December 15, 2009

Mr. William M. Arnold, President
Century Industries
P.O. Box 17084
Bristol, VA 24209

SUBJECT: REQUEST FOR ADDITIONAL INFORMATION FOR THE REVIEW OF THE MODEL NO. VERSA-PAC PACKAGE

Dear Mr. Arnold:

By letter dated October 13, 2009, Century Industries submitted its responses to a Request for Supplemental Information dated September 25, 2009, and provided a revised application for approval of the Model No. Versa-Pac package.

In connection with the staff's review of the application, Revision No. 1, dated October 2009, we need the information identified in the enclosure to this letter. We request that you provide this information by January 15, 2010. If you are unable to meet this deadline, you must notify us in writing no later than January 4, 2010, of your submittal date and the reasons for the delay. The staff will then assess the impact of the new submittal date and notify you of a revised schedule.

Please reference Docket No. 71-9342 and TAC No. L24365 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) 492-3408.

Sincerely,

/RA/
Pierre Saverot, Project Manager
Licensing Branch
Division of Spent Fuel Storage and Transportation
Office of Nuclear Material Safety
and Safeguards

Docket No. 71-9342
TAC No. L24365

Enclosure: Request for Additional Information

cc w/encl.: Everett Redmond, NEI

December 15, 2009

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Century Industries
P.O. Box 17084
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Request for Additional Information
for the
Model No. Versa-Pac Package
Docket No. 71-9342

By letter dated October 13, 2009, Century Industries submitted an application for approval of the Model No. Versa-Pac package.

This Request for Additional Information (RAI) identifies information needed by the staff in connection with its review of the "Safety Analysis Report for Century Industries Versa-Pac Shipping Container," Revision No. 1, dated October 2009. The requested information is listed by chapter number and title in the applicant's Safety Analysis Report. The staff reviewed the application using the guidance in NUREG 1609, "Standard Review Plan for Transportation Packages for Radioactive Material."

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

Chapter 1 – General Information

1.1 Provide a temperature range or limit for the Standard Operating Procedure (SOP) 6.11, paragraphs 6.2.4 and 6.3.3.

The procedure instructs the user to adjust the temperature but provides no indication of acceptable temperature, temperature range, or source material which specifies a proper temperature (e.g., resin manufacturer literature). Typically, polyurethane resins specify optimum mixing/reaction/cure temperatures. Also, acceptable methods for adjusting and maintaining the temperature should be specified.

This information is required by the staff to determine compliance with 10 CFR 71.7(a).

1.2 Revise the licensing drawings to clarify and harmonize all dimensions, and use consistent units (inches).

The coherence between the dimensions referred to in the application and those presented in the licensing drawings is not always clear.

This information is required by the staff to determine compliance with 10 CFR 71.33.

1.3 Revise the licensing drawings for the Model No. VP-110 package to reflect the eight vertical stiffeners as well as other differences from the Model No. VP-55 package, as described in the application. Also, it is not clear that the licensing drawings show eight bolts while test photographs do show eight bolts for the package.

This information is required by the staff to determine compliance with 10 CFR 71.33.

1.4 Specify the conveyance types for the Model No. Versa-Pac package.

The applicant does not specify that the Model No. Versa-Pac package is for exclusive use or nonexclusive use shipment, but presents an evaluated maximum accessible surface temperature of 140^{o}F in Table No. 3-1 of the application, in compliance with 10 CFR 71.43(g).

The application should indicate the types of conveyance considered for this package in Chapter 1 of the application.

This information is required by the staff to determine compliance with 10 CFR 71.33 and 71.43(g).

1.5 Provide the mass limits for U-234 and U-236, the radionuclide inventory, and A_1/A_2 values of the contents of the package.

The applicant identifies the Model No. Versa-Pac package as a Type A Fissile package with "contents containing no more than one A_1 or A_2 quantity, as appropriate, and a weight not exceeding 350 grams U-235 in any pyrophoric form, enriched up to 100 wt%."

