

**CERTIFICATE OF COMPLIANCE
FOR RADIOACTIVE MATERIAL PACKAGES**

1. a. CERTIFICATE NUMBER	b. REVISION NUMBER	c. DOCKET NUMBER	d. PACKAGE IDENTIFICATION NUMBER	PAGE	PAGE
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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
- | | |
|--|---|
| a. ISSUED TO (<i>Name and Address</i>) | b. TITLE AND IDENTIFICATION OF REPORT OR APPLICATION |
| NAC International, Inc.
2 Sun Court, Suite 220
Peachtree Corners, GA 30092 | "OPTIMUS®-L (OPTImal Modular Universal Shipping Cask) Safety Analysis Report," Revision 3, April 2025, as supplemented. |

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.: OPTIMUS®-L
- (2) Description

The OPTIMUS®-L packaging consists of (i) a Cask Containment Vessel (CCV), (ii) a CCV bottom support plate, (iii) an Outer Packaging (OP) assembly, and (iv) Shield Insert Assemblies (SIAs). The CCV bottom support plate is a free-standing coated carbon steel plate positioned at the bottom end of the CCV cavity below the contents. The CCV fits within the cavity of the OP. The packaging may also be configured with a Shield Insert Assembly (SIA) within the cavity of the CCV.

The CCV is the packaging containment system. It is a stainless-steel cylindrical vessel that includes a body weldment, bolted lid, bolted port cover, and elastomeric O ring seals. The CCV has an outer diameter of 34.5 inches, which expands to 39.0 inches at the bolt flange and lid, and an overall height of approximately 51.4 inches. The internal cavity of the CCV has a diameter of 32.5 inches and is 47.0 inches high. The CCV cylindrical shell and bottom plate have an identical thickness. The CCV lid is fastened to the CCV body by 1-inch diameter socket head cap screws. The CCV lid's inner plug fits inside the top opening of the CCV body.

The CCV bottom support plate is a free-standing coated carbon steel plate that is positioned at the bottom end of the CCV cavity below the contents.

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

The OP assembly consists of a base and lid assembly with a closed-cell polyurethane foam sealed inside the stainless-steel inner and outer shells. An insulation is bonded to the inner surface of the OP lid outer end plate to minimize heating of the OP lid foam from insolation. The OP has an outside diameter of 49.0-inch and is 70-inch high. The OP lid is secured to the OP base by high-strength steel bolts.

The SIA is a coated carbon steel container, placed inside the CCV cavity, which provides additional gamma shielding. The SIA configurations used in the OPTIMUS®-L packaging are either 1-inch thick or 2¼-inch thick. The internal cavity of the SIA has a diameter of 24.0 inches and is 35.25 inches high. The 1-inch-thick SIA is used inside the CCV cavity. The 2¼-inch thick SIA used in the CCV cavity requires an annular spacer plate placed underneath the bottom of the 2¼-inch thick SIA to position it near the top of the CCV cavity to facilitate loading operations.

The OPTIMUS®-L packaging is configured with the GEO basket assembly inside the CCV cavity to transport TRISO compact contents. The GEO basket assembly is an internal support structure that maintains the geometry of the TRISO compacts for criticality control. In that configuration, the CCV bottom support plate is not included.

The Shielded Device Insert Assembly (SDIA) is placed inside the CCV cavity for transporting shielded devices containing special and normal form sealed source content. The SDIA is placed in the CCV cavity during transport. The insert consists of two (2) axial aluminum spacers, placed at the bottom and top of the configuration, with an insert between the axial spacers. Both axial spacers are equivalent and can be used at either the top or bottom of the configuration. Additional axial dunnage shall be inserted below and above the Shielded Devices to fill the axial gaps.

The cavity of the package has a diameter of 32.5 inches and is 47 inches long. The outer diameter (excluding tiedown arms) of the OPTIMUS®-L package is 49 inches and the outer height (excluding lifting lugs) is 70 inches. The maximum weight of the contents (including the CCV bottom support plate, SIA, dunnage or shoring) is 3,500 lbs and the maximum gross weight of the package is approximately 9,200 lbs.

