ORNL/TM-7179
Dist. Category UC-71

Contract No. W-7405-eng-26

OPERATIONS DIVISION

Radioisotope Department

OAK RIDGE NATIONAL LABORATORY
SHIPPING CONTAINERS FOR
RADIOACTIVE MATERIALS

R. W. Schaich

Date Published: May 1980

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OAK RIDGE NATIONAL LABORATORY
Oak Ridge, Tennessee 37830
operated by
UNION CARBIDE CORPORATION
for the
DEPARTMENT OF ENERGY

Printed in the United States of America. Available from
National Technical Information Service
U.S. Department of Commerce
5285 Port Royal Road, Springfield, Virginia 22161
NTIS price codes—Printed Copy: A10 Microfiche A01

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POST OFFICE BOX X
OAK RIDGE, TENNESSEE 37830

October 26, 1981

To: Distribution - ORNL/TM-7179 - Oak Ridge National Laboratory Shipping
Containers for Radioactive Materials

Attached are revisions to ORNL/TM-7179. Please make the following changes
to your copy of this report.

Section I.C

Add pages I.C.8a and I.C.8b

Replace pages I.C.15 and I.C.16

Section II.B

Replace pages II.B.3, II.B.4, II.B.5,
and II.B.6

Replace pages II.B.57 and II.B.58,
and add page II.B.58a

Replace pages II.B.91, II.B.92, and
II.B.93

Section III

Replace pages III.13, III.14, and
III.15

Replace Distribution Page

R W Schaich
R. W. Schaich
Process Group
Operations Division

RWS:drw

Attachments

released 12/16/81

ORNL-DWG 81-6269

Revised 9/1/81

ORNL Gas Container - Returnable Type A-Box

I.C.8a

I.C.8b

Revised 9/1/81

ORNL Gas Container - Type A

DOT-IAEA TYPE A
ORNL SHIPPING CONTAINERS

C. Radioactive Gases

5. Non-Shielded - Non-Returnable
(1000 cc)

Size: 2" O.D. x 25 1/2 " Long (Cylinder)

31 1/2" x 5 1/2" x 5 1/2" (Plywood box)

Inner Containment: Steel gas cylinder (1000 cc) with an "O" ring
sealed valve.

Outer Containment: Plywood box.

Weight: Cylinder - 3 lbs.

Cylinder and Plywood Box - 13 lbs.

Radioactive Materials: All Type A quantities of radioactive gases not
requiring lead shielding to meet DOT regulations on radiation
readings. All gas pressures are less than atmospheric.

ORNL Photo 5112-81

I.C.16

DOT Type A Shipping Package for Non-Returnable Tritium Gas Cylinder

Table 1. (Continued)

Element ¹	Radionuclide ³	Transport Group							Element ¹	Radionuclide ³	Transport Group						
		I	II	III	IV	V	VI	VII			I	II	III	IV	V	VI	VII
Europium (63)....	Eu-147.....	...	...	X	...	...	...	...	Iridium (77).....	Ir-190.....	...	...	...	X	...	...	...
	Eu-148.....	...	...	X	...	...	...	...		Ir-192.....	...	...	X	...	...	...	...
	Eu-149.....	...	...	X	...	...	...	...		Ir-194.....	...	...	...	X	...	...	...
	Eu-150.....	...	...	X	...	...	...	...	Iron (26).....	Fe-55.....	...	...	...	X	...	...	...
	Eu-152m.....	...	...	...	X	...	...	...		Fe-59.....	...	...	...	X	...	...	...
	Eu-152.....	...	...	X	...	...	...	...	Krypton (36).....	Kr-85m.....	...	...	X	...	...	...	...
	Eu-154.....	...	X	...	...	...	...	...		Kr-85m (uncompressed) ²	...	...	...	...	X	...	...
Fluorine (9).....	F-18.....	...	...	...	X	...	...	...		Kr-85.....	...	...	X	...	...	...	...
	Gadolinium (64)..	Gd-151.....	...	...	X	...	...	...		Kr-85 (uncompressed) ²	...	...	...	...	...	X	...
Gallium (31).....	Gd-153.....	...	...	...	X	...	...	...		Kr-87.....	...	X	...	...	...	...	...
	Gd-159.....	...	...	...	X	...	...	...		Kr-87 (uncompressed) ²	...	...	...	...	X	...	...
	Ga-67.....	...	...	X	...	...	...	...	Lanthanum (57)....	La-140.....	...	...	...	X	...	...	...
Germanium (32)...	Ga-72.....	...	...	...	X	...	...	...		Pb-203.....	...	...	...	X	...	...	...
	Ge-68.....	...	...	X	...	...	...	...	Lead (82).....	Pb-210.....	...	X	...	...	...	...	...
Gold (79).....	Ge-71.....	...	...	...	X	...	...	...		Pb-212.....	...	X	...	...	...	...	...
	Au-193.....	...	...	X	...	...	...	...	Lutetium (71).....	Lu-170.....	...	...	X	...	...	...	...
	Au-194.....	...	...	X	...	...	...	...		Lu-171.....	...	...	X	...	...	...	...
	Au-195.....	...	...	X	...	...	...	...		Lu-172.....	...	...	X	...	...	...	...
	Au-196.....	...	...	...	X	...	...	...		Lu-174.....	...	X	...	...	...	...	...
	Au-198.....	...	...	...	X	...	...	...		Lu-177.....	...	...	...	X	...	...	...
	Au-199.....	...	...	...	X	...	...	...	Magnesium (12)....	Mg-28.....	...	...	X	...	...	...	...
Hafnium (72).....	Hf-181.....	...	...	...	X	...	...	...		Mn-52.....	...	...	...	X	...	...	...
Holmium (67).....	Ho-166.....	...	...	...	X	...	...	...	Manganese (25)....	Mn-54.....	...	...	...	X	...	...	...
Hydrogen (1).....	H-3(see tritium)	...	...	...	...	...	...	...		Mn-56.....	...	...	...	X	...	...	...
Indium (49).....	In-113m.....	...	...	...	X	...	...	...	Mercury (80).....	Hg-197m.....	...	...	...	X	...	...	...
	In-114m.....	...	...	X	...	...	...	...		Hg-197.....	...	...	...	X	...	...	...
	In-115m.....	...	...	...	X	...	...	...		Hg-203.....	...	...	...	X	...	...	...
	In-115.....	...	...	...	X	...	...	...	Mixed Fission Products.....	MF-P.....	...	X	...	...	...	...	...
Iodine (53).....	I-123.....	...	...	X	...	...	...	...		Mo-93.....	...	X	...	...	...	...	...
	I-124.....	...	...	X	...	...	...	...	Molybdenum (42)...	Mo-99.....	...	...	...	X	...	...	...
	I-125.....	...	...	X	...	...	...	...		Nd-147.....	...	...	...	X	...	...	...
	I-126.....	...	...	X	...	...	...	...	Neodymium (60)....	Nd-149.....	...	...	...	X	...	...	...
	I-129.....	...	...	X	...	...	...	...		Np-237.....	X	...	...	...	...	...	...
	I-130.....	...	...	X	...	...	...	...	Neptunium (93)....	Np-239.....	X	...	...	...	...	...	...
	I-131.....	...	...	X	...	...	...	...									
	I-132.....	...	...	...	X	...	...	...									
	I-133.....	...	...	X	...	...	...	...									
	I-134.....	...	...	...	X	...	...	...									
	I-135.....	...	...	...	X	...	...	...									

Table 1. (Continued)

Element ¹	Radionuclide ³	Transport Group							Element ¹	Radionuclide ³	Transport Group						
		I	II	III	IV	V	VI	VII			I	II	III	IV	V	VI	VII
Nickel (28).....	Ni-56.....	...	...	X	...	...	...	...	Protactinium (91).	Pa-230.....	X	...	...	...	...	...	...
	Ni-57.....	...	...	X	...	...	...	...		Pa-231.....	X	...	...	...	...	...	...
	Ni-59.....	...	...	...	X	...	...	...		Pa-233.....	...	X	...	...	...	...	...
	Ni-63.....	...	...	...	X	...	...	...	Radium (88).....	Ra-223.....	...	X	...	...	...	...	...
	Ni-65.....	...	...	...	X	...	...	...		Ra-224.....	...	X	...	...	...	...	...
Niobium (41).....	Nb-91.....	...	...	X	...	...	...	...		Ra-226.....	X	...	...	...	...	...	...
	Nb-93m.....	...	...	...	X	...	...	...		Ra-228.....	X	...	...	...	...	...	...
	Nb-95.....	...	...	...	X	...	...	...	Radon (86).....	Rn-220.....	...	...	...	X	...	...	...
	Nb-97.....	...	...	...	X	...	...	...		Rn-222.....	...	X	...	...	...	...	...
Osmium (76).....	Os-185.....	...	...	...	X	...	...	...	Rhenium (75).....	Re-183.....	...	...	...	X	...	...	...
	Os-191m.....	...	...	...	X	...	...	...		Re-186.....	...	...	...	X	...	...	...
	Os-191.....	...	...	...	X	...	...	...		Re-187.....	...	...	...	X	...	...	...
	Os-193.....	...	...	...	X	...	...	...		Re-188.....	...	...	...	X	...	...	...
Palladium (46)...	Pd-103.....	...	...	...	X	...	...	...	Rhodium (45).....	Re Natural.....	...	...	...	X	...	...	...
	Pd-109.....	...	...	...	X	...	...	...		Rh-99.....	...	...	X	...	...	...	...
Phosphorus (15)..	P-32.....	...	...	...	X	...	...	...		Rh-102.....	...	...	X	...	...	...	...
	P-33.....	...	...	...	X	...	...	...		Rh-103m.....	...	...	...	X	...	...	...
Platinum (78)....	Pt-191.....	...	...	...	X	...	...	...	Rubidium (37).....	Rh-105.....	...	...	...	X	...	...	...
	Pt-193.....	...	...	...	X	...	...	...		Rb-84.....	...	...	X	...	...	...	...
	Pt-193m.....	...	...	...	X	...	...	...		Rb-86.....	...	...	...	X	...	...	...
	Pt-195m.....	...	...	...	X	...	...	...		Rb-87.....	...	...	...	X	...	...	...
	Pt-197m.....	...	...	...	X	...	...	...	Ruthenium (44)....	Rb Natural.....	...	...	...	X	...	...	...
	Pt-197.....	...	...	...	X	...	...	...		Ru-97.....	...	...	...	X	...	...	...
Plutonium (94)...	Pu-238 ⁴	X	...	...	...	...	...	...		Ru-103.....	...	...	...	X	...	...	...
	Pu-239 ⁴	X	...	...	...	...	...	...		Ru-105.....	...	...	...	X	...	...	...
	Pu-240.....	X	...	...	...	...	...	...	Samarium (62).....	Ru-106.....	...	...	X	...	...	...	...
	Pu-241 ⁴	X	...	...	...	...	...	...		Sm-145.....	...	...	X	...	...	...	...
	Pu-242.....	X	...	...	...	...	...	...		Sm-147.....	...	...	X	...	...	...	...
Polonium (84)....	Po-210.....	X	...	...	...	...	...	...		Sm-151.....	...	...	...	X	...	...	...
Potassium (19)...	K-42.....	...	...	...	X	...	...	...	Scandium (21).....	Sm-153.....	...	...	...	X	...	...	...
	K-43.....	...	...	X	...	...	...	...		Sc-44m.....	...	...	X	...	...	...	...
Praseodymium (59)	Pr-142.....	...	...	...	X	...	...	...		Sc-46.....	...	...	X	...	...	...	...
	Pr-143.....	...	...	...	X	...	...	...		Sc-47.....	...	...	...	X	...	...	...
Promethium (61)..	Pm-143.....	...	...	X	...	...	...	...	Selenium (34).....	Sc-48.....	...	...	...	X	...	...	...
	Pm-144.....	...	...	X	...	...	...	...		Se-75.....	...	...	...	X	...	...	...
	Pm-145.....	...	X	...	...	...	...	...	Silicon (14).....	Si-31.....	...	...	...	X	...	...	...
	Pm-146.....	...	X	...	...	...	...	...		Ag-105.....	...	...	...	X	...	...	...
	Pm-147.....	...	...	...	X	...	...	...		Ag-110m.....	...	...	X	...	...	...	...
	Pm-149.....	...	...	...	X	...	...	...		Ag-111.....	...	...	...	X	...	...	...