The application should (i) clarify that it is either the individual material or the material mixture in the package containing less than one A_1 or A_2 quantity and document it in the application, and (ii) provide the radionuclide inventory and A_1 (or A_2) values of the uranium materials shipped in the package.

A mass limit for U-234 is also not explicitly given. The critical mass of U-234 is less than that of U-235; therefore, this isotope is of concern. Identify the mass limit for U-234.

This information is required by the staff to determine compliance with 10 CFR 71.31 and 71.33.

1.6 Validate the ignition temperatures of paper, cotton and rubber in Table No. 1-4 and revise the selected materials for packaging the contents.

The applicant lists the ignition temperatures of 842^{o}F for paper and 887^{o}F for cotton based on References 1 and 2 in Chapter No. 1 of the application. The staff reviewed these references and validated the ignition temperatures of 424~475^{o}F for paper, and 482^{o}F for cotton which have ignition temperatures below the HAC maximum temperature of 552^{o}F and have potential for auto-ignition under HAC fire. The applicant is required to validate/revise the ignition temperatures in Table No. 1-4 of the application and remove materials that may ignite within the package.

This information is required by the staff to determine compliance with 10 CFR 71.31 and 71.33.

1.7 Provide the melting points of all selected materials for packaging within the Versa-Pac

The applicant stated in SAR 1.2.2 that all materials must be in solid from with no freestanding liquids, and predicted maximum payload temperatures of 144^{o}F under NCT and 552^{o}F under HAC. The applicant should list the melting points of all selected materials in a new table or in Table No. 1-4 for justification and documentation.

This information is required by the staff to determine compliance with 10 CFR 71.31 and 71.33.

Chapter 2 – Structural Evaluation

2.1 Provide detailed information on the center of gravity for the Model No. VP-110 package.

Section No. 2.1.3 of the application defines the center of gravity only for the Model No. VP-55 package.

This information is required by the staff to determine compliance with 10 CFR 71.33.

2.2 Present an evaluation of the effect of vibration on the closure bolts.

Section No. 2.6.5 of the application refers to settling or compaction of the payload but does not properly justify that normal vibration incident to transport does not affect the closure bolts.

This information is required by the staff to determine compliance with 10 CFR 71.71(c)(5).

2.3 Explain how package failure by buckling is prevented for compression loading.

The compression evaluation considers the cross-sectional areas as one solid; however, the structural members are slender or thin walled and thus susceptible to buckling.

This information is required by the staff to determine compliance with 10 CFR 71.71(c)(9).

2.4 Justify compliance with penetration regulatory requirements.

No calculation or test result is presented in Section No. 2.6.10 of the application to support the claim that regulations are met. The application should also clearly indicate that the pin was attached to the pad. This is not clear from either the photographs or the description.

This information is required by the staff to determine compliance with 10 CFR71.71(c)(10).

2.5 List the density values for the foams used in the HAC drop tests and explain why the effect of the polyurethane density on the end drop test is negligible.

The specified density for the foam on the top and bottom of the package can vary from 5 to 11 pcf. Foam mechanical properties are known to vary with density and, as such, heavier foam might result in a stiffer response.

This information is required by the staff to determine compliance with 10 CFR 71.73(c)(1).

2.6 Remove the following sentence from page No. 2-18 of the application and from the conclusions section of Appendix No. 2.12.4: "The results of this test series provide additional support to the reasoning that the 55 gallon version is bound by the previously conducted physical test series of the 110 gallon version and previous preliminary testing of the Versa-Pac shipping container."

The 110-gallon drum is strengthened with eight longitudinal stiffeners versus four for the 55-gallon version; thus, the stress paths are different and such reasoning has no basis.

This information is required by the staff to determine compliance with 10 CFR 71.73(c)(1).

Chapter 3 – Thermal Evaluation

3.1 Provide a description of the functions of the fiberglass thermal break and its operations in the Model No. Versa-Pac package.

