC No. L24141 in future correspondence related to this request. The staff is available to meet to discuss your proposed responses. If you have any questions regarding this matter, I may be contacted at (301) 492-3339.

Sincerely,

/RA/

Kimberly J. Hardin, Senior Project Manager
Licensing Branch
Division of Spent Fuel Storage and Transportation
Office of Nuclear Material Safety
and Safeguards

Docket No. 71-9315
TAC No. L24141
Enclosure: Request for Additional Information

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NAME	KHardin		MDeBose		RParkhill		ABarto		LCampbell	
DATE	1/7/09		1/8/09		1/8/09		1/9/09 via e-mail		1/12/2009	

OFC	SFST		SFST		SFST		SFST		SFST	
NAME	MWaters		EBenner							
DATE	1/09/2009		1/12/2009							

C=Without attachment/enclosure E=With attachment/enclosure N=No copy **OFFICIAL RECORD COPY**

Request for Additional Information
U.S. Department of Energy (DOE)
Docket No. 71-9315
Certificate of Compliance No. 9315
Model No. ES-3100 Package

By application dated October 11, 2007, as supplemented March 11 and 25, and September 28, 2008, the U.S. Department of Energy (DOE or the applicant) requested an amendment to Certificate of Compliance (CoC) No. 9315 for the Model No. ES-3100 package. The applicant requested various revisions to the CoC. This request for additional information (RAI) identifies information needed by the U.S. Nuclear Regulatory Commission staff in connection with its review of the application. The requested information is listed by chapter number and title in the applicant's Safety Analysis Report (SAR). NUREG-1609, "Standard Review Plan for Transportation Packages for Radioactive Materials," was used by the staff in its review of the application.

The applicant is proposing changes to the SAR and CoC to:

1. Revise criticality safety calculations in the SAR and fissile loadings in the CoC,
2. Revise the Criticality Safety Index (CSI),
3. Revise the quantity of off-gassing material and add a Teflon bottle as a convenience container,
4. Revise the carbon concentration in uranium oxide,
5. Revise the concentration of neptunium-237 in uranium, and
6. Add uranium alloyed with aluminum and molybdenum as authorized contents.

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

Chapter 3 Thermal Review

3-1 Explain and justify the basis for the limit of 1500 g of off-gassing material and add this information to the SAR. The original RAI 3-4 requested the applicant to justify the 1500 g limit of off-gassing material per CVA. The applicant added Appendix 3.6.7, "Estimates of Hydrogen Buildup in the ES-3100 Package Containing Highly Enriched Uranium." Section 3.6.7.5 of this appendix states that the polyethylene contributes very little to the hydrogen generation.

This information is needed to ensure compliance with 10 CFR 71.43(d).

3-2 Revise the maximum normal operating pressure (MNOP) analysis to include partial pressure from the radiolysis gas generation.

The applicant provided a gas generation model and basis to justify the compliance of the hydrogen concentration limit in the new Appendix 3.6.7. However, the original MNOP analysis does not include the partial pressure due to the generated hydrogen. A maximum partial pressure from hydrogen during the transportation period should be estimated and included in the MNOP evaluation.

This information is needed to ensure compliance with 10 CFR 71.31(a)(2) and 71.43(d).

3-3 Provide the basis for the hydrogen generation model contained in Appendix 3.6.7.

(A) Provide justification for the applicability of the ORNL model.

The applicant uses a G value of 0.28 in the gas generation model to derive the gas generation rate and the time to reach the concentration limit, which is based on ORNL's report. This value is significantly lower than the bounding value (1.6) provided in staff's guidance report NUREG-CR6673. The application should provide justification of the applicability of using ORNL results, which includes the material composition, operating conditions, and package geometry.

(B) Provide the experimental validation of the gas generation model.

The applicant should provide the experimental validation to support the gas generation model since the G value used is a best-estimate value in contrast to the conservative bounding value. Validation is needed to address uncertainty in the analysis, such as effectiveness factor (GF), void volume calculation, weight measurement, and the ideal gas law.

(C) Justify the margin for the compliance of the hydrogen concentration limit.