Table 1. (Continued)

Element ¹	Radionuclide ³	Transport Group							Element ¹	Radionuclide ³	Transport Group						
		I	II	III	IV	V	VI	VII			I	II	III	IV	V	VI	VII
Sodium (11).....	Na-22.....	...	...	X	...	...	...	...	Thorium (90).....	Th-227.....	...	X	...	...	...	...	...
	Na-24.....	...	...	...	X	...	...	...		Th-228.....	X	...	...	...	...	...	...
Strontium (38)...	Sr-85m.....	...	...	...	X	...	...	...		Th-230.....	X	...	...	...	...	...	...
	Sr-85.....	...	...	...	X	...	...	...		Th-231.....	X	...	...	...	...	...	...
	Sr-89.....	...	...	X	...	...	...	...		Th-232.....	...	...	X	...	...	...	...
	Sr-90.....	...	X	...	...	...	...	...		Th-234.....	...	X	...	...	...	...	...
	Sr-91.....	...	...	X	...	...	...	...		Th Natural.....	...	...	X	...	...	...	...
	Sr-92.....	...	...	...	X	...	...	...	Thulium (69).....	Tm-165.....	...	...	X	...	...	...	...
Sulphur (16).....	S-35.....	...	...	...	X	...	...	...		Tm-167.....	...	...	X	...	...	...	...
Tantalum (73)...	Ta-179.....	...	...	X	...	...	...	...		Tm-168.....	...	...	X	...	...	...	...
	Ta-182.....	...	...	X	...	...	...	...		Tm-170.....	...	...	X	...	...	...	...
Technetium (43)..	Tc-95.....	...	...	X	...	...	...	...		Tm-171.....	...	...	...	X	...	...	...
	Tc-96m.....	...	...	...	X	...	...	...	Tin (50).....	Sn-113.....	...	...	...	X	...	...	...
	Tc-96.....	...	...	...	X	...	...	...		Sn-117m.....	...	...	X	...	...	...	...
	Tc-97m.....	...	...	...	X	...	...	...		Sn-121.....	...	...	X	...	...	...	...
	Tc-97.....	...	...	...	X	...	...	...		Sn-125.....	...	...	...	X	...	...	...
	Tc-99m.....	...	...	...	X	...	...	...	Tritium (1).....	H-3.....	...	...	...	X	...	...	...
	Tc-99.....	...	...	...	X	...	...	...		H-3 (as a gas, as luminous paint, or absorbed on solid material).	...	...	...	...	...	...	X
Tellurium (52)...	Te-121.....	...	...	X	...	...	...	...			...	...	...	...	...	...	...
	Te-123.....	...	...	X	...	...	...	...	Tungsten (74).....	W-181.....	...	...	...	X	...	...	...
	Te-125m.....	...	...	...	X	...	...	...		W-185.....	...	...	...	X	...	...	...
	Te-127m.....	...	...	...	X	...	...	...		W-187.....	...	...	...	X	...	...	...
	Te-127.....	...	...	...	X	...	...	...			...	...	...	...	...	...	...
	Te-129m.....	...	...	X	...	...	...	...	Uranium (92).....	U-230.....	...	X	...	...	...	...	...
	Te-129.....	...	...	...	X	...	...	...		U-232.....	...	X	...	...	...	...	...
	Te-131m.....	...	...	X	...	...	...	...		U-233 ⁴	...	X	...	...	...	...	...
	Te-132.....	...	...	...	X	...	...	...		U-234.....	...	X	...	...	...	...	...
Terbium (65).....	Tb-160.....	...	...	X	...	...	...	...		U-235 ⁴	...	...	X	...	...	...	...
Thallium (81)...	Tl-200.....	...	...	...	X	...	...	...		U-236.....	...	X	...	...	...	...	...
	Tl-201.....	...	...	...	X	...	...	...		U-237.....	X	...	...	...	...	...	...
	Tl-202.....	...	...	...	X	...	...	...		U-238.....	...	...	X	...	...	...	...
	Tl-204.....	...	...	X	...	...	...	...		U Natural.....	...	...	X	...	...	...	...
		...	...	...	...	...	...	...		U Enriched ⁴	...	...	X	...	...	...	...
		...	...	...	...	...	...	...		U Depleted.....	...	...	X	...	...	...	...

Table 1. (Continued)

Element ¹	Radionuclide ³	Transport Group							Element ¹	Radionuclide ³	Transport Group						
		I	II	III	IV	V	VI	VII			I	II	III	IV	V	VI	VII
Vanadium (23)....	V-48.....	...	...	...	X	...	...	...	Ytterbium (70)....	Yb-175.....	...	...	...	X	...	...	...
	V-49.....	...	...	X	...	...	...	...		Y-86.....	...	...	X	...	...	...	...
Xenon (54).....	Xe-125.....	...	...	X	...	...	...	...	Yttrium (39).....	Y-87.....	...	...	X	...	...	...	...
	Xe-131m.....	...	...	X	...	...	...	...		Y-88.....	...	...	X	...	...	...	...
	Xe-131m	...	...	...	...	...	...	...		Y-90.....	...	...	...	X	...	...	...
	(uncompressed) ² .	...	...	...	...	X	...	...		Y-91m.....	...	...	X	...	...	...	...
	Xe-133.....	...	...	X	...	...	...	...		Y-91.....	...	...	X	...	...	...	...
	Xe-133	...	...	...	...	...	...	...		Y-92.....	...	...	...	X	...	...	...
	(uncompressed) ² .	...	...	...	...	...	X	...		Y-93.....	...	...	...	X	...	...	...
	Xe-135.....	...	X	...	...	...	...	...	Zinc (30).....	Zn-65.....	...	...	...	X	...	...	...
	Xe-135	...	...	...	...	...	...	...		Zn-69m.....	...	...	...	X	...	...	...
	(uncompressed) ² .	...	...	...	...	X	...	...		Zn-69.....	...	...	...	X	...	...	...
									Zirconium (40)....	Zr-88.....	...	...	X	...	...	...	...
										Zr-93.....	...	...	...	X	...	...	...
										Zr-95.....	...	...	X	...	...	...	...
										Zr-97.....	...	...	...	X	...	...	...

¹Atomic number shown in parentheses.²Uncompressed means at a pressure not exceeding 14.7 p.s.i. (absolute).³Atomic weight shown after the radionuclide symbol.⁴Fissile radioactive material.

I.A.1

DOT-IAEA TYPE A
ORNL SHIPPING CONTAINERS

A. Radioactive Liquids and Solids

1. Non-Shielded - Non-Returnable

Size: 8" x 8" x 8" or 12" x 12" x 12"

Inner Containment: Duraglass bottle or Special Form capsule in a schedule 40 steel pipe nipple. Glass bottle volume varies from 15 cc to 200 cc.

Outer Containment: DOT SPEC 2N tin can in cardboard (12B) box with protective cardboard inserts.

Weight: 3 lbs.

Radioactive Materials: All Type A quantities of radioactive liquids or solids requiring minimal shielding (liquids in Duraglass bottles only).

ORNL Non-Returnable Type A Package

ORNL-DWG 76-6220R

DISPOSABLE CONTAINER FOR RADIOACTIVE LIQUID AND SOLID SHIPMENTS
LIMITED TO DOT TYPE A QUANTITIES

I.A.4

Blank

I.A.5

DOT-IAEA TYPE A
ORNL SHIPPING CONTAINERS

A. Radioactive Liquids and Solids

2. Shielded - Non-Returnable

Size: 8" x 8" x 8"

Innter Containment: Duraglass bottle (15-200 cc size) or Special Form capsule wrapped in absorbent material and sealed in lead shields (0.5 or 1.0 inches thick).

Outer Containment: DOT SPEC 2N tin can in cardboard (12B) box with protective cardboard inserts.

Weight: 0.5 in. lead shielding - 22 lbs.

1.0 in. lead shielding - 33 lbs.

Radioactive Materials: All Type A quantities of radioactive liquids or solids requiring lead shielding to meet DOT radiation requirements (liquids in Duraglass bottles only).

ORNL Non-Returnable Type A Package
(8 in. by 8 in. by 8 in.)

ORNL-DWG 74-9293R

DISPOSABLE CONTAINER FOR RADIOACTIVE
LIQUID AND SOLID SHIPMENTS

Limited to DOT Type A Quantities

I.A.8

DOT-IAEA Type A
ORNL SHIPPING CONTAINERS

A. Radioactive Liquids and Solids

3. Shielded - Returnable Outer Container

Size: 15" x 15" x 15"

Inner Containment: Duraglass bottle (15-50 cc size) or Special Form capsule wrapped in absorbent material and sealed in lead shields (0.5 to 1.2 inches thick).

Outer Containment: DOT SPEC 2N tin can in cardboard (12B) box with protective cardboard inserts. Cardboard box is placed in a fiberglass aluminum reinforced case.

Weight: 0.5 in. lead shield - 40 lbs.

1.0 in. lead shielding - 48 lbs.

1.2 in. lead shielding - 51 lbs.

Radioactive Materials: All Type A quantities of radioactive liquids or solids requiring lead shielding to meet DOT radiation requirements (liquids in Duraglass bottles only).

DOT IAEA Type A Shielded - Returnable Outer Container
(15 in. by 15 in. by 15 in.)

Revised 3/1/81

DOT-IAEA Type A Returnable Container

Revised 3/1/81

DOT-IAEA TYPE A
ORNL SHIPPING CONTAINERS

A. Radioactive Liquids and Solids

4. Shielded - Returnable

Size: 17.5" x 17.5" x 16.5" - 2.0 in. lead

21.5" x 21.5" x 16.5" - 2.5 and 3.0 in. lead

Inner Containment: Duraglass bottle (15-100 cc) or Special Form capsule
in an "O" ring sealed stainless steel container.

Outer Containment: Stainless steel clad lead container with "O" ring
seal under bolted lid.

Weight: 2.0 in. lead - 136 lbs.

2.5 in. lead - 198 lbs.

3.0 in. lead - 212 lbs.

Radioactive Materials: All Type A quantities of radioactive liquids or
solids requiring lead shielding to meet DOT regulations on radiation
readings (liquids in Duraglass bottles only).

ORNL Returnable Type A Container

NOTES:

- (a) RETURNABLE SHIPPING CONTAINERS ARE IN THREE SIZES: 12 in. x 12 in., 17 in. x 17 in., 21 in. x 21 in.
- (b) THICKNESS OF LEAD SHIELDING VARIES FROM $1\frac{1}{2}$ in. TO 3 in.
- (c) VOLUME SIZE OF SHIPMENT FROM 15 ml TO 200 ml

ORNL RETURNABLE SHIELDED SHIPPING
CONTAINER; USA DOT-7A TYPE A

I.B.1

DOT-IAEA TYPE A
ORNL SHIPPING CONTAINERS

B. Radioactive Solids Only

1. Cyclotron Target - 1" Lead

Size: 12 3/8" x 12 1/2" x 6"

Inner Containment: Metallic target.

Outer Containment: Stainless steel clad lead container with neoprene gasket under shield cover.