The applicant specifies a fiberglass (band/rings) thermal break in the package to limit the heat flow into the payload cavity through the steel flange components. The staff needs more information on the thermal break to ensure that its functions are reliable during package shipment.

The description should address fiberglass material specifications, thermal performance, thermal resistance, condensation performance under very low temperature (-40^{o}F), corrosion resistance, and procedures/operations to limit the heat flow into the payload cavity.

This information is required by the staff to determine compliance with 10 CFR 71.33 and 71.35.

3.2 Clarify the types of uranium compounds and payload materials which could be unstable, decompose, or undergo auto-ignition under 600^{o}F. Provide a description and material specifications for the payload containers in the design drawings.

The applicant states in Section No. 3.2.1 of the application (Material Properties) that the payloads that are unstable or decompose at temperatures below 600^{o}F or that could further pressurize the package, may not be shipped in the Model No. Versa-Pac package. It is not clear how the package users will identify the types of the payloads which could be unstable, decompose, or undergo auto-ignition at temperatures below 600^{o}F. It is important to clearly specify the contents allowed for shipment in the Certificate of Compliance.

This information is required by the staff to determine compliance with 10 CFR 71.31 and 71.33.

3.3 Clarify the decay heat used in the thermal analyses.

The applicant specifies in Section No. 3.4.2 and Appendix 3.5.1 of the application that a conservative decay heat of 11.4 watt is used in the thermal analyses, but displays a decay heat of 10.0 watt as an applied heat load in Table No. 3-2 of the application and in the figures of Appendix No. 3.5.4 for the NCT and HAC thermal evaluations. The applicant should clarify the heat load used in the thermal analyses and update the application as appropriate.

This information is required by the staff to determine compliance with 10 CFR 71.35, 71.71, and 71.73.

3.4 Clarify the meaning of maximum allowable external/internal working pressure and its use in the package analyses.

The applicant specifies in Section No. 3.2.2 of the application that a maximum allowable external and internal working pressure of 15.0 psig is determined to avoid collapse of the payload cavity. The applicant should (i) explain how this working pressure is determined for the non-sealed Model No. Versa-Pac package, and (ii) clarify whether this allowable working pressure is applicable for all permitted contents in the package.

This information is required by the staff to determine compliance with 10 CFR 71.35 and 71.71.

3.5 Convert the units of the thermal material properties in Table No. 3.5.1-3 of the application to traditional thermal units.

The applicant needs to convert the units, used in ALGOR code, of density from (lb_f-s^2/in)/(in^3) to lb_m/in^3, thermal conductivity from (in-lb_f)/(s-in-^oF) to Btu/(s-in-^oF) or Btu/(hr-in-^oF), specific heat from (in-lb_f)/((lb_f-s^2/in)-^oF) to Btu/(lb_m-^oF), and heat generation rate from (in-lb_f)/(s-in^3) to Btu/(s-in^3) or Btu/(hr-in^3). The new converted units should be listed either in Table No. 3.5.1-3 or in a new table for consistency with other thermal units used in the thermal analysis and for consistency with the standard English units commonly used for the package thermal analysis.

This is needed for the staff to validate the material properties used in this application.

This information is required by the staff to determine compliance with 10 CFR 71.33 and 71.35.

3.6 Identify the size of the air gap between the outer lid and the payload cavity lid in the package and specify this dimension in the design drawings.

The applicant simulates the air gap, between the outer lid and payload cavity lid, with a conduction equivalent condition in the thermal model, as specified in Appendix No. 3.5.1 and describes the method in Appendix No. 3.5.2 of the application. The applicant is required to provide the size of the air gap in the application for documentation and thermal model validation.

This information is required by the staff to determine compliance with 10 CFR 71.33, 71.35, 71.71, and 71.73.