(3) Drawings

The packaging is constructed and assembled in accordance with the following NAC International Drawing Nos.:

70000.14-L502, Rev 1P	Packaging Assembly – OPTIMUS-L
70000.14-L510, Rev 0P	CCV Assembly – OPTIMUS
70000.14-L511, Rev 0P	CCV Body Weldment – OPTIMUS
70000.14-L512, Rev 0P	CCV Lid – OPTIMUS
70000.14-L513, Rev 0P	Port Cover – OPTIMUS
70000.14-L514, Rev 0P	CCV Bottom Support Plate – OPTIMUS-L

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5.(a) (3) Drawings (continued)

70000.14-L540, Rev 0P	Outer Packaging Assembly – OPTIMUS-L
70000.14-L541, Rev 1P	Outer Packaging Base – OPTIMUS-L
70000.14-L542, Rev 1P	Outer Packaging Lid – OPTIMUS-L
70000.14-L550, Rev 1P	1-Inch Shield Insert Assembly (SIA) – OPTIMUS
70000.14-L551, Rev 1P	2¼-Inch Shield Insert Assembly (SIA) – OPTIMUS
70000.14-L553, Rev 0P	2¼-Inch SIA Annular Spacer Plate – OPTIMUS-L
70000.14-L560, Rev 2P	GEO Basket Assembly, OPTIMUS-L
70000.14-L561, Rev 1P	GEO Basket Weldment, OPTIMUS-L
70000.14-L595, Rev 1P	Shielded Device Insert Assembly, OPTIMUS-L

(b) Contents

(1) Type and Form of Material

- (i) Byproduct, source, special nuclear material, non-fissile or fissile-excepted, as special form or non-special form in the form of process solids or resins, either dewatered, solid, or solidified waste.
- (ii) Dewatered, solid, or solidified transuranic-containing wastes (TRU), fissile, non-fissile, or fissile-excepted;
- (iii) Neutron activated metals or metal oxides in solid form, in secondary containers;
- (iv) Miscellaneous radioactive solid waste materials, including special form material;
- (v) Irradiated fuel waste (IFW) consisting of low-enriched uranium (LEU) fuel and activated metal structural components (e.g., cladding, liners, baskets, etc.).

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5.(b) (1) Type and Form of Material (continued)

- (vi) TRISO Compacts, consisting of unirradiated solid right circular cylinders, manufactured from slightly contaminated uranium with trace quantities limits, as specified in Table 1 below.

Table 1. Maximum Authorized Concentrations

Isotope	Maximum Content
^{232}U	2.6×10^{-9} g/gU
^{234}U	1.00×10^{-2} g/gU
^{235}U	2.00×10^{-1} g/gU
^{236}U	7.72×10^{-2} g/gU
^{238}U	Balance of Uranium
^{237}Np	3.85×10^{-6} g/gU
^{238}Pu	1.56×10^{-10} g/gU
$^{239}\text{Pu}/^{240}\text{Pu}$	4.29×10^{-8} g/gU
Fission Products	0.25 mCi/gU

- (vii) Shielded Devices are shielded steel weldments containing sealed sources meeting the specifications in Table 2.

Table 2. Specifications of Shielded Devices

Parameter	Shielded Device
Maximum weight (Shielded Device)	2,200 lb. (997 kg ref.)
Maximum Content Activity (Shielded Device)	^{60}Co – 5 Ci and ^{137}Cs – 2,800 Ci
Maximum Surface Dose Rate (Shielded Device)	100 mrem/hr
Maximum Dimensions	
Height	40 in. (101.6 cm ref.)
Diameter	14 in. excluding beam port, if present (35.56 cm ref.)

(2) Maximum quantity of material per package

- (i) Maximum weight of contents: 3,500 pounds including radioactive waste, secondary containers, CCV bottom support plate, SIA, and shoring.
- (ii) Maximum decay heat: 50 watts.

