Century Industries P.O. Box 17084, Bristol, Virginia 24209
Phone: 423-646-1864/276-628-7553

February 17, 2010

Mr. Pierre M. Saverot – Project Manager
Office of Nuclear Material Safety and Safeguards
Mail Stop: EBB-3D-02M
United States Nuclear Regulatory Commission
Executive Boulevard Building
6003 Executive Boulevard
Rockville, Maryland 20852

RE: Application for Certificate of Compliance No. 9342 for the Model No. Versa- Pac Package, Docket No. 71-9342 and TAC No. L24365 – Response for Request of Additional Information

Dear Mr. Saverot,

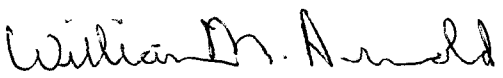
Century Industries is pleased to have this opportunity to provide the additional information requested in U.S. Nuclear Regulatory Commission letter dated December 15, 2009, from the Licensing Branch, Division of Spent Fuel Storage and Transportation Office of Nuclear Material Safety and Safeguards.

Certificate Number	Model Number
USA/9342/AF	VP-55 & VP-110

In continuing support of our application, we have provided the revised Safety Analysis Report (SAR) (3 Hard Copies and 4 Copies on CD) for the Versa-Pac Shipping Container, Revision 2 dated January, 2010. The document provides the responses and as well, supplements the comprehensive evaluation of the package design performance with respect to the current U.S. regulations. The revised SAR has been formatted in accordance with the Regulatory Guide 7.9, Revision 2.

Also, please find attached the individual response to each Request for Additional Information (RAI) listing each question as stated in the letter noted above, along with the required response as requested for your review.
If you or your staff have any questions, or need any additional information, please let me know.

Sincerely,



William M. (Mike) Arnold
President – Century Industries
Phone: 423-646-1864
E-mail: CenturyIndWMA@aol.com

Century Industries P.O. Box 17084, Bristol, Virginia 24209
Phone: 423-646-1864/276-628-7553

DOCKET NO. 71-9342
&
TAC NO. L24365

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION (RAI) AND EDITORIAL OBSERVATIONS RELATED TO THE MODEL NO. VERSA-PAC PACKAGE

Chapter 1: General Information

1.1 Provide a temperature range or limit to 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 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 requested by the staff to determine compliance with 10 CFR 71.7 (a).

Response to 1.1

Standard Operating Procedure 6.11 has been revised to provide instructions that refer to the resin manufacturer literature for additional information, temperature ranges for mold and curing temperatures. It also has been revised to provide instructions regarding heat sources and maintenance of mold and curing room temperatures, as required.

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.

Response to 1.2

Licensing drawings have been revised to clarify and correct inconsistent units

found within the body of the application and the drawings, as required.

1.3 Revise the licensing drawings for the Model No. VP-110 package to reflect the eight vertical stiffeners (Item TB), 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 show eight bolts for the package.

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

Response to 1.3

The licensing drawings have been corrected showing 8 vertical stiffeners (Item TB) instead of the 4 previously shown in drawing revision 1, as required.

1.4a Specify the package's containment boundary in this chapter of the application.

The applicant describes the containment boundary in Section No. 4.1 of the application but does not mention it in Chapter 1 under Package Description as required in accordance with NEREG-1609.

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

Response to 1.4

The containment boundary description has been added to Chapter 1, Paragraph 1.2.1, Packaging under Package Description, as required.

1.4b 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 non-exclusive use shipment, but presents an evaluated maximum accessible temperature of 140°F in Table 3-1 of the application, in compliance with 10 CFR 71.43(g). the application should indicate the type 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).

Response to 1.4b

The conveyance information has been added to Chapter 1, Paragraph 1 under Introduction stating that compliance and construction meet the requirements of 71.43(g) for both exclusive and nonexclusive use transport, as required.

1.5 Provide the mass limits for U234 and 236, the radionuclide inventory and A_1 and 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 of U-235 in any pyrophoric form, enriched up to 100wt%."

