



UNITED STATES  
NUCLEAR REGULATORY COMMISSION  
WASHINGTON, D.C. 20555-0001

February 2, 2012

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

SUBJECT: REVISION NO. 6 OF CERTIFICATE OF COMPLIANCE NO. 9342 FOR THE  
MODEL NO. VERSA-PAC PACKAGE

Dear Mr. Arnold:

As requested by your application dated January 24, 2012, enclosed is Certificate of Compliance No. 9342, Revision No. 6, for the Model No. Versa-Pac package. Changes made to the enclosed certificate are indicated by vertical lines in the margin. The staff's Safety Evaluation Report is also enclosed.

The approval constitutes authority to use the package for shipment of radioactive material and for the package to be shipped in accordance with the provisions of 49 CFR 173.471. Registered users of the package under the general license provisions of 10 CFR 71.17 or 49 CFR 173.471 have been provided a copy of this certificate.

If you have any questions regarding this certificate, please contact Pierre Saverot of my staff at (301) 492-3408.

Sincerely,

A handwritten signature in black ink that reads "Christine Lipa".

Christine Lipa, Acting Chief  
Licensing Branch  
Division of Spent Fuel Storage and Transportation  
Office of Nuclear Material Safety  
and Safeguards

Docket No. 71-9342  
TAC No. L24616

Enclosures: 1. Certificate of Compliance  
No. 9342, Rev. No. 6  
2. Safety Evaluation Report

cc w/encls 1 & 2: R. Boyle, Department of Transportation  
J. Shuler, Department of Energy  
Registered Users

**CERTIFICATE OF COMPLIANCE  
FOR RADIOACTIVE MATERIAL PACKAGES**

1. a. CERTIFICATE NUMBER	b. REVISION NUMBER	c. DOCKET NUMBER	d. PACKAGE IDENTIFICATION NUMBER	PAGE	PAGES
9342	6	71-9342	USA/9342/AF-96	1	OF 4

2. PREAMBLE

- a. This certificate is issued to certify that the package (packaging and contents) described in Item 5 below meets the applicable safety standards set forth in Title 10, Code of Federal Regulations, Part 71, "Packaging and Transportation of Radioactive Material."
- b. This certificate does not relieve the consignor from compliance with any requirement of the regulations of the U.S. Department of Transportation or other applicable regulatory agencies, including the government of any country through or into which the package will be transported.

3. THIS CERTIFICATE IS ISSUED ON THE BASIS OF A SAFETY ANALYSIS REPORT OF THE PACKAGE DESIGN OR APPLICATION

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|---|---|
| a. ISSUED TO ( <i>Name and Address</i> )<br>Century Industries<br>P.O. Box 17084<br>Bristol, VA 24209 | b. TITLE AND IDENTIFICATION OF REPORT OR APPLICATION<br>Century Industries application dated January 24,<br>2012. |
|---|---|

4. CONDITIONS

This certificate is conditional upon fulfilling the requirements of 10 CFR Part 71, as applicable, and the conditions specified below.

5.

(a) Packaging

- (1) Model No.: Versa-Pac in two configurations, i.e., VP-55 and VP-110.
- (2) Description

The Model No. Versa-Pac is either a 55-gallon (Model No. VP-55) or a 110-gallon (Model No. VP-110) package for shipment of uranium oxides, uranium metal, uranyl nitrate crystals and other uranium compounds, e.g., uranium carbides, uranyl fluorides and uranyl carbonates, and thorium 232 as TRISO fuel.

The exterior skin of the packaging is a UN1A2/X400/S minimum, 16 gauge carbon steel material for the Model No. VP-55 and a UN1A2/Y409/S minimum, 16 gauge carbon steel for the Model No. VP-110.

Both models use a 12 gauge bolted closure ring, ASTM A 307 bolts and nuts, a closed-cell EPDM gasket, a drum cover reinforced by a 10 gauge thick plate with four or eight bolts depending upon the Model No. VP-55 or VP-110, respectively.

