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

October 13, 2009

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 – Response for Request of Supplemental Information

Dear Mr. Saverot,

Century Industries is pleased to have this opportunity to provide the supplemental information requested in U.S. Nuclear Regulatory Commission letter dated September 25, 2009, from Mr. Steven Baggett, Acting Chief, 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 1 dated October, 2009. The document supplements, as requested, 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 Supplemental Information (RSI) listing each question as stated in the letter noted above, along with the required response as requested for your review.

Please accept our apologies for the delay in responding, as our review of the revised sections took longer than we anticipated.

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

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Phone: 423-646-1864/276-628-7553

DOCKET NO. 71-9342

RESPONSE FOR REQUEST FOR SUPPLEMENTAL INFORMATION (RSI) AND OBSERVATIONS RELATED TO THE MODEL NO. VERSA-PAC PACKAGE

Chapter 1: General Information

RSI 1-1: Provide enlarged and clearly marked hardcopies to improve the quality of the engineering drawings for both Versa-Pac package models. Verify that all key dimensions and tolerances are provided.

Drawings should be consistent with the guidance in NUREG/CR-5502: "Engineering Drawings for 10 CFR Part 71 Package Approvals."

This information is needed to determine compliance with 10 CFR 71.31 and 71.33.

Response to RSI 1-1

Drawings have been provided within the SAR enlarged to the 11" x 17" size to provide a better quality drawing that is easier to read. The addition of certain notes to provide information, have also been noted.

RSI 1-2: Provide a clear statement of the containment boundary components and indicate the containment boundary on the Licensing Drawings.

The applicant describes "containment features" in Section 1.2.1.7, but the package containment boundaries are not properly defined in the application.

This information is needed to determine compliance with 10 CFR 71.33(a)(4).

Response to RSI 1-2

Licensing drawings have been corrected to provide additional drawings showing the containment, associated members, and second and third individual points of closure.

Section 1.2.1.7 has been amended adding clarity to the description of the containment boundaries as follows:

The primary containment boundary of the Versa-Pac shipping container is defined as the inner containment body, containment end plate, inner flange ring, silicone coated fiberglass gasket, ½" blind flange, ½" bolts, washers and insert holders. Figure 1-1 further illustrates these components by text description enclosed within a text box.

In addition to this information, there are no penetrations, valves or venting devices used within the containment boundary.

RSI 1-3: Provide heat sources and boundary conditions including insulation, convection, insolations, and adiabatic conditions of both NCT and HAC on the drawings of the Versa-Pac packages.

This information is needed to determine compliance with 10 CFR 71.33 and 71.71.

Response to RSI 1-3

Illustrations have been added to Section 3, Thermal, as Appendix 3.5.4showing the information requested.

RSI 1-4: Describe the functions and operations of the thermal break installed in the Versa-Pac package.

The Versa-Pac package includes the fiberglass thermal break, as shown in Figure 1-1, in the system. The applicant is required to provide detailed information on the functions and related operations of the thermal break.

This information is needed to determine compliance with 10 CFR 71.33 and 71.73.

Response to RSI 1-4

Information has been added to Section 1, Paragraph 1.2.1 Package Description, in addition please find the following information:

The fiberglass thermal break provides a disruption of heat flow to the interior of the package during a fire event, since it is a non-metallic interface with low thermal conductivity and moderate specific heat capacity. There are no moving parts to the thermal break, and its functionality is maintained as long as it separates FB from FK (See included Section 1 drawings) by ½". The attachment of the thermal break to FB and FK must be limited to the twelve 3/8" bolts specified by the drawing.

Chapter 2: Structural Evaluation

RSI 2-1: Provide the results of the 55 gallon package shallow-angle drop test.

This information is needed to determine compliance with 10 CFR 71.71 and 71.73.

Response to RSI 2-1

A series of testing was conducted to provide additional information and verification that the 55 gallon version of the Versa-Pac shipping container design would successfully demonstrate the capability to meet the requirements set forth in 10 CFR 71 and Century Industries Test Plan TP-0002 Revision 0 with similar results provided by previously conducted testing of the 110 gallon version when subjected to the affects of both NCT and HAC shallow angle drops.

Based upon the results of the test series the 55 gallon version demonstrated that it is capable of meeting the requirements set forth in the Test Plan and 10 CFR 71 by retention of the outer closure, no openings, tears or failure that would lead to the loss of material, no open pathway to the insulation materials and no loss of the inner containment payload. The 55 gallon version performed as expected and provides additional information to aide support that the 110 gallon version binds the smaller 55 gallon package.

Section 2 has been revised to provide the details of this test series in Section 2.7.3.8 & 2.7.3.9. Section 2.7.8 has also been updated to include the results of the additional 55 gallon shallow angle drop testing. The full report, Test Plan TP-0002 and Test Specification TS-0002 Revision 0 are included in Appendix 2.12.4.