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.

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

Response to 1.5

Table 1-5 has been added in Section 1 to identify the limits for U-234 and U-236 as applied to the package. The A_2 values are used as stated in 10CFR71 and are applied to the package since the payload is limited to normal form material.

Table 1-5 Summary if Uranium Isotopic Limits for U-234 and U-236

Uranium Isotope	A_2	Ci/g	Package Gram Limit (1)
U-234 (2)	2.4	$6.2X10^{-3}$	387
U-234 (3)	$5.4X10^{-1}$	$6.2X10^{-3}$	87
U-234 (4)	$1.6X10^{-1}$	$6.2X10^{-3}$	25
U-236 (2)	Unlimited	$6.5X10^{-5}$	Unlimited
U-236 (3)	$5.4X10^{-1}$	$6.5X10^{-5}$	87
U-236 (4)	$1.6X10^{-1}$	$6.5X10^{-5}$	25

1. The mixture A_2 value is calculated per 10CFR71 by the user. The payload radionuclide inventory including U-234 and U-236 shall be less than the calculated mixture A_2 value.
2. These values apply only to compounds of uranium that take the chemical form of UF_6, UO_2F_2 and $UO_2(NO_3)_2$ in both normal and accident conditions of transport.
3. These values apply only to compounds of uranium that take the chemical form of UO_3, UF_4, UCl_4 and hexavalent compounds in both normal and accident conditions of transport.
4. These values apply to all compounds of uranium other than those specified in (2) and (3) of this table.

1.6 Validate the ignition temperature 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°F for paper and 887°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°F for paper, 482°F for cotton and 500-601°F for rubber which have ignition temperature below the HAC maximum temperature of 552°F and have potential for auto-ignition under HAC fire. The applicant is required to validate/revise the ignition temperature in Table 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.

Response to 1.6

Table 1-4 has been revised to remove those items of concern and modified to include melting points of the packaging materials shown as typical packaging materials. An ASTM specification has been added to provide guidance for the user when shipping in the Versa-Pac to establish the temperature requirements for packaging materials other than those provided in Table 1-4.

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 form with no freestanding liquids, and predicted maximum payload temperatures of 144°F under NCT and 552°F under HAC. The applicant should list the melting points of all selected materials in a new Table or in Table 1-4 for justification and documentation.

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

Response to 1.7

As provided in Table 1-4 melting points of materials used for packaging have been added, along with a statement of guidance for the user of the Versa-Pac for materials other than those listed.

Chapter 2 – Structural Evaluation

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

Section 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.

Response to 2.1

The center of gravity of the 110-gallon version is at 17.5" and has been added to Section 2.1.3 of the revised SAR.

2.2a Justify the compliance with minimum size requirement.

No justification is provided for the assertion in Section 2.4.1 of the application that the package complies with minimum size requirements.

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

Response to 2.2a

Revised section 2.4.1 to list the minimum dimension of both the VP-55 and VP-110, which is the diameter of the outer package.

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

Section 2.6.5 of the application refers to settling or compaction of the payload but does not properly justify that normal vibration incident to transportation does not affect the closure bolts.

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

Response to 2.2b

The SAR was corrected in Section 2.6.5 as required "Vibration testing conducted on the outer drum during the performance design qualification test as set forth in 49 CFR 178.608 were successfully performed with past experience indicating no failure to the drum ring closure. In addition, the Versa-Pac includes an additional bolted closure thru the lid attached to the internal structure. This bolted closure utilizes ½" bolts and locking washers that are torqued to a prescribed rating to prevent the loss of the bolts during transportation.

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).

