

**CERTIFICATE OF COMPLIANCE  
FOR RADIOACTIVE MATERIAL PACKAGES**

1.	a. CERTIFICATE NUMBER	b. REVISION NUMBER	c. DOCKET NUMBER	d. PACKAGE IDENTIFICATION NUMBER	PAGE	PAGES
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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>DAHER-TLI<br>8161 Maple Lawn Boulevard<br>Suite 480<br>Fulton, MD 20759 | b. TITLE AND IDENTIFICATION OF REPORT OR APPLICATION<br>Daher-TLI consolidated application dated<br>February 17, 2021. |
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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: 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, uranium hexafluoride in the 1S or 2S cylinders, and TRISO fuel. The 1S and 2S cylinders are ANSI N14.1 Standard compliant, which means that each cylinder (which includes new or re-certified cylinders) must be fabricated, inspected, tested, and maintained in accordance with ANSI N14.1-2012 or earlier version of ANSI N14.1 at the time of fabrication.

The exterior skin of the packaging is a UN1A2/Y425/S minimum, carbon steel material for the Model No. VP-55 and a UN1A2/Y409/S minimum, carbon steel for the Model No. VP-110.

All models use a bolted closure ring, ASTM A429 bolts and nuts, a silicone 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.

All models are strengthened with vertical stiffeners, two inner liners insulated by a ceramic fiber blanket and a 1/4" carbon steel reinforcing plate on the bottom. The packaging's interior 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.

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5.(a)(2) Description (continued)

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 for the Model Nos. VP-55 and VP-110 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.

When utilizing the 5-inch steel pipe inner container in the Model No. VP-55, (5-inch pipe with the threaded cap), the 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 payload vessel blind flange, and the bolts.

When transporting 1S and 2S cylinders in the VP-55, a 9 lbs/ft<sup>3</sup> polyethylene foam liner is inserted into the package cavity, with a minimum thickness of 2 inches.

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

**Table 1 - Weight and Dimensions**

Model No.	Packaging OD (in.)	Packaging Height (in.)	Payload Containment Cavity ID (in.)	Payload Containment Cavity Height (in.)	Packaging Tare Weight (lbs.)	Maximum gross weight (lbs.)
VP-55	23-3/16	34-3/4	15	25-7/8	390	750
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 DAHER-TLI Drawing Nos.:

VP-55-LD, Rev. 4 (sheets 1 and 2) 55 Gallon Versa-Pac Shipping Container

VP-110-LD, Rev. 3 (sheets 1 and 2) 110 Gallon Versa-Pac Shipping Container

The 5-inch steel pipe inner container is constructed and assembled in accordance with Daher-TLI Drawing No. VP-55-2R Rev. 0, sheet 1 of 1.

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5.(b) Contents

(1) Type and form of material

- (i) 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. Materials may include natural thorium in any form. Materials may include neutron poisons (e.g., boron, hafnium, erbium, and gadolinia).

Contents are limited to:

- 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.
- E. Natural thorium in any form.
- (ii) TRISO fuel and compacts composed of uranium kernels encased within layers of carbon and SiC to form TRISO particles. The uranium may be in the form of uranium oxides, carbides, and/or nitrides. Uranium kernels and TRISO particles are of unrestricted size, density, and uranium content per kernel/particle. Uranium kernels and TRISO particles may be loose or mixed in a graphite matrix and pressed into compacts of various fuel forms (e.g., annular cylinders, planks, right circular cylinders, spheres, etc.). Pressed TRISO fuel compacts may include a graphite fuel free zone at the periphery of the component.
- (iii) Uranium Hexafluoride is authorized for shipment when loaded into 1S or 2S cylinders, or in sample tubes when less than 0.1 kg in total quantity, utilizing a 9 PCF polyethylene foam liner with a thickness of at least 2 inches. Aside from the polyethylene foam liner, no hydrogenous packing materials are permitted when shipping 1S/2S cylinders.

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5.(b)(1) Type and form of material (continued)

Contents may be pre-packaged in polyethylene, polytetrafluoroethylene, aluminum, and carbon steel, 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. The quantity of hydrogenous packing materials is unlimited unless otherwise specified. Materials with a hydrogen density greater than 0.141 g/cm<sup>3</sup> are not authorized.

Radioactive contents shall have an auto-ignition temperature and melting point greater than 600°F.

(2) Maximum quantity of material per package:

The U-235 and uranium mass limits are determined by enrichment and are not to exceed the limits established below:

**Table 2 - Loading Table for Model Nos. VP-55 and VP-110**

Weight Percent U-235	U-235 Mass Limit (g)	
	Ground/Vessel	Air
≤ 100%	360	360
≤ 20%	445	445
≤ 10%	505	505
≤ 5%	610	610
≤ 1.25%	1,650	--

For contents restricted by Table 2A, hydrogenous packing materials are not to exceed 1 lb (454 g) of material. Uranium compounds containing hydrogen (e.g., hydrates and hydrides) are not permissible under Table 2A. The bumper pads and insulation plug are not considered in the 1 lb. hydrogenous material limit.