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

- (iii) Fissile contents must not exceed the fissile gram equivalents (FGE) in Table 3 for the specified criticality configuration limits. Plutonium contents in quantities greater than 0.74 TBq (20 Ci) must be in solid form.

Table 3. TRU Waste FGE Limits

Config. ID	FGE Criticality Configuration Description			FGE Limit ⁽¹⁾ ²³⁹ Pu (²³⁵ U)
	Machine Compacted ⁽²⁾	Weight % Special Reflector ⁽³⁾	Minimum ²⁴⁰ Pu Credit	
FGE-1		≤ 1		340 (528) g
FGE-2a		≤ 1	≥ 5 g	350 (544) g
FGE-2b		≤ 1	≥ 15 g	375 (583) g
FGE-2c		≤ 1	≥ 25 g	395 (614) g
FGE-3		> 1		121 (188) g
FGE-5	x	≤ 1		250 (388) g

- (1) FGE conversion based on a ratio of subcritical mass limits in ANSI/ANS-8.1, Section 5.2 of 0.7 kg (1.5 lb) for ²³⁵U and 0.45 kg (1.0 lb) for ²³⁹Pu. FGE equivalents determined using Table 7-1 of the application.
- (2) For uncompacted or manually compacted TRU waste, materials with hydrogen density up to that of water (0.1117 g/cm³) are unlimited, but materials with hydrogen density greater than water are limited to the hydrogen density of polyethylene (0.1336 g/cm³) and may not exceed 15% of the total contents by volume. For machine compacted contents, hydrogenous materials in the contents are limited to the hydrogen density of polyethylene (0.1336 g/cm³) in an unlimited quantity.
- (3) Special reflector materials are defined as beryllium, beryllium oxide, carbon (graphite), heavy water, magnesium oxide, and depleted uranium. The weight% of the special reflector materials is calculated as the mass of all special reflector materials present divided by the total mass of all waste material contents inside the secondary container. For FGE-3, these materials are unlimited.

- (iv) IFW contents shall not exceed the Fissile Equivalent Mass (FEM) limits from Table 4 for the specified criticality configuration limits.

Table 4 - IFW Waste FEM Limits

Config. ID ⁽¹⁾	LEU Waste Criticality Configuration Description		
	Weight % Special Reflector ⁽²⁾	Enrichment Limit (wt.% ²³⁵ U)	Uranium Mass Limit, lbs. (kg)
FEM-1	≤ 1	≤ 0.90 wt.%	2,500 (1,134)

- (1) IFW contents must be non-machine compacted. Materials with hydrogen density up to that of water (0.1117 g/cm³) are unlimited, but materials with hydrogen density greater than water are limited to the hydrogen density of polyethylene (0.1336 g/cm³) and may not exceed 15% of the total contents by volume.
- (2) Special reflector materials are defined as beryllium, beryllium oxide, carbon (graphite), heavy water, magnesium oxide, and depleted uranium. The weight% of the special reflector materials is calculated as the mass of all special reflector materials present divided by the total mass of all waste material contents inside the secondary container.

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

- (v) Contents shall not exceed the maximum activity limits in Tables 7.5-1 and 7.5-2 of the application using the procedure described in Attachment 7.5-1 of the application. Table 7.5-2 of the application applies to packages centered on the trailer and correspond to loadings with either no SIA, 1-inch SIA, or 2 ¼ inch SIA. Sample maximum loadings for key nuclides are in Table 5 for a package centered on the trailer.