3.7 Provide a thermal stress validation by the analysis of polyurethane foam disk during and after HAC.

The applicant lists the thermal expansion coefficient (3.4×10^{-5} in/in/^oF) of the 3-inch thick polyurethane foam disk in Table No. 2-2 of the application, and claims that the Model No. Versa-Pac package design is not anticipated to be subject to thermal stress during the required 30-minute thermal test, by using a previously approved Century Champion Package in which the structures and thermal insulation are similar to the Model No. Versa-Pac package. The applicant is required to provide this analysis directly from the Model No. Versa-Pac package thermal test model results of the polyurethane foam disk on its maximum temperature difference across the disk and maximum average temperature of the disk during or after the fire for thermal stress evaluation and validation.

This information is required by the staff to determine compliance with 10 CFR 71.35 and 71.73.

3.8 Update the Summary of Results of Appendix No. 3.5.3 of the application.

The applicant revised Table No. 3-1 (Evaluation Results) in the application, Revision No. 1, but did not update the temperatures (e.g., 423^oF) under the Section titled “Summary of Results” in Appendix No. 3.5.3. The applicant should correct all errors of temperatures in this Section “Summary of Results” of Appendix No. 3.5.3 to ensure that the thermal stress analysis is consistently documented throughout the application.

This information is required by the staff to determine compliance with 10 CFR 71.33.

Chapter 6 – Criticality Evaluation

6.1 Clarify how many packages could be shipped at one time.

The applicant provides a new CSI of 0.9 in the application dated October 2009. With this new revised CSI, the number of packages shipped at one time should also be revised.

This information is required by the staff to determine compliance with 10 CFR 71.59.

6-2 Explain how the limit of 300 packages was chosen.

Figures No. 6-8, 6-10, 6-14, and 6-15 demonstrate trends that were used to determine a limit of 300 packages per shipment.

However, it does not appear that many studies were done around the actual number of packages to be shipped. The staff needs an explanation as to why there appears to be a gap in the analysis in arrays of size from 200-400, when 300 packages is going to be the limit.

This information is required by the staff to determine compliance with 10 CFR 71.59

6-3 Justify the use of 15" – 15.125" for the inner payload diameter in the criticality evaluation.

Appendix No. 2.12.4, page No. 17, of the application shows that the tests required by 10 CFR 71.73 decrease the inner payload diameter. Table No. 6-3 does not take into account this discrepancy and only applies the tolerance to increase the inner payload diameter. The staff investigated this discrepancy and found that using a smaller inner payload diameter causes an increase in reactivity. The staff requests a justification as to why the value from the tests was not used, and why the tolerance was only applied in the positive direction.

This information is required by the staff to determine compliance with 10 CFR 71.55.

6-4 Clarify the payload inner height used in the criticality evaluation.

On Table No. 6-3, the payload vessel inner height is given in inches and in centimeters; however, the conversion does not match. The staff requests a clarification on what the actual height is.

This information is required by the staff to determine compliance with 10 CFR 71.55.

6-5 Demonstrate that the use of polyethylene in the criticality evaluation is bounding.

The applicant states in Section No. 6.3.4.3.1 that the polyethylene moderator used bounds water and other compounds containing more carbon and hydrogen. However, the staff investigated this claim and found that polyethylene is not the most reactive moderator to use out of the four listed. The staff needs a demonstration of how the polyethylene moderator is bounding.

This information is required by the staff to determine compliance with 10 CFR 71.55.

6-6 Clarify what constitutes vertical members and vertical tubing with regard to the criticality evaluation.

Section No. 6.3.1.1 states that vertical members are excluded in the criticality model, while Table No. 6-3 states that vertical tubing is included. This terminology was not found on the drawings and the staff needs a clarification on what was modeled and what was excluded.

This information is required by the staff to determine compliance with 10 CFR 71.55.

6-7 Demonstrate that the fissile lump was placed in the package to achieve the most reactive configuration.

The tables at the end of Chapter No. 6 of the application show a variety of studies that were performed to find the most reactive configuration. However, the staff could not find a study to look at the placement of the fissile lump within the package.

The staff needs a demonstration that the fissile mass was placed in the most reactive configuration.

This information is required by the staff to determine compliance with 10 CFR 71.55.