Weight: 129 lbs.

Radioactive Materials: All Type A quantities produced on a cyclotron target.

TYPE A ORNL RETURNABLE CYCLOTRON TARGET SHIPPING PACKAGE
1-in. LEAD SHIELDING, WEIGHT-129 lbs

ORNL Cyclotron Target Type A Container

I.B.5

DOT-IAEA TYPE A
ORNL SHIPPING CONTAINERS

B. Radioactive Solids Only

2. Cyclotron Target - 2" Lead

Size: 13 1/2" x 13 1/2" x 7 7/8"

Inner Containment: Metallic target.

Outer Containment: Stainless steel clad lead container with neoprene gasket under shield cover.

Weight: 285 lbs.

Radioactive Materials: All Type A quantities produced on a cyclotron target.

ORNL-DWG 76-10835R

TYPE A ORNL RETURNABLE CYCLOTRON TARGET SHIPPING PACKAGE
2-in. LEAD SHIELDING, WEIGHT-285 lbs

DOT-IAEA TYPE A
ORNL SHIPPING CONTAINERS

B. Radioactive Solids Only

3. Cyclotron Target - 4" Lead

Size: 15 5/8" x 18 1/4" x 12"

Inner Containment: Metallic target.

Outer Containment: Stainless steel clad lead container with neoprene gasket under shield cover.

Weight: 400 lbs.

Radioactive Materials: All Type A quantities produced on a cyclotron target.

ORNL Photo 6386-76

ORNL Cyclotron Target Type A Container

ORNL-DWG 76-12825R2

ORNL RETURNABLE CYCLOTRON TARGET SHIPPING PACKAGE
4-in. LEAD SHIELDING, WEIGHT-800 lbs

DOT-IAEA TYPE A
ORNL SHIPPING CONTAINERS

B. Radioactive Solids Only

4. TRU Neutron Shipping Container

Size: 44" O.D. x 48" high

Inner Containment: Special Form capsules.

Outer Containment: Steel container with water extended polyester
filling.

Weight: 3700 lbs.

Radioactive Materials: All Type A quantities of radioactive solids
requiring neutron shielding to meet DOT radiation requirements.

TRU Neutron Shipping Container - Type A

TRU NUCLEAR SHIPPING CONTAINER (TYPE A)

(ATKINSON STEEL CO., SERIAL No. 241)

Gross wt. 3700 lbs

DOT-IAEA TYPE A
ORNL SHIPPING CONTAINERS

C. Radioactive Gases

1. Shielded - Non-Returnable

Size: 8" x 8" x 8" or 12" x 12" x 12"

Inner Containment: Glass ampule in a sealed lead shield which is placed in a schedule 40 steel pipe nipple. Absorbent material is wrapped around steel pipe for cushioning. Ampule volume is normally 5 cc.

Outer Containment: DOT SPEC 2N tin can in cardboard (12B) box with protective cardboard inserts.

Weight: 4 lbs.

Radioactive Materials: All Type A quantities of radioactive gases requiring minimal shielding. All gas pressures are less than atmospheric.

ORNL Non-Returnable Type A Package
(8 in. by 8 in. by 8 in.)

DISPOSABLE CONTAINER FOR RADIOACTIVE GAS SHIPMENTS

I. C. 4

Blank

DOT-IAEA TYPE A
ORNL SHIPPING CONTAINERS

C. Radioactive Gases

2. Shielded and Non-Shielded - Returnable Cylinders
(10 cc)

Size: 3 1/2" O.D. x 7 5/16" long

Inner Containment: Stainless steel cylinder (10 cc volume) with a bellows sealed valve.

Outer Containment: Stainless steel cylinder with "O" ring seal under valve cap. Lead shielded between inner and outer containment for gases requiring shielding.

Weight: Without lead - 6 lbs.

With lead - 9 lbs.

Radioactive Materials: All Type A quantities of radioactive gases such as tritium, xenon-133, and krypton-85. Lead shielding is used on xenon-133 and krypton-85 to meet DOT regulations on radiation readings. All gas pressures are less than atmospheric.

ORNL RETURNABLE GAS CYLINDER — USA DOT 7A TYPE A
10cc ISOTOPE CONTAINER

DOT-IAEA TYPE A
ORNL SHIPPING CONTAINERS

C. Radioactive Gases

3. Shielded and Non-Shielded - Returnable Cylinders
(50, 150, 300, 500 cc)

Size: See ORNL Dwg. 77-19134R

Inner Containment: Stainless steel cylinder (50-500 cc volume) with a bellows sealed valve.

Outer Containment: Stainless steel cylinder with "O" ring seal under valve cap. Lead shielded between inner and outer containment for gases requiring shielding.

Weight: See ORNL Dwg. 77-19134R

Radioactive Materials: All Type A quantities of radioactive gases such as tritium, xenon-133, and krypton-85. Lead shielding is used on xenon-133 and krypton-85 to meet DOT regulations on radiation readings. All gas pressures are less than atmospheric.

ORNL Gas Container - Type A

ORNL Gas Container - Type A

ORNL-DWG 77-19134R

CONTAINER NUMBER	VOLUME (milliliters)	WEIGHT (pounds)	LENGTH (in.)	DIAMETER (in.)
HOH-50	50	9	12 5/16	3 1/2
HOXe-50	50	15	12 5/16	3 1/2
HOKr-50	50	15	12 5/16	3 1/2
HOH-150	150	11	15 3/16	3 1/2
HOXe-150	150	35	15 3/16	3 1/2
HOKr-150	150	35	15 3/16	3 1/2
HOH-300	300	12	16 1/16	3 1/2
HOKr-300	300	36	16 1/16	3 1/2
HOH-500	500	15	21 7/16	3 1/2
HOKr-500	500	50	21 7/16	3 1/2

ORNL RETURNABLE GAS CYLINDER—USA DOT 7A TYPE A

DOT-IAEA TYPE A
ORNL SHIPPING CONTAINERS

C. Radioactive Gases

4. Shielded and Non-Shielded - Returnable Cylinders
(1000 cc)

Size: See ORNL Dwg. 75-16651R

Inner Containment: Stainless steel cylinder (1000 cc volume) with a bellows sealed valve.

Outer Containment: Stainless steel cylinder with "O" ring seal under valve cap. Lead shielded between inner and outer containment for gases requiring shielding. Gas cylinder placed in 20WC fire and impact shield for transport.

Weight: See ORNL Dwg. 75-16651R

Radioactive Materials: All Type A quantities of radioactive gases such as tritium, xenon-133 and krypton-85. Lead shielding is used on xenon-133 and krypton-85 to meet DOT regulations on radiation readings. All gas pressures are less than atmospheric.

I.C.12

ORNL Photo 0174-81

ORNL Gas Package - Type A

Revised 3/1/81

ORNL-DWG 75-16651R

CONTAINER NUMBER	VOLUME (milliliters)	WEIGHT (pounds)	LENGTH (in.)	DIAM (in.)
HOH-1000	1000	35	16 ⁵ / ₈	6 ⁵ / ₈
HOKr-1000	1000	112	16 ⁵ / ₈	6 ⁵ / ₈
HOH-2000	2000	50	23 ¹ / ₂	6 ⁵ / ₈
HOKr-2000	2000	168	23 ¹ / ₂	6 ⁵ / ₈
HOH-5000	5000	76	28 ¹ / ₈	8
HOKr-5000	5000	275	28 ¹ / ₈	8

ORNL RETURNABLE GAS CYLINDER;
USA DOT 7A TYPE A

I.C.13

DOT-IAEA TYPE A
ORNL SHIPPING CONTAINERS

C. Radioactive Gases

5. Non-Shielded - Non-Returnable
(1000 cc)

Size: 2" O.D. x 25 1/2 " Long (Cylinder)

31 1/2" x 5 1/2" x 5 1/2" (Plywood box)

Inner Containment: Steel gas cylinder (1000 cc) with an "O" ring
sealed valve.

Outer Containment: Plywood box.

Weight: Cylinder - 3 lbs.

Cylinder and Plywood Box - 13 lbs.

Radioactive Materials: All Type A quantities of radioactive gases not
requiring lead shielding to meet DOT regulations on radiation
readings. All gas pressures are less than atmospheric.

I.C.16

DOT Type A Shipping Package for Non-Returnable Tritium Gas Cylinder

ORNL-DWG 76-13674R

NON-RETURNABLE TRITIUM GAS CYLINDER SHIPPING PACKAGE

DOT-IAEA TYPE A
ORNL SHIPPING CONTAINERS

C. Radioactive Gases

6. Shielded Cylinder - Impact Shield

Size: 24 1/8" O.D. x 41 7/8" in height

Inner Containment: Stainless steel cylinders (2000 cc and 5000 cc volume) with bellows sealed valve.

Outer Containment: Stainless steel cylinder with "O" ring seal under valve cap. Lead shielding between inner and outer cylinders.

Cylinder placed in gas cylinder impact shield (see ORNL Dwg. 74-8422).

Weight: 2000 cc cylinder - 168 lbs.

5000 cc cylinder - 276 lbs.

Impact shield - 320 lbs.

Radioactive Materials: All Type A quantities of gases requiring lead shielding to meet DOT regulations on radiation readings.

Revised 3/1/81

ORNL Gas Package - Type B

ALL DIMENSIONS GIVEN IN INCHES

TYPE B
ORNL GAS CYLINDER FIRE SHIELD
WEIGHT-320 lbs

II. ORNL TYPE B PACKAGES

Oak Ridge National Laboratory (ORNL) shipping containers for radioactive materials which meet the requirements of the Code of Federal Regulations (CFR) No. 49 (Transportation) and the International Atomic Energy Agency (IAEA) Safety Series No. 6 (1973) for Type B packaging are divided into two categories.

- A. Radioactive Gases
- B. Radioactive Solids

The quantities of radioactive material that are approved for shipment by the CFR-49 (Transportation, Part 173.389e) in a Type B package are listed below.

Transport group	Type B quantity
I.....	20
II.....	20
III.....	200
IV.....	200
V.....	5,000
VI and VII.....	50,000
Special form.....	5,000

Large quantities of specific radionuclides can be shipped in packages approved by the Department of Energy (DOE) and the Nuclear Regulatory Commission (NRC). A Certificate of Compliance is issued by the NRC for each package and states the limits for radioactive materials than can be shipped as large quantity.

An IAEA Certificate of Competent Authority is required for all Type B shipments to foreign countries.

The transport group for each radionuclide can be determined from Table I.

II.A.1

A. RADIOACTIVE GASES

GAS CYLINDER FIRE AND IMPACT SHIELD

(2000, 5000, 16000 cc)

ORNL Gas Package - Type B

II.A.3

DOE Form EV-418
(11-77)
10 CFR 71U.S. DEPARTMENT OF ENERGY
CERTIFICATE OF COMPLIANCE
For Radioactive Materials Packages

1a. Certificate Number 5552	1b. Revision No. 3	1c. Package Identification No. USA/5552/B (DOE-OR)	1d. Page No. 1	1e. Total No. Pages. 2
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2. PREAMBLE

2a. This certificate is issued to satisfy Sections 173.393a, 173.394, 173.395, and 173.396 of the Department of Transportation Hazardous Materials Regulations (49 CFR 170-189).

2b. The packaging and contents described in item 5 below, meets the safety standards set forth in Subpart C of Title 10, Code of Federal Regulations, Part 71, "Packaging of Radioactive Material for Transport and Transportation of Radioactive Material Under Certain Conditions."

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): Oak Ridge National Laboratory Post Office Box X Oak Ridge, Tennessee 37830	(2) Title and Identification of report or application: Safety Analysis Report for Packaging for the ORNL Gas Cylinder Fire and Impact Shield. Report No.: ORNL/ENG/TM-5	(3) Date: October 1977
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4. CONDITIONS
This certificate is conditional upon the fulfilling of the requirements of Subpart D of 10 CFR 71, as applicable, and the conditions specified in item 5 below.