Both models are strengthened with vertical stiffeners, two inner liners insulated by a ceramic fiber blanket and a ¼" carbon steel reinforcing plate on the bottom. The packaging's interior

**CERTIFICATE OF COMPLIANCE  
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1. a. CERTIFICATE NUMBER	b. REVISION NUMBER	c. DOCKET NUMBER	d. PACKAGE IDENTIFICATION NUMBER	PAGE	PAGES
9342	6	71-9342	USA/9342/AF-96	2 OF	4

5.(a) (2) Description (Continued)

is completely insulated with layers of a ceramic fiber blanket around the containment cavity with rigid polyurethane foam disks on the top and bottom of the cavity.

A 1/2" thick fiberglass ring is used as a thermal break at the payload cavity flange. The cavity blind flange is secured to the flange with twelve bolts.

The primary containment boundary is defined as the payload cavity with its associated welds, the containment end plate, the inner flange ring, the silicone-coated fiberglass gasket, the cavity blind flange, and the bolts.

The approximate dimensions and weights of the packaging are as follows:

Model No.	Packaging OD (in.)	Packaging Height (in.)	Payload Containment Cavity ID (in.)	Payload Containment Cavity Height (in.)	Packaging Weight (lbs.)	Maximum loaded weight (lbs.)
VP-55	23-1/16	34 3/4	15	25-7/8	390	640
VP-110	30-7/16	42 3/4	21	29-3/4	705	965

(3) Drawings

The packaging is constructed and assembled in accordance with Century Industries Drawing Nos.:

VP-55-LD-1 Rev. No. 8, VP-55-LD-2 Rev. No. 10, sheets 1 of 2 and 2 of 2.

VP-110-LD-1 Rev. No. 8, VP-110-LD-2 Rev. No. 8, sheets 1 of 2 and 2 of 2.

5.(b) Contents

(1) Type and form of material

Solid, homogeneous (powder or crystalline), or non-homogeneous, uranium materials with no free-standing liquids. Materials shall be stable and in a non-pyrophoric form. Density is not limited.

**CERTIFICATE OF COMPLIANCE  
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1.	a. CERTIFICATE NUMBER	b. REVISION NUMBER	c. DOCKET NUMBER	d. PACKAGE IDENTIFICATION NUMBER	PAGE	PAGES
	9342	6	71-9342	USA/9342/AF-96	3 OF	4

5(b)(1) Type and Form of Material (Continued)

Contents are limited to:

- (i) A. Uranium oxides ( $U_xO_y$ ).
- B. Uranyl nitrate crystals in the form of uranyl nitrate hexahydrate, trihydrate or dihydrate.
- C. Other uranium compounds, e.g., uranyl fluorides and uranyl carbonates. Uranium compounds may also contain carbon or be mixed with carbon or graphite. Uranium carbide is authorized for shipment. However, uranium hydrides are not authorized for shipment.
- D. Uranium metal or uranium alloys.
- (ii) TRISO fuel as C/SIS/C coated  $ThUC_2$  particles pressed with a carbon matrix to form rods.

Contents may be pre-packaged in polyethylene, polytetrafluoroethylene, aluminum, and carbon steel per Table No.1-4 of the application. Aluminum Trihydrate, Sodium Borate (Borax, fused), perlite, paper labels, plastic tape, plastic bags, plastic bottles and desiccant such as "Quik-Solid" are also authorized as packing materials. Materials with a hydrogen density greater than  $0.141 \text{ g/cm}^3$  are not authorized.

The hydrogenous packing material load in the form of paper and plastics is limited to a total of 200 grams per package.

Radioactive contents shall have an auto-ignition temperature and melting point greater than  $600^\circ\text{F}$ .

- (2) Maximum quantity of material per package:

Not to exceed 350 grams U-235 enriched up to 100 weight percent.

The net weight of the authorized contents shall not exceed 250 lbs for the Model No. VP-55, and 260 lbs for the Model No. VP-110.

- (3) Contents are limited to normal form material. The radionuclide inventory of the loaded contents, including U-234 and U-236, shall be less than the calculated mixture  $A_2$  value.
- (4) Decay heat is limited to 11.4 W.