Table 5. TRU Waste and IFW Activity Limits for Key Isotopes

Isotope	Activity Limits (Ci) per package configuration		
	No SIA inside the CCV cavity	1-inch SIA inside the CCV cavity	2¼-inch SIA inside the CCV cavity
⁶⁰ Co	8.197x 10 ⁻²	1.632 x 10 ⁻¹	4.284 x 10 ⁻¹
¹³⁷ Cs ⁽¹⁾	4.066 x 10 ⁻¹	1.077	4.228
²⁵² Cf	1.217 x 10 ⁻²	1.289 x 10 ⁻²	1.469 x 10 ⁻²
²⁴⁴ Cm	3.819 x 10 ²	4.074 x 10 ²	4.654 x 10 ²

(1) Includes ^{137m}Ba daughter

- (vi) Explosives, corrosives, non-radioactive pyrophoric, and sealed items containing compressed and/or flammable gas (e.g., aerosol cans, lecture bottles, etc.) are prohibited. Pyrophoric radionuclides may be present only in residual amounts less than 1 wt.%. All nonradioactive pyrophoric material be reacted (or oxidized) and/or otherwise rendered nonreactive prior to placement in a secondary container (e.g., drum).
- (vii) Free liquids shall not exceed 1% of the CCV cavity volume.
- (viii) For TRISO Compacts, as described in 5(b)(1)(vi):

Table 6. TRISO Compacts Parameters

Design Parameter	Parameter Limit
Maximum total weight	≤ 581 lbs (263 kg)
Maximum enrichment	≤ 20% ²³⁵ U
Total mean uranium loading	≤ 68 kgU
Maximum mean matrix density	≤ 1.8 g/cc

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

(ix) For Shielded Devices, as described in Item 5.(b)(1)(vii):

Shielded Devices, contents, are limited to special and normal form sealed source content. The Shielded Device Insert Assembly is configured in the CCV cavity for transportation, shown General Arrangement Drawing No. 70000.14-L595. The insert consists of two (2) axial aluminum spacers, placed at the bottom and top of the configuration, with cellulosic fiberboard radial insert situated between the axial spacers.

(c) Criticality Safety Index (CSI)

For 5(b)(2)(i) through 5.(b)(2)(vii) CSI: 5.0
For 5(b)(2) (viii) CSI: 0.0
For 5(b)(2)(ix) Shielded Devices CSI: 0.0

6. In addition to the requirements of 10 CFR Part 71, Subpart G:

- (a) The package must be loaded and prepared for shipment in accordance with the Package Operations in Section 7 of the application.
- (b) The package must be tested and maintained in accordance with the Acceptance Tests and Maintenance Program in Section 8 of the application.

7. The package must be transported under exclusive-use.

8. Shoring or dunnage must be placed between loose fitting contents and the CCV cavity, baskets and/or tubes to prevent excessive movement during transport. The shoring or dunnage material shall not react negatively with the packaging materials or contents and should have an auto-ignition temperature above 300°F to ensure the material being transported maintains its geometry under routine and normal conditions of transport.

9. Non-metallic components must have an auto-ignition temperature of 300°F or higher and must be evaluated, prior to shipment, for gas generation in accordance with Attachment 7.5-3 of the application.

10. All radioactive contents shall be packaged in secondary container(s) (e.g., drums, liners, specialty bags, etc.).

11. TRISO Compacts shall be shipped dry, i.e., no free liquids, and may include non-metallic components, such as spacers and/or adhesive-backed seals or labels, as contents.

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12. Hydrogen must be limited to a molar quantity that would be no more than 5% by the volume of the innermost layer of confinement during transport. The port of the CCV lid shall be plugged. Compliance with the hydrogen and other flammable gas limit must be demonstrated for each shipment.
13. The package is not authorized for air transport.
14. The package authorized by this certificate is hereby approved for use under the general license provisions of 10 CFR 71.17.
15. Expiration date: December 31, 2026.

REFERENCES

"OPTIMUS®-L (OPTImal Modular Universal Shipping Cask) Safety Analysis Report," Revision 3, April 2025, submitted on April 10, 2025.

Supplemented on July 8, 2024; July 17, 2024; and November 18, 2024.

FOR THE U.S. NUCLEAR REGULATORY COMMISSION

Yaira K. Diaz Sanabria, Chief
Storage and Transportation Licensing Branch
Division of Fuel Management
Office of Nuclear Material Safety
and Safeguards

Date: April 30, 2025.