5. Description of Packaging and Authorized Contents, Model Number, Fissile Class, Other Conditions, and References:

a. Packaging:

(1) Model: Gas Cylinder Fire Impact Shield.

(2) Description:

Packaging for Type B quantities of radioactive gases - Noble gases or tritium.

The inner containment vessels consist of the following Hoke cylinders:

Hoke Cat. No.	Capacity - Volume (l)	Tare Wt. - (lb)
1467 - 2,000	2	50
1467 - 5,000	5	76
1467 -16,000	16	106

and other vessels of equivalent construction with capacities of 16 liters or less. The gas cylinders are supported by padded inserts to prevent lateral or vertical motion within the inner 12 in. diameter x 30-5/8 in. high, 16 gauge steel vessel. The 1/4 inch thick gasketed lid is held in

6a. Date of Issuance: June 28, 1978	6b. Expiration Date:
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FOR THE U.S. DEPARTMENT OF ENERGY

7a. Address (of DOE Issuing Office) U. S. Department of Energy Post Office Box e Oak Ridge, Tennessee 37830	7b. Signature, Name, and Title (of DOE Approving Official) H. N. Culver for William H. Travis, Director Safety & Environmental Control Division
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II.A.4

Page 2 - Certificate No. 5552 - Revision 2

12-3/8 in. diameter bolts. Lead, as required, will be positioned inside the inner vessel.

The outer shell consists of a 16 gauge steel, 80 gallon drum with a one-eighth in. thick removable head. The outer drum is two ft. diameter x 41-1/8 in. high. Sealed vent holes are provided in the two types of outer drums. Two types of outer drums are utilized:

- (i) The outer drum is mild steel. It utilizes a 12-gauge closure ring with a 3/8 inch diameter bolt and lock nut, or
- (ii) The outer drum is 304L stainless steel. Its lid is held in place by 8-3/8 inch diameter bolts and nuts and equipped with lock washers.

The space between the inner vessel and outer drum is filled with a high temperature phenolic foam containing glass fibers meeting DOE Specification SP-9. The maximum gross weight of the package is 750 pounds and includes lead shielding.

(3) Drawings

The packagings are as described and fabricated in accordance with Oak Ridge National Laboratory Drawing No. M-11514-EM-001-E.

b. Contents:

(1) Type and Form of Material

Non-fissile radioactive noble gases and tritium.

(2) Maximum quantity of gases not to exceed Type B quantities of radioactive material consisting of:

Not more than 30,000 Ci of tritium or any noble gases and,

(3) Maximum pressures of gases not to exceed:

(i) Four-fifths atm (11.8 psia) for tritium.

(ii) Five psi (19.7 psia) for other noble gases.

(4) Maximum decay heat load not to exceed five watts.

A. RADIOACTIVE GASES

SRO-LP 50 FIRE AND IMPACT SHIELD

(50,000 cc)

SRO Tritium Shipping Container - Type B

II.A.7

ORNL DWG 74-8422

SRO Gas Package - Type B

NOTE: * SERIAL NUMBER AS SPECIFIED
ON PURCHASE ORDER

FLAT-TYPE ARRANGEMENT

FIRE AND IMPACT SHIELD FOR
LP-50 GAS CYLINDER

ORNL-DWG 78-6200

NOTE: * SERIAL NUMBER AS SPECIFIED
ON PURCHASE ORDER

DOME-TYPE ARRANGEMENT

FIRE AND IMPACT SHIELD FOR
LP-50 GAS CYLINDER

Appendix A

Form NRC-518 (12-73) 10 CFR 71		U.S. NUCLEAR REGULATORY COMMISSION CERTIFICATE OF COMPLIANCE For Radioactive Materials Packages		
1.(a) Certificate Number 6678	1.(b) Revision No. 0	1.(c) Package Identification No. USA/6678/B	1.(d) Pages No. 1	1.(e) Total No. Pages 2
2. PREAMBLE				
<p>2.(a) This certificate is issued to satisfy Sections 173.393a, 173.394, 173.395, and 173.396 of the Department of Transportation Hazardous Materials Regulations (49 CFR 170-189 and 14 CFR 103) and Sections 146-19-10a and 146-19-100 of the Department of Transportation Dangerous Cargoes Regulations (46 CFR 146-149), as amended.</p> <p>2.(b) The packaging and contents described in item 5 below, meets the safety standards set forth in Subpart C of Title 10, Code of Federal Regulations, Part 71, "Packaging of Radioactive Materials for Transport and Transportation of Radioactive Material Under Certain Conditions."</p> <p>2.(c) 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.</p>				
3. This certificate is issued on the basis of a safety analysis report of the package design or application-				
3.(a) Prepared by (Name and address): E.I. du Pont de Nemours & Company Savannah River Plant Aiken, South Carolina 29801		3.(b) Title and identification of report or application: E.I. du Pont de Nemours & Company Report No. DPSPU-74-124-5, April 1975.		
		3.(c) Docket No. 71-6678		
4. CONDITIONS This certificate is conditional upon the fulfilling of the requirements of Subpart D of 10 CFR 71, as applicable, and the conditions specified in item 5 below.				
5. Description of Packaging and Authorized Contents, Model Number, Fissile Class, Other Conditions, and References:				
(a) Packaging				
(1) Model No: LP-50				
(2) Description				
<p>Packaging for large quantities of tritium. The containment vessel is a nominal 50 liter 304L stainless steel vessel fitted with stainless steel vacuum valve assembly. The containment vessel is 13-5/8-inch O.D. by 25 inches high with 0.078 inch wall thickness. The containment vessel is held within a closed aluminum bucket with a 14 inch O.D., 30 inches high and minimum 15/64 inch walls. The aluminum bucket is centered and supported within a 16-gage, 23-1/2 inch O.D. by 40 inch steel drum using celotex insulation. The drum is closed using a bolted locking ring. The package gross weight is 260 pounds.</p>				
(3) Drawings				
<p>The packaging is fabricated in accordance with DuPont Drawings Nos.: S5-2-5733, Rev. 7; S5-2-5734, Rev. 9; S5-2-5735, Rev. 1; S4-2-596, Rev. 0, S5-2-186, Rev. 46; S5-2-187, Rev. 22; and S5-2-147, Rev. 13; and Figure 4 of DuPont Report No. DPSPU-74-124-5, April 1975.</p>				

II.A.11

Page 2 - Certificate No. 6678 - Revision No. 0 - Docket No. 71-6678

(b) Contents

(1) Type and form of material

Tritium in mixture with other gases.

(2) Maximum quantity of material per package

Not more than 75,300 cm³ of tritium at STP (1 atm, 25°C), and a maximum activity of 193,500 Curies.

6. The maximum internal fill pressure in the primary containment vessel shall not exceed 24.2 psia at 25°C (77°F).

7

Acceptance, maintenance and use of the package shall be in accordance with the procedures and requirements of Chapters 6 and 7 of DuPont Report No. DPSPU-74-124-5, April 1975.

8. The leak test described in paragraph 7.1.3 of DuPont Report No. DPSPU-124-5, April 1975 shall be repeated after the third use of each packaging. In addition, a primary containment vessel before use of a packaging for shipment, shall have been tested in accordance with the above leak test (paragraph 7.1.3, DPSPU-124-5) within the preceeding 12 month period.

8. Expiration date: October 31, 1982.

Reference

E.I. duPont de Nemours and Company Report No. DPSPU-124-5, April 1975.

FOR THE U.S. NUCLEAR REGULATORY COMMISSION

Charles E. MacDonald, Chief
Transportation Branch
Division Fuel Cycle and
Material Safety

Date: SEP 29 1977

II.A.13

A. RADIOACTIVE GASES

KRYPTON-85 SHIPPING CONTAINER

Figure 1 Krypton Shipping Container

Form AEC-418
(12-73)
10 CFR 71
AECM 5701

U.S. ATOMIC ENERGY COMMISSION
CERTIFICATE OF COMPLIANCE
For Radioactive Materials Packages

1a. Certificate Number USA/5958/BL(ERDA-ID)	1b. Revision No. Original	1c. Package Identification No. USA/5958/BL(ERDA-ID)	1d. Page No. 1	1e. Total No. Pa. 5
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2. PREAMBLE

- 2a. This certificate is issued to satisfy Sections 173.303a, 173.304, 173.305, and 173.306 of the Department of Transportation Hazardous Materials Regulations (49 CFR 170-189 and 14 CFR 103) and Sections 146-19-10a and 146-19-10b of the Department of Transportation Dangerous Cargoes Regulations (46 CFR 146-149), as amended.
- 2b. The packaging and contents described in item 5 below, meets the safety standards set forth in Subpart C of Title 10, Code of Federal Regulations, Part 71, "Packaging of Radioactive Material for Transport and Transportation of Radioactive Material Under Certain Conditions."
- 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):

Allied Chemical Corporation
550 Second Street
Idaho Falls, Idaho 83401

(2) Title and Identification of report or application:

Report ICP-1077, Safety Analysis
Report for Packaging - Krypton Shipping
Container - USA/5958/BL(ERDA-ID), by C. W. Nielsen

(3) Date:

June 1975

4. CONDITIONS

This certificate is conditional upon the fulfilling of the requirements of Subpart D of 10 CFR 71, as applicable, and the conditions specified in item 5 below.

5. Description of Packaging and Authorized Contents, Model Number, Fissile Class, Other Conditions, and References:

5.a. Description of Packaging (Common name - Krypton Shipping Container)(1) Outer Packaging

- (a) End-loading cylindrical thermal shield consisting of concentric inner and outer steel walls (16 gage each) 6" apart, filled with high-temperature resistant (to 2,200°F) phenolic foam plastic and longitudinal oak stringers at 90° intervals.
- (b) Closed by 1/2" steel plate bolted to flanged inner steel wall with six 1/2" bolts. Outer cover (phenolic foam filled to 5-3/8") attached with six 3/4" bolts torqued to 30 ft. lbs.
- (c) Exterior dimensions: Thermal shield 83-1/2" long, 30" diameter, with metal framework (2" schedule 40 pipe) which measures 69-3/4" long and 30-1/4" wide. Framework used for lifting and tie-down purposes.
- (d) Metal identification plate with container nomenclature, serial number, quantity of radioactivity, and name and address of owner.

(2) Inner Packaging(a) Radiation Shield Container

1. End-loading cylindrical steel-encased (1/4") lead (2" thick) shield with 3 steel-encased plugs for loading, valve access, and access to gas cylinder retaining steel band.
2. Closure by retention of end shielding plug with clamp (11" x 4-1/2") held in place by two 5/8" set screws. Shield cask cap (3/4" thick) measuring 14" diameter is held in place by "V" ring (clamped with

6a. Date of Issuance: AUG 4 1975

6b. Expiration Date: None

FOR THE U.S. ATOMIC ENERGY COMMISSION

7a. Address (of AEC Issuing Office)
U.S. Energy Research & Development Administration
Idaho Operations Office
550 Second Street
Idaho Falls, Idaho 83401

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

R. Glenn Bradley
R. Glenn Bradley, Manager

two 5/16" bolts).

(b) Gas Cylinder

1. Primary containment by DOT Specification 3A gas cylinder (length 52" and outside diameter of 9") rated to 2015 psig.
2. Equipped with special high temperature monel valve (#440 X 70), Kerotest Mfg. Corporation, 2525 Liberty Avenue, Pittsburgh, Pa. 15222. Valve Measures 4-5/8" with a torque of 90 in. lbs. for closure.
- (3) Gross Weight: 5200 lbs.
- (4) Sketches of completely assembled container (Figure 1), lead shield and gas cylinder (Figure 2) and special monel valve (Figure 3) are attached.