Response to 2.3

The primary load bearing members of the Versa-Pac are the steel 55-gallon drum shell, the vertical stiffeners, and the inner liner. These components, when assembled as a unit, can be analyzed as an axial member in compression. Assuming the metal thickness of 0.036" and 0.05" for the drum and inner liner, respectively, and using 1-1/4" x 1-1/4" x 0.12" for conservatism (the actual thicknesses are 0.06", 0.0598". and 0.135" respectively), the load bearing cross-sectional area is approximated as:

$_{TT}(22.5")(0.036) + _{TT}(19.25")(0.05") + 4(1.25"^2) = 7.738\ in^2$

Five times the weight of the package is: (5) (390 lb.) = 1,950 lb

The compressive stress on the steel members is: 1,950 lb/7.738 in^2 = 252 psi

The margin of safety against compressive failure is: M.S. = (36,000/252) – 1 = 141.85.

To further demonstrate that the Versa-Pac meets the requirements set forth in 10 CFR 71.71(c)(9) the Versa-Pac was subjected to a load greater than 5 times the weight of the package fro a period of 24 hours without any damage. Test results are reported in a new Appendix 2.12.5 in Section 2.

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 CFR 71.71(c)(10).

Response to 2.4

The Versa-Pac shipping container was subjected to the penetration described under 10 CFR 71.71(c)(10) for penetration using a 1.25 inch diameter steel bar weighing 13.2 pounds and dropped form a height of 40 inches (1 Meter) onto several different areas of the test package considered to be the weakest parts of the package without measurable damage to the impact point. Test results are reported in a new Appendix 2.12.5 in Section 2.

Also, please note the in Section 2.7.1 under Free Drop paragraph 2 states that "For the puncture drop, a puncture ram was welded to the test pad."

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 form 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).

Response to 2.5

The density of the foam used for the HAC test series in both the top and bottom of the test packages was 6 pcf. The density of the foam material that will be utilized in the top and bottom structural components of the Versa-Pac production units will also be 6 pcf with a tolerance of ±1.

Due to the design of the Versa-Pac structural internal components, the vertical stiffeners, horizontal re-enforcing rings, multiple layers of steel sheeting welded to the Versa-Pac frame and bolt and flange system utilized within the package, the foam density provides minimum stiffness to the overall strength of the package design. The foam products used in the top and bottom of the Versa-Pac are primarily for thermal insulation benefit and are encased in carbon steel components.

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 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).

Response to 2.6

The sentence was removed form both Page No. 2-18 and from the conclusions of Appendix 2.12.4 as required. A note stating that the report in Appendix 2.12.4 was amended has been added to the report.

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°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.

Response to 3.1

Section 1.2.1, Packaging provides the following description of the functions of the fiberglass thermal break, "A ½" thick fiberglass ring is used as a thermal break at the payload cavity flange. The thermal break is sandwiched between the steel components, with twelve ½ inch bolts providing the connection between the structural members through the fiberglass and effectively limits the flow of heat to the payload cavity through the steel flange components. There are no moving parts to the thermal break, and its functionality is maintained as long as it separates the steel components FB and FK (See Drawings in Appendix 1.3.1). A specification for the fiberglass material is provided in Appendix 1.3.5.

As a general rule, the resin used in the fiberglass material is resistant to acidic attack.

3.2 Clarify the types of uranium compounds and payload materials which could be unstable, decompose, or undergo auto-ignition under 600°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°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°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.

Response to 3.2

Section 3.2.1 has been modified by removing the term "auto-ignition" and replacing it with "melting-point" to provide better definition under material properties.

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.

Response to 3.3

Table No. 3-2 and Appendix 3.5.4 have been corrected to display the appropriate decay heat of 11.4 watts.

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.

Response to 3.4

Additional information has been added to Section No. 3.2.2 to provide clarification as required.

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-°F) to Btu/(s-in-°F) or Btu/(hr-in-°F), specific heat from (in-lb_f)/((lb_f-s^2/in)-°F) to Btu/(lb_m-°F), 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.

Response to 3.5

Table No. 3.5.1-3 has been revised and corrected.

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.

Response to 3.6

The air gap between the top of the inner lid and the bottom of the outer lid in the 55 gallon version is 5/8" and 1" in the 110 gallon version.

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/°F) 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.