Chapter 3: Thermal Evaluation

RSI 3-1: Provide details on the ALGOR computer code and its capabilities for performing thermal evaluations.

The applicant uses the finite-element code ALGOR for both NCT and HAC thermal evaluations whereas staff does not have any documentation pertaining to the ALGOR software regarding its capabilities and validation for thermal modeling.

This information is needed to determine compliance with 10 CFR 71.31(c).

Response to RSI 3-1

ALGOR is widely used and the software is provided with a Validation and Verification package. These problems are used to validate the accuracy of the product and verify the installation of the product on each machine. These problems can be found at: http://www.algor.com/service_support/accuracy_ver/verification_examples.asp. Selected problems have been executed on the computer used for the Versa-Pac evaluation and have been verified as producing the published results.

RSI 3-2: Provide information on the thermal model of the HAC fire accident, such as heat transfer paths and the thermal model including insolations, heat transfer coefficients, and radiation emissivity under the HAC 30-min fire transient and the following cool-down period.

This information is needed to determine compliance with 10 CFR 71.35 and 71.73.

Response to RSI 3-2

This information is in Section 3, modeled as all conduction, we also added external condition information in the tables of the appendix.

RSI 3-3: Identify the air gaps which may exist after the puncture and drop tests and thus affect the heat transfer of the package under NCT and HAC, and clarify how gaps are considered in the NCT and HAC thermal models.

This information is needed to determine compliance with 10 CFR 71.35, 71.71, and 71.73.

Response to RSI 3-3

Due to the flexibility of insulation materials (Ceramic Fiber Blanket), which surround the Versa-Pac Shipping Container, any gaps that might occur from impact damage under NCT and HAC testing would be filled with insulation, preventing air gaps within the insulated package. Note that no breaks in the outer skin were present in Section 2.

RSI 3-4: Provide the predicted temperature history (temperature vs. time) during the HAC 0-30 minutes fire transient and the follow-up cool-down.

The application only displays the fire event temperatures at 30 minutes for HAC analysis. This temperature history is important for the staff to evaluate the post-fire time frame required for the package to reach temperature stability in a fire accident. The applicant should determine peak temperatures and times after the 30 minute fire.

This information is needed to determine compliance with 10 CFR 71.35 and 71.73.

Response to RSI 3-4

This information was added to Section 3 with the maximum peak content temperature occurring at 22 minutes into the cool-down sequence and is 552°F at the top of payload cavity.

RSI 3-5: Provide the geometry configuration, boundary conditions, and input parameters such as insolation, decay heat generation rate, fire temperature, ambient temperature, heat transfer coefficients, emissivities, and drum cavity volume, directly from the ALGOR NCT and HAC models for code validation and confirmatory analysis.

This information is needed to determine compliance with 10 CFR 71.71 and 71.73.

Response to RSI 3-5

The requested information was added to Section 3.

Chapter 6: Criticality Evaluation
RSI 6-1: Clarify which case is the most reactive credible condition for the criticality analyses.

The applicant describes different aspects of a bounding case in the text, but there is no link between the text, Table 6-1, or Section 6.9.1 in order for staff to determine what k_{eff} is associated with the bounding case and if this really is the most reactive credible condition.
The input files are referred to as "bounding cases," but the description of each case is unclear, the definition of bounding and the limit of what is bounded are not provided. The applicant is requested to provide clarification on the most reactive credible condition to assess whether the analyses of the package are in compliance with the regulations.

This clarification is needed to determine compliance with 10 CFR 71.35 and 71.55.

Response to RSI 6-1:

The sampling of input cases provided in Section 6.9.1, although applicable to the criticality analysis for the VERSA-PAK package, are not necessarily the bounding cases. Only a sampling of input cases are provided since the bound case changes with each modeled array size. However, the most reactive cases for each array size can be created from the provided input cases by modification of one or more entries defining the modeled array.

The text in Section 6 is modified to clarify the input cases and to provide a better link between text, tables, and input cases. Table 6-1 is further condensed to identify only the most reactive configuration.

The intent of the criticality analysis is to identify the most reactive configuration without assessing credibility. Several fissile material configurations are evaluated with the most reactive case identified for each configuration. By comparison, the most reactive fissile mass configuration is identified. In this case, the most reactive lumped spherical mass case bounds the most reactive lumped cylindrical case, which further bounds the two modeled most reactive homogeneous cases.

The homogeneous cases would most likely be considered bounding of credible fissile mass configurations within the Versa-Pak shipping package. The margin of safety is significantly higher when modeling the fissile mass homogeneously distributed or as a layer in the bottom of each package. Fissile mass migration to a concentrated optimally moderated sphere or cylinder defying gravity in ½ of the modeled packages in a 300 package array is considered to be not credible. However, the latter cases represent the most reactive fissile mass configuration for the Versa-Pak shipping package.

RSI 6-2: Provide a justification for using a single model to represent the NCT and HAC package configurations for both types of packages.