5.b. Authorized Contents

Gaseous Krypton-85 (Transport Group III) in Large Quantities, not to exceed:

- (1) 74,000 Curies
- (2) 1000 BTU/hr decay heat (293 watts)
- (3) 500 psig gas cylinder pressure.

5.c. References

- (1) A. J. Mallett and S. G. Wheatley, Fissile Material Container and Packaging Development and Testing Program, K-1661 Union Carbida Corporation, April 1, 1966
- (2) A. J. Mallett and C. E. Newton, Protective Shipping Packages for 30-Inch Diameter UF₆ Cylinders, K-1686, Union Carbide Corporation, AEC-ORGDP, April 13, 1967
- (3) 49 CFR, Parts 170-189, DOT Hazardous Materials Regulations

II.B.1

B. RADIOACTIVE SOLIDS

DOT-6M

DOT SPEC 6M - Type B Container

ORNL-DWG 76-13675R

TYPICAL ASSEMBLY DETAIL, 10 gal SIZE DOT-6M
WEIGHT-60 lbs, TYPE B

II.B.4

Form NRC-618
(12-73)
10 CFR 71

CERTIFICATE OF COMPLIANCE For Radioactive Materials Packages

1.(a) Certificate Number 5908	1.(b) Revision No. 2	1.(c) Package Identification No. USA/5908/B()F	1.(d) Pages No. 1	1.(e) Total No. 3
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2. PREAMBLE

- 2.(a) This certificate is issued to satisfy Sections 173.393a, 173.394, 173.395, and 173.396 of the Department of Transportation Materials Regulations (49 CFR 170.103 and 14 CFR 103) and Sections 146-19-10a and 146-19-100 of the Department of Transportation Dangerous Cargoes Regulations (46 CFR 146-149), as amended.
- 2.(b) The packaging and contents described in item 5 below, meets the safety standards set forth in Subpart C of Title 10, Code of Federal Regulations, Part 71, "Packaging of Radioactive Materials for Transport and Transportation of Radioactive Material Under Certain Conditions."
- 2.(c) 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—

3.(a) Prepared by (Name and address): The Babcock & Wilcox Company 609 N. Warren Avenue Apollo, Pennsylvania 15613	3.(b) Title and identification of report or application: Nuclear Materials and Equipment Corporation application dated May 3, 1974, as supplemented.
3.(c) Docket No. 71-5908	

4. CONDITIONS

This certificate is conditional upon the fulfilling of the requirements of Subpart D of 10 CFR 71, as applicable, and the conditions set forth in item 5 below.

5. Description of Packaging and Authorized Contents, Model Number, Fissile Class, Other Conditions, and References:

(a) Packaging

- (1) Model No.: DOT-6M Type B
- (2) Description

Metal packaging as described and constructed in accordance with DOT Specification 6M (Title 49 §178.104).

(b) Contents

(1) Type and form of material

- (i) Solid radioactive materials which will not decompose at temperatures up to 250°F. Carbide compounds are not authorized.
- (ii) UO₂ or UO₂-ThO₂ binary mixtures in the form of powder or compact pellets. The uranium isotopic content is nominally 97% U-233 with 10 ppm U-232.
- (iii) Plutonium nitrate or uranyl nitrate solution in flame sealed glass ampoules or screw top plastic vials, each within one or more additional plastic vials with taped lids, and within a sealed product can or polyethylene bottle containing a sufficient amount of vermiculite to absorb twice the liquid contents present.

5. (b) Contents (continued)

(2) Maximum quantity of material per package and fissile class

- (i) For the material described in 5(b)(1)(i) the maximum fissile material and maximum hydrogen per package for Fissile Class I is as follows:

<u>Fissile Material</u>	<u>Maximum fissile material per package kilograms</u>	<u>Material hydrogen per package grams</u>
U-235	1.6	20
Pu	0.9*	11
U-233	0.5	6.4

*Because of the 10 watt thermal decay heat limitation, the limit for Pu-238 is 0.02 kilograms.

- (ii) For the material described in 5(b)(1)(i) the maximum U-235 loading for uranium bearing materials with an $H/X \leq 3$ and the minimum transport index to be assigned to each package for Fissile Class II is as follows:

<u>Maximum Kgs U-235</u>	<u>Minimum Transport Index</u>
4.2	0.1
5.4	.2
7.3	.5
9.1	1.0

- (iii) For the material described in 5(b)(1)(ii) the maximum quantity of U-233 is 500 grams at an H/U ratio not to exceed 20, as Fissile Class III with a limit of 51 packages per shipment.

- (iv) For the material described in 5(b)(1)(iii) the maximum quantity of material is not to exceed 20 Ci radioactivity and 40 ml of solution. Fissile material shall not exceed 10 grams.

6. Two steel through bolts may be installed between the lid and bottom of the steel drums.
7. Venting may be provided by a 1-inch diameter hole in the drum lid backed by a minimum 1/2-inch thick cerafelt refractory pad.

II.B.6

Page 3 - Certificate No. 5908 - Revision No. 2 - Docket No. 71-5908

8. Maximum decay heat per package shall not exceed ten (10) watts.
9. The package authorized by this Certificate of Compliance is hereby approved for use under the general license provisions of Paragraph 71.12(b) of 10 CFR Part 71.
10. Expiration date: February 28, 1981.

REFERENCES

Nuclear Materials and Equipment Corporation application dated May 3, 1974.

Westinghouse Electric Corporation supplement (WAPD-RS(CC)-620) dated May 8, 1973 is required for the contents described in 5(b)(1)(ii).

Allied Chemical Corporation, Report No. ICP-1061, December 1974 (required for the contents described in 5(b)(1)(iii) and 5(b)(2)(iv)).

FOR THE U.S. NUCLEAR REGULATORY COMMISSION

Charles E. MacDonald, Chief
Transportation Branch
Division of Fuel Cycle and
Material Safety

Date: OCT 18 1977

II.B.7

B. RADIOACTIVE SOLIDS

DOT-20WC-1

II.B.8

ORNL Photo 2866-78

DOT 20WC-1 - Type B Container

II.B.9

B. RADIOACTIVE SOLIDS

DOT-20WC-3

DOT 20WC-3 - Type B Container

II.B.11

B. RADIOACTIVE SOLIDS

DOT-20WC-4

ORNL Photo 2420-78

DOT 20WC-4 - Type B Container

ORNL-DWG 76-13677

FIRE SHIELD; US DOT-20 WC-4

II.B.15

B. RADIOACTIVE SOLIDS

DOT-20WC-5

II.B.16

ORNL Photo 2406-78

DOT 20WC-5 - Type B Container

DEPARTMENT OF TRANSPORTATION
HAZARDOUS MATERIALS REGULATIONS BOARD
WASHINGTON, D.C. 20590

SPECIAL PERMIT NO. 5800

This special permit is issued pursuant to 46 CFR 146.05-4 of the U. S. Coast Guard (USCG) Dangerous Cargo Regulations and 49 CFR 170.13 of the Department of Transportation (DOT) Hazardous Materials Regulations, as amended.

1. The U. S. ATOMIC ENERGY COMMISSION (USAEC) and its contractors and licensees, the DEPARTMENT OF DEFENSE and its contractors, and licensees of "agreement states" as approved by the USAEC, are hereby authorized to ship Type B quantities of any non-fissile radioactive material in either normal or special form, as provided for herein.
2. Each user of this permit must register his identity with this Board prior to his first shipment under the permit.
3. The authorized packaging consists of an interim DOT Specification 20WC wooden protective jacket, as described in Appendix A hereto, when used with any single one of the following types of inner containment vessels which must fit snugly within the jacket:
 - a. A DOT Specification 55 (or equivalent) metal-encased shielded inner containment vessel;
 - b. A DOT Specification 2R (or equivalent) metal inner containment vessel; or
 - c. A DOT Specification 7A inner packaging which has a metal outer wall (not authorized for normal form radioactive materials).
4. The packaging design is based upon the ambient conditions as prescribed in Marginal C-2.4.3 of the Regulations for the Safe Transport of Radioactive Materials, 1967 Edition, International Atomic Energy Regulation (IAEA).
5. The authorized package meets the criteria of the International Atomic Energy Agency for Type B packaging for radioactive materials.
6. Prior to each shipment authorized by this permit, the shipper shall notify the consignee and, for export shipments, the competent authority of any country into or through which the package will pass, of the dates of shipment and expected arrival. The shipper shall notify each consignee of any special loading/unloading instructions prior to his first shipment.

7. The outside of each package must be plainly and durably marked "USA DOT SP 5800" and "TYPE B", in connection with and in addition to the other markings and labels prescribed by the DOT regulations. Each shipping paper issued in connection with shipments made under this permit must bear the notation "DOT SPECIAL PERMIT NO. 5800", in connection with the commodity description thereon.

8. Each package of gross weight in excess of 50 kilograms (110 pounds) must have its gross weight in kilograms plainly and durably marked on the outside of the package.

9. Shipments are authorized only by vessel, cargo-only aircraft, passenger-carrying aircraft, rail, and motor vehicle.

10. No special operational transport controls are necessary during carriage except as specified herein, and no special arrangements have been made under Marginal C-6.5 of the IAEA Regulations.

11. For shipments by water, the shipper or agent shall notify the USCG Captain of the Port in the port area through which the shipment is to be made, of the name of the vessel on which the shipment is to be made, and of the time, date, and place of loading. When the initial notification is given in a port area, it must be accompanied by a copy of this permit, addressed to the attention of that Captain of the Port.

12. Any incident involving loss of contents must be promptly reported to this Board.

13. This permit does not relieve the shipper or carrier from compliance with any requirement of the DOT regulations, including 46 CFR Parts 146 to 149 of the USCG Regulations, except as specifically provided for herein, or the regulations of any foreign government into or through which the package will be carried.

14. This permit expires January 15, 1971.

DOT SPECIAL PERMIT NO. 5800, APPENDIX A

January 1, 1969

Interim DOT Specification 20WC

§ 178.194 Specification 20WC wooden protective jacket

§ 178.194-1 General requirements

(a) Each jacket must meet the applicable requirements of § 173.24 of this chapter.

(b) Maximum gross weight of the jacket plus the contents may not exceed the following:

- (1) Spec. 20WC-1: 500 pounds
- (2) Spec. 20WC-2: 500 pounds
- (3) Spec. 20WC-3: 1000 pounds
- (4) Spec. 20WC-4: 2000 pounds
- (5) Spec. 20WC-5: 4000 pounds

§ 178.194-2 Materials of construction

(a) The general configuration of the wooden protective jacket is a hollow cylindrical shell constructed of one-piece discs and rings of plywood or solid hardwood reinforced with steel rods.

(b) Plywood must be exterior-grade, void-free, douglas fir (or equivalent) not more than one inch thick. Solid hardwood is authorized for Spec. 20WC-2 only.

(c) Discs and rings must be glued together with a strong, shock-resistant adhesive, such as either of the following:

(1) A resorcinol-formaldehyde adhesive, which has been bonded under heat and pressure; or

(2) A polyvinyl-acetate emulsion, which has been reinforced with cement-coated nails. The nails must be randomly spaced and must be at least 2-1/2 times as long as the minimum thickness of the plywood discs or rings.