Response to 3.7

Appendix 3.5.5 has been added to provided the analysis from the Versa-Pac package thermal test model results of the polyurethane foam disk as requested.

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°F) 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.

Response to 3.8

Appendix 3.5.3 has been updated as required.

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.

Response to 6.1

The revised criticality analysis realizes a CSI of 1.0. The number of packages that can be shipped at one time (non-exclusive use) corresponding to a CSI of 1.0 is 50. Section 6.1.3 was revised accordingly.

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.

Response to 6.2

The SAR does not support the transport of 300 packages per shipment. The 300 package array size is used in conjunction with the 5N criterion to establish the CSI. Additional calculations were performed for arrays of 300 packages and greater for stacked package heights ranging from one package to 12 packages. The results demonstrate that arrays of packages of 300, using the original model configuration, will not exceed the USL of 0.9400.

With the performance of additional sensitivity studies the model array size was reduced to 272 packages in order to not exceed the USL of 0.9400. Additional calculations were performed with package array sizes involving 272 packages. For 272 packages, the CSI is then (5N=272, N=54.4, CSI=50/54.4=0.919, rounded to 1.0) set to 1.0.

Section 6.6 was revised to supplement the original array studies. Specifically, Section 6.6.2.2.8 was added to provide extended array studies with four different configurations.

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.

Response to 6.3

Appendix 2.12.4, Page 17, indicates that the inner diameter of the VP-55 was slightly reduced by 1/16" (0.1588-cm) after the 30-ft slap-down test. A reduction in the modeled diameter of the package will slightly increase the k_{eff} for the homogeneously modeled system but will have little or no effect on the more reactive in-homogeneous lumped fissile mass) modeled system. Table 6-6 summarizes the result for the homogeneous case in which the package radius is reduced from 19.2088-cm to 19.05-cm. A reduction in the radius of 0.1588-cm results in an increase if k_{eff} for the homogeneous case of 0.0129, however the maximum k_{eff} for the homogeneous model of 0.7304 is significantly low such that additional reductions in the diameter will not challenge the USL.

A reduction in the modeled diameter of the package will have little or no effect on the more reactive in-homogeneous (lumped fissile mass) modeled system since the reduced diameter does not otherwise limit placement of the modeled spherical mass in the sensitivity studies.

Sections 6.6.2.1 and 6.6.2.2 were revised to provide this additional information.

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.

Response to 6.4

The conversions from inches to centimeters were not correctly applied in the third and fifth columns of Table 6-3 for the payload inner height. The corrected values consistent with the design and modeled values are 68.7387-cm and 69.0562-cm, respectively.

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.

Response to 6.5

Polyethylene with an increased density from 0.92 to 0.98 g/cc is the more effective moderator of compounds as stated in Table 6-4. However, basically the limiting hydrogen moderation is 0.141 g/cc. The last sentence in the last paragraph of Section 6.3.4.3.1 was modified to change the bounding poly-moderation from a poly-density of 0.98 g/cc to correspond to the maximum evaluated hydrogen density for the package of 0.141 g/cc. Furthermore, the following statement was also added to this section, "Materials with a hydrogen density greater than 0.141 g/cc are not allowed". Table 6-8 was revised to add results for cases moderated with paraffin.

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.

Response to 6.6

The four vertical members as indicated in Section 6.3.1.1 refer to the vertical square tubing. Section 6.3.1.1 was revised to clarify the description of these items. Also, as stated in Table 6-3, the vertical and horizontal tubing was neglected for conservatism and modeled as optimum water moderation.

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.

Response to 6.7

Additional sensitivity studies were performed using four additional array configurations. Additional discussions are provided in Section 6.6.2.2.8 however the modeled array is reduced from 300 to 272 packages and the CSI is increased from 0.9 to 1.0. The reduced array size was necessitated by the identification of a more reactive array configuration (k_{eff} increase of about 0.0072). An array labeled as MOD1 was slightly more reactive than the original array now defined as MOD0 for some array configurations. Summary results are provided in Tables 6-10 and 6-11.

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.

