



Department of Energy

Washington, DC 20585

July 13, 2022

Mr. Wren Fowler
Director, Licensing
NAC International, Inc.
3930 East Jones Bridge Rd, Suite 200
Norcross, Georgia 30092

Dear Wren Fowler,

In response to your request to Dr. James Shuler dated June 8, 2022, enclosed is Department of Energy (DOE) Certificate of Compliance (CoC) Number 9225, Revision 13, for the Model NAC-LWT and its DOE Safety Evaluation Report (SER). The CoC is renewed for five years (from the expiration of Revision 12 on September 30, 2022). Changes to the CoC are indicated by vertical bars in the right page margin.

This CoC is issued by DOE under the authority of 49 CFR 173.7(d) and is conditional upon fulfilling the applicable Operational and Quality requirements of 49 CFR Parts 100-199 and 10 CFR Part 71, and the conditions specified in Item 5 of the CoC.

The expiration date of Revision 13 is September 30, 2027.

If you have any questions, please contact me or Dr. Shuler of my staff at (301) 903 5513.

Sincerely,

**Julia C.
Shenk**

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C. Shenk
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Julia C. Shenk
Headquarters Certifying Official
Director
Office of Packaging and Transportation

Enclosures

cc: James Shuler, EM-4.24
Docket 22-39-9225



U.S. DEPARTMENT OF
ENERGY

DOE Packaging Certification Program

**CERTIFICATE OF COMPLIANCE
For Radioactive Materials Package**

DOE F 5822.1
(5-85 Formerly EV-618)
Rev (9-2011)

1a. Certificate Number	1b. Revision No.	1c. Package Identification No.	1d. Page No.	1e. Total No. Pages
9225	13	USA/9225/B(U)F-96 (DOE)	1	8

2. PREAMBLE

- 2a. This certificate is issued under the authority of 49 CFR Part 173.7(d).
- 2b. The packaging and contents described in Item 5 below meet the safety standards set forth in subpart E, "Package Approval Standards" and subpart F, "Package, Special Form and LSA-III Tests" Title 10, Code of Federal Regulations, Part 71.
- 2c. 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 —

(1) Prepared by (*Name and Address*):

NAC International, Inc.
3930 E. Jones Bridge Road,
Suite 200
Norcross, GA 30092

(2) Title and identification of report or application:

Safety Analysis Report for Packaging
for the NAC-LWT Legal Weight Truck Cask
System, Revision 3, as supplemented in 5(e)

(3) Date:

May 2016

4. CONDITIONS

This certificate is conditional upon fulfilling of the applicable Operational and Quality Assurance requirements of 49CFR parts 100 – 199 and 10CFR Part 71, and the conditions specified in Item 5 below.

5. Description of Packaging and Authorized Contents, Model Number, Transport Index, other Conditions, and References:

(a) Packaging

(1) Model Number: NAC-LWT

(2) Description:

The NAC-LWT is a steel-encased, lead-shielded shipping cask. The following content configurations are approved for transport:

(a) Sandia National Laboratories (SNL) Debris Bed Experiments (DBE) contained in welded stainless steel DBE Transport Canisters and radioactive material from the Alpha Gamma Hot Cell Facility (AGHCF). The DBE Transport Canister provides a secondary leak-tight boundary for the DBE contents.

(b) Irradiated sodium-bonded nuclear reactor fuel derived mixed fission products (FDMFP) from the Argonne National Laboratory (ANL) Alpha Gamma Hot Cell Facility (AGHCF). FDMFP will be shipped in individual leak-tight, sealed 6CVS containment vessels.

6a. Date of Issuance: July 13, 2022

6b. Expiration Date: September 30, 2027

FOR THE U.S. DEPARTMENT OF ENERGY

7a. Address (*of DOE Issuing Office*)

U.S. Department of Energy
Office of Packaging and Transportation (EM-4.24)
1000 Independence Avenue, SW
Washington, DC 20585

7b. Signature, Name, and Title (*of DOE Approving Official*)

Julia C. Shenk
Julia C. Shenk
Headquarters Certifying Official
Director
Office of Packaging and Transportation