(d) Full-length steel rods are required for reinforcement and lid closure. For Specs. 20WC-1 and 20WC-2, a minimum of six rods at least 0.25 inches in diameter are required. For Spec. 20WC-3, a minimum of 12 rods, at least 0.375 inches in diameter are required. For Spec. 20WC-4, a minimum of 16 rods at least 0.375 inches in diameter are required, and for Spec. 20WC-5, a minimum of 16 rods at least 0.5 inches in diameter are required. For Specs. 20WC-1 and 20WC-2, steel rods must be equally spaced around the circumference of the rings and discs, midway between the O.D. and I.D. of the rings. For Specs. 20WC-3 and 20WC-4, bolts may be staggered alternately in two rows, at $\pm$ 0.5 inches from the

II.B.20

line midway between the O.D. and I.D. of the rings. For Spec. 20WC-5, bolts may be staggered alternately in two rows at $\pm$ one inch from the line midway between the O.D. and I.D. of the rings. Rod ends must be threaded and secured with lock nuts and steel washers, or equivalent device, to provide at least a one inch diameter bearing surface on each end. Ends of the rods must terminate 0.75 inches below the surface of the plywood for Specs. 20WC-1 and 20WC-2. For Specs. 20WC-3, 20WC-4, and 20WC-5, the ends of the rods must terminate 1.5 inches below the surface of the plywood, and that portion of each end disc which extends beyond the rod ends must be further held in place with lag screws at least four inches long.

(e) Thickness of wooden shell:

- (1) Spec. 20WC-1: At least four inches thick.
- (2) Spec. 20WC-2: At least three inches thick. The jacket must be completely encased by a steel shell at least 18-gauge thickness, such as Spec. 17H steel drum. The steel shell must be vented by at least four 0.25 inch diameter holes, which must be covered with a durable weatherproof tape.
- (3) Spec. 20WC-3: At least five inches thick for the jacket wall, and at least six inches thick for the end discs. In addition, at least three plywood chines, two inches wide and protruding two inches beyond the outer surfaces, must be located at each end and midway along the length of the jacket.
- (4) Spec. 20WC-4: At least six inches thick for the jacket wall, and at least six inches thick for the end discs. In addition, at least three plywood chines, two inches wide and protruding two inches beyond the outer surfaces, must be located at each end and midway along the length of the jacket.
- (5) Spec. 20WC-5: At least six inches thick for the jacket wall, and at least eight inches thick for the end discs. In addition, at least five plywood chines, two inches wide and protruding two inches beyond the outer surfaces, must be located at each end and equally spaced along the length of the jacket.

(f) Figures 1 and 2 illustrate representative designs.

§ 178.194-3 Closure

(a) Closure for the wooden protective jacket is provided by the steel reinforcing rods. The end cap (lid) must fit tightly to the body of the jacket to prevent a heat path to the inside of the jacket. The lid joint for Specs. 20WC-3, 20WC-4, and 20WC-5 may not be co-planar with the end of the inner containment vessel.

II.B.21

(b) Spec. 20WC-2. Locking ring closure, if used, must conform to § 178.104-4. Flanged closure, if used, must have at least eight steel bolts (at least 0.25 inch diameter) and lock nuts (or equivalent device), spaced not more than five inches between centers.

§ 178.194-4 Tests

(a) Each jacket must be visually inspected for defects such as improper bonding, cracking, corrosion of steel rods, an improperly fitting closure lid, or other manufacturing defects. Particular attention must be given to any separation of the plywood discs and rings which would provide a heat path to the inside of the jacket.

§ 178.194-5 Painting

(a) Each jacket must be completely painted with a high quality exterior weather resistant paint.

§ 178.194-6 Marking

(a) Each jacket must be marked on the external surface as follows: "USA DOT 20WC-() TYPE B" and "RADIOACTIVE MATERIAL". The appropriate numeral must be inserted in the marking to indicate the appropriate Spec. 20WC category; e.g., "USA DOT 20WC-2".

II.B.23

B. RADIOACTIVE SOLIDS

DOT-21WC

DOT 21WC - Type B Container

II.B.25

ORNL-DWG 67-7812R

RADIOISOTOPE SHIPPING CONTAINER WITH FIRE AND IMPACT SHIELD
TYPE B DOT-21WC, WEIGHT-4500 lbs

USA DOT SPEC 21WC

§ 178.195 SPECIFICATION 21WC; wooden-steel protective overpack.

§ 178.195-1 General requirements.

(a) Each jacket must meet all the applicable requirements of § 173.24 and this subchapter.

(b) The maximum authorized gross weight of the overpack, including its inner container and contents may not exceed 1360 kilograms (3000 pounds).

§ 168.195-2 Materials of construction and other requirements.

(a) The general configuration of the protective overpack must be a combination of two nested plywood boxes, each 2.5 centimeters (1 inch) thick, nested within a third wooden box of nominal 5 centimeters (2 inch) thickness solid hardwood. The three nested boxes must be enclosed within a welded framework constructed of mild steel strap, nominally 1 centimeter (3/8-inch) thick by 8-10 centimeters (3-4 inches) wide. All outer surfaces of each box must be coated with intumescent paint.

(b) Plywood must be exterior-grade, void-free, Douglass fir, or equivalent, at least 2.5 centimeters (1 inch) thick. Solid hardwood must be maple, or equivalent.

(c) All box joints and interior surfaces must be glued with a strong, shock-resistant adhesive such as polyvinyl-acetate emulsion, or equivalent.

(d) All hardwood joints must be mitered, or equivalent, reinforced with No. 10 cement-coated nails spaced on nominal 15 centimeters (6 inch) centers.

(e) All plywood joints must be butt-type, or equivalent, reinforced with No. 10 cement-coated nails spaced on nominal 15 centimeters (6 inch) centers.

(f) The angles and strapping of the metal frame must be spaced such that separation distances do not exceed 15 centimeters (6 inches).

(g) The lid must be of the same material as the box and fabricated in such a manner that closure forms a mitered joint with the hardwood box and 2 stepped-joints with the plywood boxes.

§ 178.195-3 Closure. Closure for the protective overpack must be provided by at least 4 mild steel hinges formed from minimum 2.5 centimeter (1 inch) x 5 millimeter (3/16-inch) bar stock. Hinge pins must be minimum 6 millimeter (1/4-inch) diameter by 13.3 centimeters (5 1/4-inches) long mild steel rod drilled at both ends for cotter pins.

§ 178.195-4 Tests. Prior to each use, each overpack must be visually inspected for defects such as wood checking or splintering, weld cracking, corrosion of steel parts, improper joint bonding, or improperly fitting closure lid.

§ 178.195-5 Required marking. (a) Marking must be as prescribed in § 178.24 of this subchapter.

(b) Marking on the outside of each overpack must include the following:

(1) "USA-DOT 21WC" and "TYPE B" as appropriate.

§ 178.195-6 Typical assembly detail.

B. RADIOACTIVE SOLIDS

LiOH FIRE AND IMPACT SHIELD

ORNL LiOH Fire and Impact Shield
Type B Container

ORNL-DWG 74-3850R2

TYPE B
LiOH FIRE AND IMPACT SHIELD (SUGARMAN CASK)
 wt 4000 lb

Form AEC-418
(12-73)
10 CFR 71
AECM 5201

U.S. ATOMIC ENERGY COMMISSION
CERTIFICATE OF COMPLIANCE
For Radioactive Materials Packages

1a. Certificate Number USA/9851/BLF (ERDA-ORO)	1b. Revision No. 0	1c. Package Identification No. USA/9851/BLF (ERDA-ORO)	1d. Page No. 1	1e. Total No. Pages. 2
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2. PREAMBLE

2a. This certificate is issued to satisfy Sections 173.393a, 173.394, 173.395, and 173.396 of the Department of Transportation Hazardous Materials Regulations (49 CFR 170-189 and 14 CFR 103) and Sections 146-19-10a and 146-19-100 of the Department of Transportation Dangerous Cargoes Regulations (46 CFR 146-149), as amended.

2b. The packaging and contents described in item 5 below, meets the safety standards set forth in Subpart C of Title 10, Code of Federal Regulations, Part 71, "Packaging of Radioactive Material for Transport and Transportation of Radioactive Material Under Certain Conditions."

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): Oak Ridge National Laboratory Post Office Box X Oak Ridge, TN 37830	(2) Title and Identification of report or application: Safety Analysis Report for Packaging for the ORNL Lithium Hydroxide Fire and Impact Shield Report No.: ORNL/ENG/TM-8	(3) Date: November 1977
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4. CONDITIONS
This certificate is conditional upon the fulfilling of the requirements of Subpart D of 10 CFR 71, as applicable, and the conditions specified in item 5 below.

5. Description of Packaging and Authorized Contents, Model Number, Fissile Class, Other Conditions, and References:

(a) Packaging:

(1) Model: Lithium Hydroxide Fire and Impact Shield

(2) Description:

Packaging for inner Type A and DOT Specification 55 packages to permit transport of Type B and large quantities of radioactive materials and limited quantities of fissile materials, which are contained within inner special form encapsulation or DOT Specification 2R containers. The inner vessels will be blocked to minimize movement during transport.

The inner cavity of the shield is a cylinder 27 in. diameter x 26 in. high. The outer shell is 36 in. diameter x 30 3/4 in. high.

The lid is 4 5/8 in. thick. The shield is fabricated from 1/8 in. thick 304-L stainless steel with the 4 1/4 in. nominal space between inner and outer cladding being filled with LiOH.H₂O crystals. The outer surface of the shield has 92 vertical cooling fins. The flanged closure is held in position by twenty one-inch alloy steel bolts.

The gross weight of the package is 4,000 lbs.

6a. Date of Issuance: September 2, 1977	6b. Expiration Date:
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FOR THE U.S. ATOMIC ENERGY COMMISSION

7a. Address of Issuing Office: U. S. Energy Research & Development Adm. Post Office Box E Oak Ridge, Tennessee 37830	7b. Signature, Name, and Title of Approving Official: <i>Wayne Smalley, acting</i> William H. Travis, Director Safety and Environmental Control Div.
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Page 2 - Certificate of Compliance, No. USA/9851/BL (ERDA-ORO), Rev. 0

(3) Drawings:

The overpack is described and fabricated in accordance with Union Carbide Corporation, Nuclear Division, Oak Ridge National Laboratory drawings:

D-RD-2760-D through D-RD-2764-D

(b) Contents:

(1) Type and form of material:

Any solid, large quantity of radioactive materials, fissile and non-fissile, meeting special form or packaged in DOT Specification 2R inner container and whose decay heat load does not exceed 300 watts.

(2) External radiation levels will be within the levels prescribed in DOT Regulations, Title 49.

(3) Specific limits of contents:

(i) 5 g. of:

^{242}Am , ^{244}Cm , ^{245}Cm , ^{247}Cm , ^{249}Cf or ^{251}Cf

(ii) 150 g. of:

$^{238}\text{PuO}_2$

(iii) 100 g. of:

^{235}U , ^{233}U or ^{239}Pu

(c) Fissile Class:

I

B. RADIOACTIVE SOLIDS

TUNGSTEN SHIELDED CASKS

ORNL Tungsten Shielded Type B Container

II.B.37

ORNL Photo 2541-78

ORNL Tungsten Shielded Type B Container

DOE Form EV-618
(11-77)
10 CFR 71

U.S. DEPARTMENT OF ENERGY
CERTIFICATE OF COMPLIANCE
For Radioactive Materials Packages

1a. Certificate Number	1b. Revision No.	1c. Package Identification No.	1d. Page No.	1e. Total No. Pages.
5597	2	USA/5597/BL (DOE-OR)	1	2

2. PREAMBLE

2a. This certificate is issued to satisfy Sections 173.393a, 173.394, 173.395, and 173.396 of the Department of Transportation Hazardous Materials Regulations (49 CFR 170-189).

2b. The packaging and contents described in item 5 below, meets the safety standards set forth in Subpart C of Title 10, Code of Federal Regulations, Part 71, "Packaging of Radioactive Material for Transport and Transportation of Radioactive Material Under Certain Conditions."