**CERTIFICATE OF COMPLIANCE  
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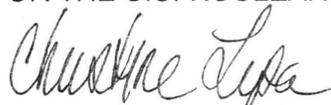
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	9342	6	71-9342	USA/9342/AF-96	4 OF	4

- 5(c) Criticality Safety Index (CSI): 1.0
6. In addition to the requirements of Subpart G of 10 CFR Part 71:
- (a) The package shall be prepared for shipment and operated in accordance with the Operating Procedures in Section No. 7 of the application.
  - (b) Each packaging must meet the Acceptance Tests and Maintenance Program of Section No. 8 of the application.
7. Transport by air of fissile material is not authorized.
8. Transport of plutonium above minimum detectable quantities is not authorized.
9. Packages must be marked with the appropriate model number, i.e., VP-55 or VP-110, as applicable. The neoprene 1/8 inch bottom pad and 3/8 inch top pad are optional for packages that are not intended to be reused.
10. Content forms may not be mixed in a single package.
11. The package authorized by this certificate is hereby approved for use under the general license provisions of 10 CFR 71.17.
12. Expiration date: June 30, 2015.

**REFERENCES**

Century Industries application "Safety Analysis Report for the Century Industries Versa-Pac Shipping Container," Revision No. 6, dated January 24, 2012.

FOR THE U.S. NUCLEAR REGULATORY COMMISSION



Christine Lipa, Acting Chief  
Licensing Branch  
Division of Spent Fuel Storage and Transportation  
Office of Nuclear Material Safety  
and Safeguards

Date: February 2, 2012



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SAFETY EVALUATION REPORT  
Model No. Versa-Pac Package  
Certificate of Compliance No. 9342  
Revision No. 6

## SUMMARY

By application dated January 24, 2012, Century Industries submitted an amendment request for the Model No. Versa-Pac package. The applicant requested that materials such as paper labels, plastic tape, plastic bottles, plastic bags and desiccant be allowed as packing materials and that the use of the neoprene top and bottom pads be optional for packages that are not intended to be reused.

NRC staff reviewed the application using the guidance in NUREG-1609, "Standard Review Plan for Transportation Packages for Radioactive Material." Based on the statements and representation in the application, and the conditions listed below, the staff concludes that these changes do not affect the ability of the package to meet the requirements of 10 CFR Part 71.

## EVALUATION

By letter dated January 24, 2012, Century Industries submitted a consolidated application, Revision No. 6, in support of an amendment request for Certificate of Compliance (CoC) No. 9342 for the Model No. Versa-Pac package. The applicant made minor changes to the licensing drawings and requested that the use of the neoprene top and bottom pads be considered optional for packages not intended to be reused. The applicant also requested that paper labels, plastic tape, plastic bottles, plastic bags and desiccant be allowed as packing materials since all of such materials have an auto-ignition temperature greater than the average temperature of the containment vessel surface boundary of 360.4°F. The applicant also requested that the melting point requirement be applicable only to the radioactive contents and not to the packing materials.

The package is designed to transport radioactive waste with a total heat load of 11.4 W for both the Model Nos. VP-55 and VP-110, with no single item having a decay heat greater than 20 W/m<sup>3</sup>. In order to evaluate the thermal performance of the package under all normal conditions (NCT) and accidental conditions (HAC) of transport, the applicant developed a quarter-symmetric transient finite element model using the ALGOR code, and modeled both the VP-55 and VP-110 packages with and without contents. Further, the applicant performed a simulation of the Model No. VP-55 package without contents and without decay heat. The model imposes an initial condition of 100°F on all nodes at the beginning of the thermal events. The applicant finally selected the Model No. VP-55 package, without decay heat and without contents, for the thermal evaluation because of its bounding performance.