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Shenk
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(c) Irradiated U_3O_8 monoliths generated at the Consolidated Edison Uranium Solidification Project (CEUSP). The CEUSP material is prepackaged in a welded, stainless steel CEUSP Can and nested as follows. Each CEUSP Can may be over packed in a CEUSP Canister Assembly, which is a tin-plated steel thin shell over-pack (typically crimped closed with a tin-plated lid). Up to seven CEUSP Canister Assemblies may be placed in a CEUSP Sleeve. A Canister Spacer is used if fewer than seven Canister Assemblies are packaged in a CEUSP Sleeve to limit the movement of the Canister Assemblies. The CEUSP Sleeve is constructed of a Type 304 stainless steel pipe, with a welded base disk and a threaded lid. Up to three CEUSP Sleeves are loaded into a CEUSP Basket Assembly. The Basket Assembly is designed to be compatible with the NAC-LWT cask design. The Basket Assembly and Sleeve Assembly are designed for ease of handling, loading, and unloading operations. The Basket protects the Sleeve, and likewise the Sleeve protects the CEUSP canister assemblies by providing structural support, heat removal, and criticality control during normal conditions of transport and hypothetical accident conditions.

When presented for transport, the authorized cask content configurations are: a) up to three individual DBE Transport Canisters, or b) up to three sealed 6CVS containment vessels for the ANL FDMFP, and appropriate baskets and spacers as required; or c) up to 21 CEUSP canister assemblies (each package may contain up to three CEUSP Sleeves, each containing up to seven CEUSP canister assemblies per sleeve).

The overall dimensions of the package, with impact limiters, are 232 inches long by 65.3 inches in diameter. The cask body is approximately 200 inches in length and 44 inches in diameter. The cask cavity is 178 inches long and 13.4 inches in diameter. The volume of the cavity is approximately 14.5 cubic feet.

The cask body consists of a 0.75-inch thick stainless steel inner shell, a 5.75-inch thick lead gamma shield, a 1.2-inch thick stainless steel outer shell, and a neutron shield tank. The inner and outer shells are welded to a 4-inch thick stainless steel bottom end forging. The cask bottom consists of a 3-inch thick, 20.75-inch diameter lead disk enclosed by a 3.5-inches thick stainless steel plate and bottom end forging. The cask lid is 11.3-inches thick stainless steel stepped design, secured to a 14.25-inch thick ring forging with twelve 1-inch diameter bolts. The cask lid seal is a metallic O-ring. A second Teflon O-ring and a test port are provided to leak test the seal. Other penetrations in the cask cavity include the fill and drain ports, which are sealed with Alternate B port covers and metallic O-rings. A second Viton® O-ring and test port are provided on each Alternate B port cover to leak test the metallic seal.

The neutron shield tank consists of a 0.24-inch thick stainless steel shell with 0.5-inch thick end plates. The neutron shield region is 164 inches long and 5 inches thick. The neutron shield tank contains an ethylene glycol/water solution that is 1% boron by weight.

The cask is equipped with aluminum honeycomb impact limiters. The top impact limiter has an outside diameter of 65.25 inches and a maximum thickness of 27.8 inches. The bottom impact limiter has an outside diameter of 60.25 inches and maximum thickness of 28.3 inches. Both impact limiters extend 12 inches along the side of the cask body.

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(3) Drawings:

The packaging is constructed in accordance with the following NAC International drawings.

Number	Revision	Sheet(s)	Title
315-40-01	7	1	Legal Weight Truck Cast Assembly
315-40-02	24	1-2	NAC-LWT Cask Body Assembly
315-40-03	22	1-7	NAC-LWT Cask Body
315-40-04	12	1	NAC-LWT Cask Lid Assembly
315-40-05	10	1-2	NAC-LWT Upper Impact Limiter
315-40-06	10	1	NAC-LWT Cask Lower Impact Limiter
315-40-08	18	1-5	NAC-LWT Parts Detail
315-40-117	3	1	Canister Assembly, SNL Experiment Shipment
315-40-118	2	1-2	Details, Canister Weldment, SNL Experiment Shipment
315-40-119	2	1-3	Details, Canister Lid, SNL Experiment Shipment
315-40-138	3	1-5	Legal Weight Truck Transport Cask Assy, SNL Experiment Transport Configurations
315-40-144	2	1-3	Legal Weight Truck, Transport Cask Assy, SNL Spacer
315-40-150	0	1	Weldment, 6CVS Inner Containment Vessel Basket, Top Module, NAC-LWT
315-40-151	0	1	Weldment, 6CVS Inner Containment Vessel Basket, Intermediate Module, NAC-LWT
315-40-152	0	1	Weldment, 6CVS Inner Containment Vessel Basket, Bottom Spacer Module, NAC-LWT
315-40-153	0	1	NAC-LWT Transport Cask Assembly, 6CVS Inner Containment Vessel Contents
315-40-154	3	1-4	6CVS Inner Containment Vessel, Assembly and Details, NACLWT
315-40-160	0	1	Legal Weight Truck Transport Cask Assembly, CEUSP Contents
315-40-161	2	1-4	Basket Assembly, CEUSP Contents
315-40-162	2	1-2	Sleeve Assembly, CEUSP Contents
315-40-163	0	1	Canister Spacer, CEUSP Contents