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—

(3) Date:

(1) Prepared by (Name and address):

Oak Ridge National Laboratory
Post Office Box X
Oak Ridge, Tennessee 37830

(2) Title and Identification of report or application:

a) Safety Analysis Report for the ORNL Tungsten-Shielded Cask, Report No. ORNL/ENG/TM-3

a) Oct. 1977

b) Safety Analysis Report for the ORNL Tungsten-Shielded Cask, Addendum 1, Report No. ORNL/ENG/TM-3, Addendum 1.

b) March 1979

4. CONDITIONS

This certificate is conditional upon the fulfilling of the requirements of Subpart D of 10 CFR 71, as applicable, and the conditions specified in item 5 below.

5. Description of Packaging and Authorized Contents, Model Number, Fissile Class, Other Conditions, and References:

a. Packaging:

(1) Model: Tungsten-Shielded Cask

(2) Description:

The packaging consists of a right circular cylinder with a hemispherical bottom. It has a maximum outside diameter of 16-in. at the base. The cask itself has an outside diameter of 8-in. The overall height is 15-1/4-in. Inner cavity dimensions are 3.120-in. diam. by 6-1/2-in. high. Shielding is composed of a 2" thickness of isostatically pressed and sintered tungsten alloy containing 95% tungsten, 3.5% nickel, and 1.5% iron, with a 1/4-in. type 304L stainless steel cladding outside and a 1/8-in. type 304L stainless steel cladding inside. The gasketed lid consists of a 150-lb. flange to which the top shield plug is attached and is held in place by eight 5/8-in. studs and bolts. A capped 1-in. pipe is welded to the underside of the cask lid to position the contents. The gross weight of the basic cask is 381 lbs.

A tungsten insert, heat shield, and skid are utilized for shipping radioactive materials having higher internal heat loads and external radiation levels. The gross weight of the cask, insert, heat shield and skid is 565 lb.

6a. Date of Issuance: JAN 25 1979

6b. Expiration Date:

FOR THE U.S. DEPARTMENT OF ENERGY

7a. Address (of DOE Issuing Office)

U. S. Department of Energy
Post Office Box E
Oak Ridge, Tennessee 37830

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

William H. Travis
William H. Travis, Director
Safety and Environmental Control Division

(3) Drawings:

The packaging is as described and fabricated in accordance with Oak Ridge National Laboratory Drawings No. M-11575-EM-001-E-Rev. 2, X3D11575-002, and X3D-11575-003-Rev. 3.

b. Contents:

(1) Type and Form of Material:

Non-fissile radioactive materials as solid and in special form.

- (2) Maximum quantity of material per package may be a large quantity and not to exceed 25 watts of thermal decay energy without the insert, heat shield, and skid and not to exceed 50 watts of thermal decay energy with the insert, heat shield, and skid. The radioactive contents will be further limited by authorized external radiation levels specified in Department of Transportation (DOT) Regulations.

B. RADIOACTIVE SOLIDS

TRU CURIUM SHIPPING CONTAINER

ORNL Photo 0784-74 R2

ORNL TRU Shipping Container - Type B

ORNL DWG 67-9810

ORNL TRU Shipping Container - Type B

II.B.44

DOE Form EV-618
(11-77)
10 CFR 71

U.S. DEPARTMENT OF ENERGY CERTIFICATE OF COMPLIANCE For Radioactive Materials Packages

1a. Certificate Number 5461	1b. Revision No. 1	1c. Package Identification No. USA/5461/BL (DOE-OR)	1d. Page No. 1	1e. Total No. Pages. 2
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2. PREAMBLE

2a. This certificate is issued to satisfy Sections 173.393a, 173.394, 173.395, and 173.396 of the Department of Transportation Hazardous Materials Regulations (49 CFR 170-189).

2b. The packaging and contents described in item 5 below, meets the safety standards set forth in Subpart C of Title 10, Code of Federal Regulations, Part 71, "Packaging of Radioactive Material for Transport and Transportation of Radioactive Material Under Certain Conditions."

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): Oak Ridge National Laboratory Post Office Box X Oak Ridge, Tennessee 37830	(2) Title and Identification of report or application: Safety Analysis Report for Packaging (SARP) of the Oak Ridge National Laboratory TRU Curium Shipping Container Report No.: ORNL-5147/R1	(3) Date: Dec. 1979
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4. CONDITIONS
This certificate is conditional upon the fulfilling of the requirements of Subpart D of 10 CFR 71, as applicable, and the conditions specified in item 5 below.

5. Description of Packaging and Authorized Contents, Model Number, Fissile Class, Other Conditions, and References:

a. Packaging:

(1) Model: ORNL TRU Curium Shipping Container

(2) Description:

Packaging for solid radioactive materials. The container is a right circular cylinder 29 in. in diameter and 30 7/8 in. high with a 304L stainless steel outer shell, which is 3/8 in. thick for the bottom and sides and 1/4 in. for the top. The shell for inner cavity is 8 1/4 in. diameter x 19 1/4 in. deep, is fabricated from 1/4 in. thick 304L stainless steel plate, and is recessed 1 3/8 in. from the top. The cavity shell is a cylinder 8 1/4 in. diameter x 19 1/4 in. high and is fabricated from 1/4 in. thick 304L stainless steel. The inner cavity for the radioactive materials is 6 in. diameter x 8 in. high and fabricated from 1/4 in. thick 304L stainless steel. Seven-eighths in. thick lead fills the space between the sides and bottom of the cavity shell and the inner cavity. The annulus between the outer shell and inner shell is filled with limonite concrete.

The inner cavity is closed with a concrete-and-lead plug which is enclosed in 1/4 in. 304L stainless steel plate. A 1/16 in. thick neoprene gasket serves as a seal between the top flange of the plug and the cask body. Eight

6a. Date of Issuance: October 1, 1979	6b. Expiration Date:
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FOR THE U.S. DEPARTMENT OF ENERGY

7a. Address (of DOE Issuing Office) U. S. Department of Energy Post Office Box E Oak Ridge, TN 37830	7b. Signature, Name, and Title (of DOE Approving Official) William H. Travis William H. Travis, Director Safety and Environmental Control Division
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Page 2 - Certificate of Compliance USA/5461/BL

(2) Description (continued)

1/2 in. x 13 NC-2 nuts on studs hold the plug flange to the cask body. A 3/8 in. diameter 304L stainless steel bail is used to lift the plug.

A 1/4 in. thick 304L stainless steel plate, which covers the top flange and bail, is held to the top of the cask by six 1/2 in. x 13 NC-2 nuts on studs.

The cask is equipped with four 1/2 in. thick lifting and tie-down ears with two 1 in. diameter holes per ear. The cask is also mounted on a skid for handling with a forklift.

The gross weight of the cask and skid is 2800 lb.

(3) Drawing:

The packaging for the TRU Curium Shipping Container is constructed in accordance with Oak Ridge National Laboratory Drawing No. M-12175-CP-078-E-3.

b. Contents:

(1) Type and Form of Material:

Any isotope of plutonium, americium, curium, berkelium, californium; and fermium in the form of metal, oxide, chloride or other salt.

(2) Maximum quantity of material per package:

- (i) A total of 10g of ^{239}Pu , ^{241}Pu , ^{242}Am , ^{243}Cm , ^{245}Cm , ^{247}Cm , and/or ^{249}Cf .
- (ii) 3g of ^{251}Cf .
- (iii) The balance of the transuranic and other non-fissile radioactive materials will be limited to a heat load of 500 Btu/hr. and to the external radiation levels specified in US DOT Regulations 49 CFR Part 173.393.
- (iv) Contents are either singly or doubly encapsulated in a welded container meeting special form requirements and may be further placed in another DOT Specification 2R container for handling purposes.

II.B.47

B. RADIOACTIVE SOLIDS

TRU TEN-TON CALIFORNIUM SHIPPING CONTAINER

ORNL TRU Californium Shipping Container - Type B

TRU TEN TON CALIFORNIUM SHIPPING CONTAINER

DOE Form EV-612
(11-77)
10 CFR 71U.S. DEPARTMENT OF ENERGY
CERTIFICATE OF COMPLIANCE
For Radioactive Materials Packages

1a. Certificate Number 5740	1b. Revision No. 1	1c. Package Identification No. USA/5740/BL	1d. Page No. 1	1e. Total No. Pages 2
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2. PREAMBLE

2a. This certificate is issued to satisfy Sections 173.393a, 173.394, 173.395, and 173.396 of the Department of Transportation Hazardous Materials Regulations (49 CFR 170-189).

2b. The packaging and contents described in item 5 below, meets the safety standards set forth in Subpart C of Title 10, Code of Federal Regulations, Part 71, "Packaging of Radioactive Material for Transport and Transportation of Radioactive Material Under Certain Conditions."

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): Oak Ridge National Laboratory Post Office Box X Oak Ridge, Tennessee 37830	(2) Title and Identification of report or application: (a) The TRU Ten-Ton Californium Shipping Container, Report ORNL-TM-3505. (b) Safety Analysis Report for Packaging (SARP) of the Oak Ridge National Laboratory TRU Californium Shipping Container, Report ORNL-5409, Rev. 1.	(3) Date: (a) Nov. 1977 (b) To be issued
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4. CONDITIONS
This certificate is conditional upon the fulfilling of the requirements of Subpart D of 10 CFR 71, as applicable, and the conditions specified in item 5 below.

5. Description of Packaging and Authorized Contents, Model Number, Fissile Class, Other Conditions, and References:

(a) Packaging

(1) Model: ORNL TRU Californium Shipping Container

(2) Description: A 304L stainless steel encased concrete shipping cask

The outer shell consists of two $\frac{1}{2}$ -in. thick, 66-in. diameter hemispherical heads joined by a 6-in. cylindrical section. The cylindrical cavity has a 1-in. thick stainless steel wall and is 3-in. diameter x 6-in. long. Shielding consists of 30-in. of Blackburn limonite concrete having a density of ~ 175 lb/ft³. Upper and lower level ball valves located at the end of concrete filled plugs define, isolate, and seal the cavity. Both of these plugs which utilize O-ring seals are bolted in place and are protected with a gasketed cover plate. Fusible plugs in the cover plates and the shell will melt to permit steam release in event of thermal exposure.

The top ball valve and plug may be replaced by other plugs for multiple source shipments. Sources are contained in DOT Specification 2R or special-form containers.

The cask is mounted onto a 1-in. thick steel base plate by eight steel $2\frac{1}{2}$ -in. NPS Schedule 40 pipe struts. The cask is transported on its own special trailer. The gross weight of the cask is 23,500 lb.

6a. Date of Issuance: January 19, 1979	6b. Expiration Date:
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FOR THE U.S. DEPARTMENT OF ENERGY

7a. Address (of DOE Issuing Office) U. S. Department of Energy Post Office Box E Oak Ridge, Tennessee 37830	7b. Signature, Name, and Title (of DOE Approving Official) William H. Travis, Director Safety & Environmental Control Division
--	--

Certificate 5740, Revision No. 1 2

(3) Drawings:

The package and special trailer are constructed in accordance with Oak Ridge National Laboratory (ORNL) Drawings M-11230-EN-001-D through 008-D, and 017-D, M-12166-CD-019-D and M11369-EM-011E and 012E.

(b) Contents

(1) Type and Form of Material.

The contents consist of isotopes of Americium (Am), Curium (Cm), Berkelium (Bk), Californium (Cf), Einsteinium (Es), and Fermium (Fm) as a solid (metal, oxide, oxysulfate, or dry salt) that is contained in a DOT Specification 2R inner container(s) or in a special form capsule(s).

(2) Maximum Quantity of Material Per Package.

3g (large quantity).

(3) Other Limitations.

(1) Maximum heat load - 5W.

(2) External radiation dose rates - limited to DOT regulations, 49 CFR 173.393.