Response to 6.8

Additional descriptions were added to the legends of Figure 6-7, 6-8, 6-9, 6-10, 6-11, 6-12, 6-13, and 6-14.

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.

Response to 6.9

The noted input case was provided for information. This input case is corrected to correlate with Figure 6-18. Additional input cases are also provided based on the additional sensitivity study in response to Question 6-7.

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.

Response to 6.10

Section 6.6.2.2.9 was added to evaluate interspersed moderation within package regions independently. A revised model is provided in Section 6.9 which adds five different moderation regions to the package model. Basically, the payload, payload insulation region, inner/outer liners, top/bottom insulation, and the exterior package regions were independently evaluated. In some cases, a higher k_{eff} result was identified with selective interspersed moderation beyond a volume fraction of 0.0001. The results are summarized in Table 6-12. Maximum or bounding results for the package are further presented in Table 6-1. With a reduction in the modeled package array size from 300 to 272, the results are within the USL of 0.94 when considering region varied interspersed water moderation.

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).

Response to 7.1

SOP 6.11 has been corrected for clarity and continuity in paragraphs 7.2.1 and 7.2.2. This change incorporates the staff note to require the resin manufacturer to supply and verify that each individual resin batch meets Century Industries SOP 6.11 requirements of 100 ppm of leachable chloride content. Paragraph 7.2.1 now states that " The foam manufacturer shall also supply records from the resin manufacturer, verifying the chloride content of the urethane foam resin, taken from samples of each resin batch, meet the leachable chloride content of less than a 100 ppm."

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).

Response to 7.2

SOP 6.11 has been corrected for clarity and continuity in paragraphs 7.2.1 and 7.2.2. This change incorporates the staff note to require the resin manufacturer to supply records for each individual resin batch. It also requires independent laboratory results to insure that each foam resin batch meets Century Industries SOP 6.11 requirements of 100 ppm of leachable chloride content. Paragraph 7.2.1 now states, "The foam manufacturer shall supply records from the resin manufacturer for each urethane resin batch. They shall also supply from an independent laboratory, results to verify that the leachable chloride content taken from foam samples of each resin batch, meet the leachable chloride content requirement of less than 100 ppm."

7.3 Update Section 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).

Response to 7.3

A new paragraph was added to the SAR Section 7.1.2 stating under item c, "Verify that no freestanding liquids or other volatile compounds are present in the containment area prior to loading any contents."

Editorial

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

Response to E-1

Adjusted paragraph 3.1 & 3.2 to provide the method for calculating Thermal Conductivity in accordance with ASTM C201.

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 the information.

Response to E-2

Revised the Installation Record to provide a place for recording the thickness and density of the ceramic fiber insulation materials on the data sheet.

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

Response to E-3

Corrected the statement in paragraph 4.1 to read "All fiberglass products shall be stored in a dry area at ambient temperatures. Fiberglass products may be stored either vertically or horizontally and should be properly supported to reduce the possibility of damage.

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

Response to E-4

Revised the report to include the needed information to read " The test item tare

weights and payload weights were made using a set of floor scales calibrated by Carlton Scales, Kingsport, Tennessee and traceable to NIST."

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

Response to E-5

Made the correction to show "Structural Evaluation" in stead of the incorrect "Operating Procedures"

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.

Response to E-6

Corrected paragraph 2.1.3 on page 2-3 of Section 2 to show the correct Table 1-1, in place of Table 1-2.

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"

Response to E-7

Corrected page 2 of 3 in Appendix 3.5.4 of the application Cool-Down Sequence, by replacing the word "Conduction" with the appropriate word "Convection" as required.

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

Response to E-8

Made the correction to the nameplate information located in Section 9 of Appendix 1.3.2 "General Note" to show the Type AF marking.

E-9 Correct typographical errors, e.g. "Descrete carbon steel" in Section No. 6.1.1; "preparation of empty package for transport" in the title of Section 7.3, ect.

Response to E-9

Corrected the typographical error under Section 7.3 in the SAR.