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(b) Contents:

(1) Type and form of material

- (i) Up to three Sandia National Laboratories (SNL) irradiated Debris Bed Experiments (DBE) as listed in Table 1.2-10 of the SARP. Characteristics of each authorized DBE content are limited to:

Characteristic	Maximum Value
DBE Weight	450 lbs
DBE Transport Canister Loaded Weight	1,100 lbs
DBE Length (w/o Handling Adapters)	75 inches
DBE Transport Canister Length	90 inches
²³⁵ U Mass per DBE	8.0 kg
²³⁵ U Enrichment	94%
Activation Source Term	15.3 Ci ⁶⁰ Co
Irradiation Time	80 hours
Heat Load per Cask	100 W

The minimum cool time is 10 years. Each DBE must be contained in a welded stainless steel DBE Transport Canister

- (ii) Up to three sealed 6CVS containment vessels for ANL irradiated sodium-bonded nuclear reactor fuel derived mixed fission products (FDMFP) for each shipment.

The following apply for each NAC-LWT shipping cask:

- Maximum content weight for one 6CVS containment vessel: 200 lbs.
- Maximum total decay heat load in the NAC-LWT cask cavity: 36 W (≤ 12 W per 6CVS, three 6CVS maximum per cask)
- Minimum cooling time: >16 years
- Maximum normal operating temperature: $\leq 200^{\circ}\text{F}$
- 6CVS containment vessel design pressure: 800 psig
- No sodium is permitted external to the 6CVS containment vessel.
- Aluminum fuel element (FE) tubes of various diameters with stainless steel threaded plugs may be used to facilitate loading the ANL FDMFP into the 6CVS containment vessel. The tubes are considered dunnage.

For a 6CVS containing sodium-bonded metal FDMFP:

- Maximum ²³⁵U content: ≤ 4 kg
- Maximum Pu content: ≤ 1.5 kg
- Maximum ²³⁹Pu fissile gram equivalent: 3,020 g

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For a 6CVS containing sodium-bonded metal FDMFP with Bakelite or carbon-based FDMFP:

- Maximum volume of Bakelite met mounts per 6CVS: 6000 cm³
- Maximum ²³⁵U content: ≤ 2 kg
- Maximum Pu content: ≤ 0.7 kg
- Maximum ²³⁹Pu fissile gram equivalent: 2,100 g
- Carbide FDMFP satisfying the Fissile Gram Equivalent limits may be included in the package provided the carbon content of the carbide FDMFP is subtracted from the maximum allowed carbon content of the Bakelite met mounts. As Bakelite is modeled as 78 wt % carbon at a density of 1.25 g/cm³, the maximum quantity of carbon in the 6CVS is limited to 5,877 grams.
- For a 6CVS containing sodium-bonded metal FDMFP with Bakelite, gas generation by radiolysis is defined by a bounding G-Value (conservatively applied as 0.3 molecules/100eV), energy production by Bakelite/epoxy contained FDMFP, and assumed duration between loading and end of transport. To bound any potential ionizing radiation from the non-Bakelite containing components, a 25% value is applied in the analysis (3W). A 30-day transport window is assigned to the calculation. This results in a 15-day transport limit for shipments containing Bakelite.

- (iii) CEUSP generated U₃O₈ monoliths stored in CEUSP Canister Assemblies. The material is composed primarily of high enriched ²³⁵U and ²³³U oxides with various impurities. Up to 21 CEUSP Canister Assemblies may be transported per the NAC-LWT package. Each package may contain up to three CEUSP Sleeves, each containing up to 7 CEUSP canister assemblies per sleeve.