The applicant provides Appendix 3.6.7 as the hydrogen generation model and evaluates the time span for the package to reach the 5% hydrogen concentration limit. For CVA 7, the required time is one year, which has no margin toward the concentration limit. In light of the great uncertainty involved in the analysis and the best-estimated G value is used, the applicant should provide enough margin (time span) for the results in terms of material weight.

(D) Provide the operating procedures in handling potential flammable gas generation.

The applicant needs to provide a complete operating procedure in handling potential flammable gas generation. The procedures include venting, gas sampling, and shipping time control.

This information is needed to ensure compliance with 10 CFR 71.31(a)(2) and 71.43(d).

Chapter 6 Criticality Review

6-1 Clarify mass loading limits for the square bars.

Tables 6.1.a and 6.9.1.1 state that the mass loading limit for square bars using can spacers is 36 kg. Table 1.3 states that this limit is 35.2 kg. Please clarify.

This information is needed to satisfy the requirements of 71.33(b)(2).

6-2 Provide clarifying information on enrichment and mass limits for the slug configurations. Provide clarification on geometric arrangement of ≤ 80% enriched slugs.

a. Table 1.3 shows limits for enrichment > 80% with no upper bound (presumably this is 100%). This table gives a maximum U-235 mass of 17.374 kg for no spacers and 24.324 kg with spacers. The headings for Table 6.1b also give a maximum enrichment of 100%, but has different maximum mass limits. This table gives 18.277 kg U-235 for no spacers and 36.555 kg U-235 with spacers. The replacement text for Sect. 6.4.1 in response to RAI 6-8 states that the slugs are modeled as 100% wt% U-235. Other parts of Table 6.1b (new page 6-12) have mass limits consistent with Table 1.3 but an enrichment maximum of 95%. This is consistent with the information in Table 6.9.1.1. Clarify and be consistent with the mass and enrichment limits.

b. The heading row of Table 6.1b states a maximum mass of 36.555 kg of U-235 for ≤ 80% enriched slugs with canned spacers. Further down in the table the maximum mass of U-235 for this configuration is 29.318 kg. This is consistent with the information in Table 1.3. Please clarify the mass limit for this configuration.

c. Provide additional justification that the modeled arrangement of the slugs is the most reactive. In the response to RAI 6-8 you show that for an arrangement of 5 slugs that the most reactive is when there is 1.0 cm spacing between the slugs. However, it is not clear to the staff why, in some instances, you choose no spacing between the slugs. In addition, although you present some sensitivity studies, it is not clear in the other slug configurations (6 or more slugs per stack or double stacked slugs) that the most reactive configuration was found. Provide additional clarification demonstrating that the most reactive slug configuration was found for these other configurations.

d. Table 6.9.1.1 states for case ncia5est11_2_5_3 for slugs with enrichment ≤ 80% that there are double stacked slugs. Provide the arrangement of the slugs.

e. Table 6.9.1.1 states for case ncia5est12_2_2_7_3 for slugs with enrichment ≤ 95%, CSI=0.4, that there are double stacked slugs. Provide the arrangement of the slugs. Confirm that ncia5est12_2_2_7_3 is a typographical error and this calculation should be listed as ncia5est11_2_2_7_3.

f. Table 6.9.1.1 states for case ncf15est11_2_2_5_3 for slugs with enrichment ≤ 80%, CSI=0.4, that there are double stacked slugs. Provide the arrangement of the slugs. Table 6.9.1.1 and Table 6.1b both list this configuration with the mass limit of 29.318 kg U-235 but this is not listed in Table 1.3 as part of the authorized contents. Clarify if this is to be included as part of the authorized contents.

This information is needed to satisfy the requirements of 10 CFR 71.33 and 71.55. 10 CFR 71.33(b)(2) requires that the description of the contents identify maximum quantities of fissile constituents. In addition, this information is needed to demonstrate that the applicant has determined the maximum reactivity of the system per the requirements of 10 CFR 71.55(b).

6-3 Provide clarifying information on the mass and modeled configuration for cylinders of diameter ≤ 4.25 inches.