**Table 2A - Loading Table for Model No. VP-55 With Limited Hydrogenous Packing Material**

Weight Percent U-235	U-235 Mass Limit (g)	
	CSI=0.7	CSI=1.0
≤ 100%	515	--
≤ 20%	605	635
≤ 10%	685	--
≤ 5%	800	--

For contents restricted by Table 3, all fissile contents shall be loaded into a single 5-inch pipe.

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5(b)(2) Maximum quantity of material per package (continued)

**Table 3 - Loading Table for Model No. VP-55 with 5-inch pipe**

Weight Percent U-235	U-235 Mass Limit (g)	
	Ground/Vessel	Air
≤ 100%	695	395
≤ 20%	1,215	495
≤ 10%	Unlimited <sup>1</sup>	590
≤ 5%	Unlimited <sup>1</sup>	790

<sup>1</sup> Contents ≤10 wt% are limited by the volume of the 5-inch pipe container (6.4 L). This corresponds to theoretical mass limits of 122 kg of U-metal, 60 kg UO<sub>2</sub>, and 45 kg U<sub>3</sub>O<sub>8</sub>. Actual content mass will be lower due to material packing efficiency, secondary containers, shoring and package gross weight limit.

For contents restricted by Table 3A, all fissile contents shall be loaded into 5-inch pipe(s) and hydrogenous packing materials are not to exceed 1.25 lb (567 g) of material per pipe. Uranium compounds containing hydrogen (e.g., hydrates and hydrides) are not permissible under Table 3A.

**Table 3A - Loading Table for Model No. VP-55 with 5-inch pipe and Limited Hydrogenous Packing Material <sup>1</sup>**

Weight Percent U-235	Number of Pipes	CSI
≤ 20%	1	CSI=1.0 for all compounds
≤ 10%	2	CSI=1.0 for uranium oxides CSI=1.4 for all other compounds

<sup>1</sup> Contents are limited by the volume of the 5-inch pipe container (6.4 L). This corresponds to theoretical mass limits of 122 kg of U-metal, 60 kg UO<sub>2</sub>, and 45 kg U<sub>3</sub>O<sub>8</sub>, per pipe. Actual content mass will be lower due to material packing efficiency, secondary containers, shoring and package gross weight limit.

For contents restricted by Tables 4 and 5, all fissile material shall be uranium hexafluoride loaded into 1S or 2S cylinders. If both 1S and 2S cylinders are transported in the same package and/or the number of cylinders exceeds the allowed quantity in Table 4, follow the mass limits of Table 2. If a package containing 1S/2S cylinders is transported by air, follow the mass limits of Table 2. For 1S or 2S cylinders with material exceeding 20 wt% U-235, each 1S or 2S cylinder shall be loaded into an individual 5-inch pipe.

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5(b)(2) Maximum quantity of material per package (continued)

**Table 4: 1S/2S Cylinder Limits for the VP-55 (up to 20wt.% U-235)**

Cylinder Type	Mass UF <sub>6</sub> per VP-55 (lb/g)	Weight percent U-235	Number of Cylinders	U-235 Mass Limit per VP-55 (g)
1S	7.0 / 3,175	≤ 20	7	429.8
2S	9.8 / 4,445	≤ 20	2	600.8

**Table 5: 1S/2S Cylinder Limits for the VP-55 with 5-inch Pipe (up to 100wt.% U-235)**

Cylinder Type	Mass UF <sub>6</sub> per VP-55 (lb/g)	Weight percent U-235 (e is enrichment)	Number of Cylinders	U-235 Mass Limit per VP-55 (g)
1S	1.0 / 454	20 < e ≤ 100	1	306
2S	4.9 / 2,223	20 < e ≤ 100	1	1497

The net weight of the authorized contents shall not exceed 350 lbs for the Model Nos. VP-55 and 260 lbs for the Model No. VP-110, including cribbing and dunnage.

- (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<sub>2</sub> value.
- (4) Decay heat is limited to 11.4 W.

5.(c) Criticality Safety Index (CSI)

- (1) Contents Limited by Table 2 (VP-55 or VP-110): 1.0
- (2) Contents Limited by Table 2A (VP-55): As listed in Table 2A
- (3) Contents Limited by Table 3 (VP-55): 0.7 for material up to 10 wt% and 1.0 for material greater than 10 wt% and up to 100 wt%.
- (4) Contents Limited by Table 3A (VP-55): As listed in Table 3A
- (5) Contents Limited by Table 4 (only VP-55): 1.0
- (6) Contents Limited by Table 5 (only VP-55 with 5-inch pipe): 1.0

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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 authorized, as limited by the 'Air' quantities in Table 2 and Table 3.
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. Optional use of certain package components is listed in the licensing drawing notes.
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: May 31, 2024.

REFERENCES

Daher-TLI application, "Application for Certificate of Compliance for the Versa-Pac Shipping Package," Revision No.12, February 17, 2021.

FOR THE U.S. NUCLEAR REGULATORY COMMISSION

John McKirgan, Chief  
Storage and Transportation Licensing Branch  
Division of Fuel Management  
Office of Nuclear Material Safety  
and Safeguards

Date: 9/3/21