### Maximum Temperatures and Pressures

Table 3-1 of the application provides a summary of the NCT and HAC temperatures for the Model No. VP-55 package. The normal hot maximum temperature for the contents is 144°F. During the HAC fire event, the maximum temperature for the payload contents occurs 22 minutes into the cool-down sequence, and is 552°F at the top of the package cavity. Additional

analyses show that the average wall temperature is 360.4°F, and that the actual contents remain below 300°F during the fire and cool-down period. Since the Model No. Versa-Pac package is not a sealed system, the maximum normal and HAC operating pressure is near atmospheric pressure. The staff confirmed that the thermal evaluation of the Model No. VP-55 package bounds the thermal evaluation of the Model No. VP-110 package due to the identical heat load allowed in both packages.

### **Thermal Stress Evaluation**

The applicant used the ALGOR code and the results from the fire and cool-down model for the thermal stress evaluation. The thermal stress evaluation utilized (i) the static stress conditions, (ii) the linear material models with thermal and mechanical material properties provided in Tables 3.5.5-1, 3.5.5-2, and 3.5.5-3 of the application, and (iii) the conservative compressive modulus for the bounding analysis. Based on the temperature distribution and history, the applicant evaluated the stress with the maximum thermal differential which occurs 150 minutes after the beginning of the fire. The calculated maximum thermal stress in the polyurethane is 78 psi, i.e., much less than the compressive strength of the material.

The staff reviewed the temperature history, the temperature distribution, and the material properties for both the steel and the polyurethane foam, and agrees with the results of the thermal stress evaluation. The staff also agrees that the thermal stress is not a safety issue because the polyurethane plug is not a structural component of the package and is considered to be a sacrificial component in the event of a fire.

The staff confirmed that the thermal stress evaluation of the Model No. VP-55 package bounds the thermal stress evaluation of the Model No. VP-110 package because of the identical heat load allowed in both packages. Therefore, the Model No. Versa-Pac package design will not be subject to deleterious thermal stresses during the required 30 minute thermal test at 1475°F.

- 1- Hydrogenous material load of 200 grams in Model Nos. VP-55 and VP-110 packages

#### Auto-Ignition

The thermal analysis of the Model No. VP-55 package shows that the maximum calculated weighted payload temperature of 360.4°F (at 22 minutes into the fire) is well below the auto-ignition temperatures of 424~474°F for paper, 660~986°F for plastics, respectively.

Such results support the fact the package vessel provides a barrier to exclude auto-ignition (600°F) when the maximum local temperature may be around 552°F under HAC fire. With identical heat load in both models, the staff confirmed that the thermal evaluation of the Model No. VP-110 package is bounded by the thermal evaluation of the Model No. VP-55 package to exclude auto-ignition during transport.

#### Percentage of hydrogenous material load to the allowable payload

Each package may contain up to 200 grams of hydrogenous material, such as paper labels, plastic tape, poly bottles, plastic bags, and desiccant, under the worst configuration. The corresponding weight and weight percentage are shown in Table 1:

Table 1

## Weight and weight percentage of hydrogenous material

Hydrogenous Material (HM)	Weight per package (gram)	Payload per package (kg)	Weight % per package (HM/Payload)	Package Model
Plastics	108	114	0.10%	VP-55
Paper	90	114	0.08%	VP-55
Plastics	108	119	0.09%	VP-110
Paper	90	119	0.075%	VP-110

Plastics with an auto-ignition temperature greater than 660°F will not auto-ignite under a weighted package vessel temperature of 360.4°F under an HAC fire. Auto-ignition is still very unlikely or not significant for papers with an auto-ignition point of 424~474°F, i.e., below the local payload temperature of 552°F, due to their negligible weight when compared with the allowed payloads of 114 kg or 119 kg in the Model Nos. VP-55 or VP-110 packages. Staff finds that auto-ignition, from papers with a weight load less than 0.1%, is not a significant safety concern for the package during transportation.

## 2- Melting point requirement

The results of the thermal analyses show that (1) the radioactive contents have melting points above 600°F and there is no melting of the radioactive contents at the HAC maximum temperature of payload of 552°F, and (2) the temperatures inside the containment during an HAC fire may exceed the melting point of the hydrogenous packaging material. It is also to be noted that gases generated in an HAC fire can be vented and released to the atmosphere through the plastic vent plugs which will melt in a fire event prior to yielding of the steel containment vessel.