Provide the information for case nciacyt11_25_2_3 in Table 6.9.1.1 for the limiting conditions for the 100% enriched cylinders of d ≤ 4.25 inches. The information listed is the same as the preceding case without spacers. The staff believes this is a typographical error. In addition, the information in Table 6.1a is not consistent for this configuration. Some table entries state that the maximum U-235 mass for this configuration is 32 kg and further down the table (and Table 1.3) it states that the load limit is 25 kg. Please clarify.

This information is needed to satisfy the requirements of 10 CFR 71.33 and 71.55. 10 CFR 71.33(b)(2) requires that the description of the contents identify maximum quantities of fissile constituents. In addition this information is needed to demonstrate that the applicant has determined the maximum reactivity of the system per the requirements of 10 CFR 71.55(b).

6-4 Provide justification for allowing hydrogenous material to be stored with the broken metal of unspecified shapes.

In response to staff RAI 6-5, you provided information on hydrogenous material assumptions in the KENO evaluation models. Information about the assumptions used for the broken metal models is provided in response to staff RAI 6-11. In this RAI response you introduced the “packing fraction” and “dispersed content” models. You describe how the hydrogenous material was included in these models and then compare them to the “cha” model which was used to establish the mass loading limits. Table 6.9.6-11b and c show that the “cha” model is still more conservative than that of the “packing fraction” and the “dispersed content” models. Since the “cha” is the most conservative model, and was used to establish the mass loading limits for the broken metal loadings, provide information justifying the inclusion of hydrogenous packing material using this modeling approach.

This information is needed to demonstrate that the applicant has determined the maximum reactivity of the system per the requirements of 10 CFR 71.55(b).

6-5 Revise the criticality analysis for uranium oxide powders to consider low density powders.

The applicant stated in its response to RAI 6-12 that product oxide has a bulk density of 6.54 grams/cm^3, which was used to determine the amount of water that could saturate the uranium oxide powder. Staff was able to find references stating that UO_2 powders could be expected to have a bulk density of 2.0 - 5.0 grams/cm^3, depending on the process used for production. A lower powder density could allow for more water in the UO_2 – water mixture assumed in the analysis, which could therefore affect the reactivity of the package.

This information is required to ensure that the applicant has identified the most reactive credible configuration consistent with the chemical and physical form of the material per 10 CFR 71.55(b).

6-6 Revise the criticality analysis to define the “unidentified material” that may be present in the skull oxide content.

The applicant stated in its response to RAI 6-12 that: “The skull oxide content is assumed to be U_3O_8 plus, graphite, polyethylene, and unidentified material.” The unidentified material should be addressed in the criticality analysis to ensure that its presence will not increase reactivity beyond what is considered in the current analysis. Note that 10 CFR Part 71.83 states that: “When the isotopic abundance, mass, concentration, degree of irradiation, degree of moderation, or other pertinent property of fissile material in any package is not known, the licensee shall package the fissile material as if the unknown properties have credible values that will cause the maximum neutron multiplication.”

This information is required to ensure that the package design with the skull oxide content will continue to meet the requirements for fissile material packages in 10 CFR Parts 71.55 and 71.83.

6-7 Revise the benchmarking analysis in Section 6.8 of the SAR to ensure that the single calculated upper subcritical limit (USL) of 0.925 is appropriate for all of the evaluated contents for the Model No. ES-3100.

The benchmarking analysis for this application appears to have relied on a USL calculated for a group of 639 uranium systems of varying type. The benchmarking analysis should ensure that the calculated USL is appropriate for the various types of systems being evaluated (e.g., metal, oxide, solution). It should be demonstrated that the USL determined for a large group of mixed systems bounds that calculated for individual sets of similar systems. Selected benchmark experiments should have, to the maximum extent possible, the same materials, neutron spectra, and configuration as the package evaluations. It is also noted that the group of experiments used for the benchmarking analysis includes low and middle enrichments of uranium. This may not be appropriate for benchmarking the ES-3100 package, which is designed to transport primarily high enriched uranium.

This information is required to ensure that the package will remain subcritical per the fissile material requirements of 10 CFR Parts 71.55 and 71.59.