6.8 Clarify the legends in the Figures at the end of the Chapter No. 6 of the application.

Figures Nos. 6-7, 6-8, 6-9, 6-10, 6-11, 6-12, 6-13, and 6-14 have legends in the figures that are not clear to the staff. The staff needs clarification as to what the numbers in the legend represent.

This information is required by the staff to determine compliance with 10 CFR 71.55

6.9 Justify the input file VERSA_HAC_FINH_12S_10x064.inp.

Section No. 6.6.1 describes how the packages in the array will be modeled with the lump placed in the bottom corner and the packages flipped upside down so that the fissile lumps are placed closest together. Figure No. 6-18 also shows this type of modeling with the fissile lumps closest together.

However, the input file VERSA_HAC_FINH_12S_10x064.inp has an array where only the first two levels of the array have the fissile lump closest in proximity; then, the rest of the layers have the same unit. This type of modeling was investigated and found not to give the most reactive configuration, nor is it consistent with the description in the text of the application. The staff needs a justification as to why this type of modeling was used.

This information is required by the staff to determine compliance with 10 CFR 71.55.

6.10 Justify why the same material water was used throughout the criticality evaluation.

Input file VERSA_HAC_FINH_12S_10x064.inp uses the same density water for the moderation inside the payload, the foam, and the interspersed moderation. This material's density was varied for all of the regions simultaneously in the study conducted in Table No. 6-6.

The staff needs a justification as to why this is an appropriate assumption, particularly

when the inner payload of the package could be flooded independently of the other two regions.

This information is required by the staff to determine compliance with 10 CFR 71.55.

Chapter 7 – Operating Procedures

7.1 Clarify the records reporting discussed in paragraphs No. 7.2.1 and 7.2.2 of the application.

Paragraph No. 7.2.1 discusses chloride content reporting annually, whereas paragraph No. 7.2.2 describes batch testing. It is not clear if once-per-year tests are conducted or if batch tests are collected over a year and then reported once annually.

This information is required by the staff to determine compliance with 10 CFR 71.7(a).

7.2 Describe how the chloride testing, as specified in paragraphs 7.2.1 and 7.2.2, is employed as a QA/QC control if the reports are only received annually.

The staff notes that a chloride content report, provided with the delivery of each batch of resin, would provide better verification.

This information is required by the staff to determine compliance with 10 CFR 71.7(a).

7.3 Update Section No. 7.1.2 of the application to require the user to verify that no freestanding liquids or volatile compounds are loaded into the package.

This information is required by the staff to determine compliance with 10 CFR 71.43(d).

EDITORIAL

E.1 Specify the correct thermal conductivity units in paragraph No. 3.1 of SOP 6.12 which appear to be incorrect. Compare them to those indicated in paragraph No. 3.2.

E.2 Revise data sheet CI-1 of SOP 6.12 to include thickness and density. The SOP discusses the importance of measuring thickness and density but the data sheet has no place to record this information.

E.3 Revise paragraph 4.1 of SOP 6.13 which appears to be incomplete.

E.4 Revise paragraph No. 6.5 of the Versa-Pac Test Report, dated March 25, 2009, which appears to be incomplete.

E.5 Correct the title of the structural chapter. Page No. 2-1 of Chapter No. 2 of the application shows "Operating Procedures" instead of "Structural Evaluation."

E.6 Correct the reference to “Weights and Centers of Gravity,” Table No. 1-2, on page No. 2-3 of the application. The correct Table is No. 1-1.

E.7 Replace “Conduction” by “Convection” in Appendix No. 3.5.4 of the application. The Figure of the Cool-Down Sequence (page No. 1 of 3) shows “Horizontal Convection per Table 3.5.1-5.”

E.8 Correct the nameplate in Section No. 9 of Appendix No. 1.3.2 “General Notes” to show Type AF.

E.9 Correct typographical errors, e.g., “Descrete carbon steel” in Section No. 6.1.1; “prepartion of empty package for transport” in the title of Section No. 7.3; etc.