The staff reviewed the application to verify that (1) there is no melting of the radioactive contents, (2) the potential melting of the packaging hydrogenous material, i.e., paper and plastics, may be melted (see Table 3) will be limited and its impact negligible, (3) there are no interactions among the various contents and between the contents and the packaging materials, (4) the radioactive payload is a stable solid with a melting point above 600°F, (5) the pressure increase due to the melting of packaging materials during an HAC fire can be vented to the atmosphere to avoid over-pressurization, and (6) there is no significant affect on the containment system of this Type AF package.

Therefore, the staff agrees that the melting point limitation is only required for the radioactive contents to assure that there will be no significant chemical, galvanic, or other reaction among the packaging components, among the package contents or between the packaging components and the package contents, in compliance with 10 CFR 71.43(d).

Table 3

Melting Points for Typical Packaging Materials for use within the Versa-Pac

Material	Melting Point (°F/°C)	Note
Carbon Steel	2500/1371	
Aluminum	1220/660	
PTFE	621/327	High Density Plastic
LDPE	240/116	Low Density Plastic

- 3- Removal of the neoprene rubber top and bottom pads for packages not intended to be re-used.

The applicant explained that the neoprene pads, used as packing material within the containment vessel to protect the inner containment wall for packages planned to be re-used, are not required for packages not intended to be re-used. The applicant stated that the flash point for neoprene is approximately 500°F, from data available in the open literature and that the internal temperature of the package containment vessel has been shown not to exceed 400°F, i.e., a maximum of 360.4°F in an HAC fire.

The staff confirmed that the neoprene pads were not simulated in the thermal model and the thermal evaluation with no neoprene pads is still bounding because the inclusion of neoprene does not increase the thermal load of the package.

### Evaluation Findings

Based on the review of the statements and representations in the application, the staff finds that the Model No. Versa-Pac has been adequately described and evaluated and that the package design meets the containment requirements of 10 CFR Part 71. In particular, the staff made the following findings:

The thermal analysis is not affected by the removal of the neoprene top and bottom pads for packages not intended to be re-used, and the thermal evaluation is still bounding for both the Model Nos. VP-55 and VP-110 packages.

Compliance with 10 CFR 71.43(d) is ensured since there is no auto-ignition event: the maximum weighted payload temperature of 360.4°F (22 minutes after cessation of the fire, i.e., the moment when the payload temperature reaches its peak under HAC) is well below the auto-ignition temperatures of the hydrogenous material. Also, there are no interactions among contents, or between contents and packaging materials.

A melting point limitation is required only for the radioactive contents. The radioactive content is a stable solid with a melting point above 600°F and the package is vented to avoid over-pressurization. There is no release or dispersal of radioactive material during an HAC event.

The hydrogenous material load (particularly paper) is negligible or not significant to induce auto-ignition or potential reactions in the package. The hydrogenous material load (in the form of paper and plastics) is limited to a total of 200 grams per package.

### Changes to Certificate of Compliance

The following changes are included in Revision No. 6 to Certificate of Compliance No. 9342:

Item No. 3(b) was revised to include the consolidated application dated January 24, 2012.

Condition No. 5(a)(2) was revised to clarify the description of the materials for the skin of the packaging.

Condition No. 5(a)(3) was revised to update the revision numbers of the licensing drawings.

Condition No. 5(b)(1)(ii) was revised to clarify the definition of the packaging materials and limit the quantity of papers and plastics to a total of 200 grams per package.

Condition No. 9 was revised to add the statement that the neoprene top and bottom pads are optional for packages not intended to be re-used.

The expiration date of the certificate was not modified.

The January 24, 2012, consolidated application was included in the References section.

## **CONCLUSION**

Based on the statements and representations in the application, the staff has reviewed the proposed changes for the Model No. Versa-Pac package. The staff concludes that the changes indicated do not affect the ability of the package to meet the requirements of 10 CFR Part 71.

Issued with Certificate of Compliance No. 9342, Revision No. 6,  
on February 2, 2012