The following apply for each NAC-LWT shipping cask:

- Maximum content weight for one CEUSP Sleeve containing up to seven CEUSP canister assemblies: 400 lbs.
- Maximum total decay heat load in the NAC-LWT cask cavity: 33 W
- Minimum cooling time: Minimum Time from Assay (40 Years)
- Maximum normal operating temperature: ≤ 200°F
- Maximum ²³⁵U content per canister (at time of assay, prior to decay): 2.423 kg
- Maximum ²³³U content per canister (at time of assay, prior to decay): 306.9 g
- Primary material: U₃O₈

Contains impurities and Cd/Gd oxide absorber. Impurities are primarily metallic.

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(2) Maximum quantity of material per package

- (i) Maximum quantity of Sandia irradiated Debris Bed Experiments is listed in Section 5(b)(1)(i) of this certificate.
- (ii) Maximum quantity of ANL irradiated sodium-bonded nuclear reactor FDMFP is listed in Section 5(b)(1)(ii) of this certificate.
- (iii) Maximum quantity of CEUSP generated U_3O_8 monoliths stored in CEUSP Canister Assemblies is listed in Section 5(b)(1)(iii) of this certificate.

(c) Criticality Safety Index:

The Criticality Safety Index (CSI) for the NAC-LWT with:

Sandia DBE contents is zero. (CSI = 0)

ANL irradiated sodium-bonded nuclear reactor FDMFP contents is zero. (CSI = 0)

CEUSP canister assemblies contents is 100 (CSI=100)

(d) Conditions:

(1) In addition to the requirements of Subparts G and H of 10 CFR Part 71:

- (i) Except as specified in Condition 5(d)(5) of this Certificate, the package must be prepared for shipment and operated in accordance with the Operating Procedures of Chapter 7 of the SARP. The cask cavity must be backfilled with 1.0 atm helium when shipping SNL DBE and ANL FDMFP contents.
- (ii) Each package must meet the Acceptance Tests and Maintenance Program of Chapter 8 of the SARP.
- (iii) The package must be configured in accordance with NAC International Drawing 315-40-138, Rev. 3 for SNL DBE contents and Drawing 315-40-153, Rev. 0 for ANL FDMFP contents, and Drawing 315-40-160, Revision 0 for CEUSP material contents.
- (iv) Metallic O-ring seals must be replaced prior to each shipment.
- (v) Prior to each shipment of SNL DBE and ANL FDMFP contents, after loading, each cask containment seal must be tested to show no leakage greater than 2×10^{-7} std-cm³/s (helium). For each shipment of CEUSP material, the cask containment seals shall be pressure drop tested in accordance with Chapter 7 of the SARP.

(2) In addition to the marking requirements of 49 CFR Part 172, Subpart D, each cask must be durably and legibly marked on the outside of the cask with

- (i) The model number
- (ii) The DOE package identification number listed on page 1 of this certificate, and
- (iii) A serial number that uniquely identifies each cask which conforms to this certificate.

(3) All package activities authorized by this certificate must be performed in accordance with the packaging-specific quality assurance requirements of Chapter 10 of the SARP.

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- (4) This package may be transported only by a carrier who satisfies the requirements of 49 CFR Part 397 with regard to routing of a highway route controlled quantity of Class 7 (radioactive) materials and training for drivers who transport a highway route controlled quantity of Class 7 (radioactive) materials.
- (5) This package may be transported only as exclusive use.
- (6) A 6CVS containing sodium-bonded metal FDMFP with Bakelite [SARP Section 1.2.3.10] shall include the 15 day transport limit as a condition of package approval. The 15-day clock begins when the 6CVS is closed [SARP Section 7.1.14 Step 20] and ends when the consignment is accepted by the Receiver. When shipping a 6CVS containing sodium-bonded metal FDMFP with Bakelite, the shipper shall provide the receiver with the date and time the 6CVS was sealed. The shipper must verify that the shipment can be completed within the 15 day transport limit.
- (7) Revision 12 of this DOE Certificate of Compliance may be used until June 30, 2023.
- (8) This certificate authorizes use of CEUSP Canister Spacers, Serial Numbers -07 through -46 and Basket Assemblies 315-391-161-01, -02, and -03.
- (9) Only DOE or persons working under contract to DOE shall consign the package for shipment.
- (10) NRC or Agreement State licensees shall not consign a DOE certified package for shipment, but can transfer the material on-site to DOE or persons working under contract to DOE, for consignment of the package.

(e) Supplements:

- (1) *Request for Timely Renewal of Department of Energy (DOE), Certificate of Compliance (CoC) No. 9225 for the Model No. NAC- LWT Legal Weight Transport Cask System, ED20220093, June 8, 2022*

NAC-LWT CASK-BODY