Section 6.3.1 indicates that a single model can conservatively represent the NCT and HAC package configurations for both the 55 gallon and 110 gallon drums; however, there is no justification to explain this statement. A detailed explanation of this assumption is important for the staff to evaluate the validity of that statement.

This justification is needed to determine compliance with 10 CFR 71.35 and 71.71.

Response to RSI 6-2:

The constructed model evaluated in the criticality analysis, as also discussed in Section 6.1.2, conservatively represents the HAC package configuration (damaged package configuration) for the 55-gallon package design. The model is constructed considering worst case damage to both the 55-gallon and 110-gallon package designs. Due to the smaller package dimensions of the 55-gallon package design the package is inherently more reactive when compared to the 110-gallon package design. The reduced package dimensions leads to significantly more interaction between packages and results in a lower CSI. The reduced dimensions of the modeled 55-gallon package (damaged package configuration) design results in a more reactive package array when compared to undamaged 55-gallon and 110-gallon package designs. Therefore, the conservatively modeled HAC package configuration for the 55-gallon package design bounds the NCT (undamaged package configurations) for both the 55-gallon and 110-gallon packages and further bounds the HAC (damaged package configuration) for the 110-gallon package design.

With further evaluation of the HAC (damaged package configuration) modeled array size to the NCT criteria (5N) the resulting CSI (0.9) conservatively bounds the NCT criteria (5N) and HAC criteria (2N) for evaluation of package arrays. A comparison of the CSI for both NCT and HAC evaluated arrays is provided in Section 6.1.3. The Criticality Safety Index (CSI) is 0.9 (corrected based on RSI 6-4). Arrays of 300 packages are evaluated for the Normal and Hypothetical Accident Conditions. Thus, N is 300/5 = 60 or 300/2 = 150, and the minimum CSI is 50/60 = 0.83, which is rounded up to 0.9.

Section 6.3.1 was revised to provide additional details as indicated above.

RSI 6-3: Provide a justification for not conducting a comparison between the lumped spherical and cylindrical cases for the In-Homogeneous Model for the Package Arrays under HAC.

Page 6-10 of Section 6.6.1.2 states that "results for the lumped spherical and cylindrical results are anticipated to be very close." The staff cannot make a determination whether the use of spheres is acceptable or not unless the applicant provides either a detailed explanation of why this is acceptable or a demonstration that results are equivalent.

This information is needed to determine compliance with 10 CFR 71.55.

Response to RSI 6-3:

The comparison results of the lumped spherical and cylindrical cases are provided in Section 6.6.2.2.

The results of the lumped spherical mass calculations for the 12.0-cm diameter sphere produce higher k_{eff} results with a k_{eff} difference of about 0.02 when compare to lumped cylindrical mass calculations. The statement made on Page 6-10 of Section 6.6.1.2, "results for the lumped spherical and cylindrical results are anticipated to be very close." is an assumption that was verified by specific calculations as presented in Section 6.6.2.2, Pages 6-11 and 6-12. A comparison of the results is also provided in Table 6-1.

RSI 6-4: Correct the CSI from 0.85 to 0.9, and correct the number of packages for shipment. Verify that any reference to the CSI, as on page 1-1 of Chapter 1 of the SAR, includes the corrected number throughout the application.

The applicant rounds up a CSI of 0.83 to 0.85 in Section 6.1.3 of the application; per 10 CFR 71.22 and 10 CFR 71.59, the calculated CSI must be rounded up to the first decimal place. A new CSI value will also affect the number of packages allowed for shipment.

This correction is needed in accordance with 10 CFR 71.59.

Response to RSI 6-4:

The CSI is corrected to 0.9 within the SAR. This will allow shipment of up to 55 packages.

Observation 1: The applicant states that fissile material in the package will not exceed "more than an A_1 or A_2 quantity as appropriate, and the quantity may not exceed 350 grams U-235 in any pyrophoric form, enriched up to 100 wt %." Identify the method used to ensure that the mass limit for U-235 will be met.

Response to RSI 6-4, Observation 1:

The intent of the packaging is not to met the mass limit but to ensure that it is not exceeded. Although not specified, several methods can be used to ensure that the U-235 mass limit is not exceed. For instance, a passive or active assay can be used to assign a nominal value with a tolerance band (uncertainty) at a 95% confidence level. In this case, the nominal value with uncertainty can not exceed the 350 gram U-235 mass limit.

Additional details are included in Section 6.1.1.

Observation 2: A mass limit for U-234 is not explicitly given. The critical mass of U-234 is less than that of U-235; therefore this isotope is of concern in the criticality analysis.

Response to RSI 6-4, Observation 2:

A U-234 mass limit is not explicitly given in the Criticality Analysis since it is a non-fissile isotope. U-234 (like U-236 and U-238) is a neutron absorber and in the presence of U-235 allows higher fissile mass values when credited.