B. RADIOACTIVE SOLIDS

D-38 URANIUM SHIELDED SHIPPING CASK

II.B.54

ORNL Photo 94766

ORNL D-38 Uranium Shielded Container
Type B

ORNL D-38 Uranium Shielded Container
Type B

DEPARTMENT OF TRANSPORTATION
RESEARCH AND SPECIAL PROGRAMS ADMINISTRATION
 WASHINGTON, D.C. 20590

IAEA CERTIFICATE OF COMPETENT AUTHORITY

REFER TO:

Type B Fissile Radioactive Material Package Design

Certificate Number USA/5787/B()F
 (Revision 1)

This establishes that the packaging design described herein, when loaded with the authorized radioactive contents, has been certified by the National Competent Authority of the United States as meeting the regulatory requirements for Type B packaging for fissile radioactive materials as prescribed in IAEA¹ Regulations §§ 49 CFR 173.393b, 173.395(c)(2) and 173.796(c)(3) of the USA² Regulations for the transport of radioactive materials.

I. Package Identification - Model D-38 Uranium Shielded Shipping Cask.

II. Packaging Description - Packaging authorized by this certificate consists of a stainless steel, uranium shielded, right cylindrical cask 12 3/4" in diameter by 22 5/8" high with a bolted, gasketed closure. Contents are further contained in a DOT specification 2R or equivalent container, with liquids to be additionally contained in polyethylene or stainless steel bottles.

III. Authorized Radioactive Contents - The authorized contents consist of fissile or large quantities of radioactive materials n.o.s. not to exceed 500 curies, or a thermal decay energy of 80 watts. For fissile radioactive materials, contents shall not exceed 500 grams of uranium-235, 350 grams of uranium-233 or plutonium-239, or 350 grams of any combination thereof.

For fissile materials, shipments are authorized as Fissile Class I.

IV. General Conditions -

- a. Each user of this certificate must have in his possession a copy of this certificate.
- b. Each user of this certificate, other than the U. S. Department of Energy, Oak Ridge, Tennessee, shall register his identity in writing to the Office of Hazardous Materials Regulation, Materials Transportation Bureau, U. S. Department of Transportation, Washington, D. C. 20590.

- c. This certificate does not relieve any consignor or carrier from compliance with any requirement of the Government of any country through or into which the package is to be transported.

V. Marking and Labeling - The package must bear the marking USA/5787/B()F as well as the other marking and labels prescribed by the USA Regulations.

VI. Expiration Date - This certificate, unless renewed, expires on January 31, 1981.

This certificate is issued in accordance with the requirements of the IAEA and USA Regulations and in response to the November 25, 1975, petition by the U. S. Energy Research & Development Administration, Oak Ridge, Tennessee, and in consideration of the associated information provided in USERDA, Oak Ridge Certificate AEC-OR USA/5787/BLF (Appendix A).

Certified by:

R. R. Rawl, Health Physicist
Office of Hazardous Materials Regulation
U. S. Department of Transportation
Washington, D. C. 20590

(Date)

¹"Safety Series No. 6, Regulations for the Safe Transport of Radioactive Materials, 1967 Edition" published by the International Atomic Energy Agency (IAEA), Vienna, Austria.

²Title 49, Code of Federal Regulations, Parts 100-199, USA.

This certificate supersedes in its entirety DOT Special Permit 5787 with respect to international shipments.

Revision 1 issued to extend expiration date in response to the January 19, 1979, petition by the Department of Energy, Oak Ridge, TN.

Form AEC-618
(6-72)
AECM 5201

U.S. ATOMIC ENERGY COMMISSION
CERTIFICATE OF COMPLIANCE
For Radioactive Materials Packages

1a. Number AEC OR	USA 5787/BLF	1b. Revision No. 0	1c. Page No. 1	1d. Total No. 1
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2. Authority
This certificate is issued pursuant to Sections 173.394, 173.395, and 173.396 of the Department of Transportation Hazardous Materials Regulations as amended (49 CFR 170-189 and 14 CFR 103), and AEC Manual Chapters 5201 and 0529.

3. CONDITIONS

3a. This certificate is issued on the basis of SAFETY ANALYSIS REPORT FOR PACKAGING (SARP)

(1) Prepared by Oak Ridge National Laboratory P.O. Box X Oak Ridge, Tennessee 37830	(2) Number ORNL-TM-2220
	(3) Date Published October 1963

3b. The packaging described in the SARP and further described in item 4 below, when constructed and assembled as prescribed in the SARP with the contents as authorized herein, meets the standards prescribed in DOT regulations.

3c. The outside of each package must be plainly and durably marked with the letters and number shown in item 1a. on this form in accord with the standards for markings in paragraph 173.24(b) of 49 CFR 173.

3d. This certificate does not relieve the consigner from compliance with the regulations of the U.S. Department of Transportation or other regulatory agencies.

3e. Each user of packages approved under this certificate shall register his name and address with the issuing office.

4. Description of Packaging and Authorized Contents, Restrictions, and References:

A. The packaging consists of a stainless-steel clad, depleted (0.2 wt% ²³⁵U) uranium shielded cask, which is a right circular cylinder, 12-3/4" O.D. x 22-5/8" high with a 6" I.D. x 13-13/16" deep central cavity. The uranium shield is 2-3/4" thick. Cask closure is by means of a plug-type uranium-shielded top lid, which is bolted sealed with two neoprene "O"-rings. Contents must be loaded within a DOT Specification 2R or equivalent, primary inner containment, with liquids to be additionally contained in polyethylene or stainless bottles. The gross weight of the package about 1300 lb.

B. The authorized contents of each package consist of fissile and large quantities radioactive material N.O.S. in the form of solid and liquid mixed fission product fuel elements, or waste products. The maximum thermal decay energy of the contents shall not exceed 80 watts and the total radioactivity shall not exceed 500 curie. The fissile radioactive material contents shall not exceed 500 g of ²³⁵U, 350 g of ²³³U or ²³⁹Pu, or 350 g of any combination.

C. Shipments are authorized as Fissile Class I. The Transport Index is assigned on basis of external radiation levels.

D. Shipments are authorized by vessel and motor vehicle.

TO BE COMPLETED BY AEC	
5a. Address (of AEC Approving Official) U.S. Atomic Energy Commission P.O. Box E Oak Ridge, Tennessee 37830	5b. Signature (of AEC Approving Official) 5c. Name and Title (of AEC Approving Official) William H. Travis, Director Safety & Environmental Control Division 6. Expiration Date (if appropriate) 7. Date September 21.

B. RADIOACTIVE SOLIDS

HFIR IRRADIATED FUEL ELEMENT CASK

ORNL HFIR Irradiated Fuel Element Container
Type B

ORNL HFIR Irradiated Fuel Element Container
Type B

DOE Form EV-18
(11-77)
10 CFR 71U.S. DEPARTMENT OF ENERGY
CERTIFICATE OF COMPLIANCE
For Radioactive Materials Packages

1a. Certificate Number 5507	1b. Revision No. 7	1c. Package Identification No. USA/5507/BLF (DOE-OR)	1d. Page No. 1	1e. Total No. Pages. 3
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2. PREAMBLE

2a. This certificate is issued to satisfy Sections 173.393a, 173.394, 173.395, and 173.396 of the Department of Transportation Hazardous Materials Regulations (49 CFR 170-189).

2b. The packaging and contents described in item 5 below, meets the safety standards set forth in Subpart C of Title 10, Code of Federal Regulations, Part 71, "Packaging of Radioactive Material for Transport and Transportation of Radioactive Material Under Certain Conditions."

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): Oak Ridge National Laboratory Post Office Box X Oak Ridge, TN 37830	(2) Title and Identification of report or application: a. Safety Analysis Report for Packaging (SARP) - HFIR Spent Fuel Element Shipping Cask Report No.: ORNL/ENG/TM-12 (Continued on next page)	(3) Date: November 1977
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4. CONDITIONS
This certificate is conditional upon the fulfilling of the requirements of Subpart D of 10 CFR 71, as applicable, and the conditions specified in item 5 below.

5. Description of Packaging and Authorized Contents, Model Number, Fissile Class, Other Conditions, and References:

(a) Packaging:

(1) Model: HFIR* Spent Fuel Element Shipping Cask

(2) Description:

Packaging for irradiated fuel elements and irradiated UCC primary ⁹⁹Mo target capsules. The inner cavity is 17 7/8 in. diameter x 32 in. deep. The internal configuration is determined by the type of fuel elements being shipped as follows:

(i) For HFIR fuel elements - a removable post consisting of aluminum wrapped with cadmium is centered in the cavity. The fuel assembly (1 inner element and 1 outer element) is positioned in the cavity by a concentric fuel basket fabricated of stainless steel clad cadmium.

(ii) For ORR (Oak Ridge Research Reactor) type fuel elements which also include BSR (Bulk Shielding Reactor) fuel elements, for PRR (Puerto Rico Research Reactor) fuel elements, and for CP-5 (Chicago Pile No. 5) fuel assemblies - the fuel elements are positioned in the cavity by a magazine fabricated of stainless steel clad cadmium. The primary ⁹⁹Mo target capsules will be positioned in the same magazine. Adapters will be utilized to hold the capsules in the magazine. The center post is removed

~~*High Flux Isotope Reactor~~

6a. Date of Issuance: 9/4/79	6b. Expiration Date:
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FOR THE U.S. DEPARTMENT OF ENERGY

7a. Address (of DOE Issuing Office) US Department of Energy Post Office Box E Oak Ridge, TN 37830	7b. Signature, Name, and Title (of DOE Approving Official) William H. Travis William H. Travis, Director Safety & Environmental Control Division
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Page 2 - Certificate of Compliance, No. USA/5507/BLF (DOE-OR), Revision 7

3.(2) (Continued)

- b. Memorandum from R. M. Moser to William H. Travis, December 30, 1975.
- c. Memorandum from R. M. Moser to William H. Travis, October 27, 1976.
- d. Letter from M. E. Ramsey to J. A. Lenhard, July 26, 1979.

5. (Continued)

- (iii) For PRNC (Puerto Rico Nuclear Center) TRIGA/FLIP type fuel assemblies - the fuel assemblies are positioned in the cavity by a steel, aluminum and elastomer basket. The center post is removed.

Shielding consists of a nominal 8 3/4 in. thickness of lead between 1/2 inch thick stainless steel inner and outer liners. Overall dimensions are 46 3/8 in. diameter x 72 1/2 in. high. Access to the cavity is through a top plug having 14 - 1 1/2 in. alloy steel studs. The gross weight is 23,000 lb.

(3) Drawings:

The cask and modifications are described in Oak Ridge National Laboratory Drawings: M-10191-EL-001-D through -006-D, -007-C, and -008-D through 012-D.

The PRNC TRIGA/FLIP fuel basket is described in Argonne National Laboratory Drawing No.: W-0170-0090-DE-00.

(b) Contents:

(1) Type and Form of Material

Solid, large quantity of radioactive materials, fissile encased in metal cladding as irradiated fuel elements OR as irradiated primary ⁹⁹Mo target capsules.

(2) Maximum quantity of fissile material per package

- (i) One HFIR irradiated fuel assembly containing up to 9,500 g of ²³⁵U as uranium oxide at a ²³⁵U enrichment up to 93%.
- (ii) Seventeen ORR-type irradiated fuel elements each containing up to 265 g of ²³⁵U as uranium-aluminum alloy at a ²³⁵U enrichment up to 93% for a maximum ²³⁵U content of 4.505 g.

II.B.64

Page 3 - Certificate of Compliance, No. USA/5507/BLF (DOE-OR), Revision 7

- (iii) Seventeen irradiated PRR fuel elements each containing up to 192 g of ^{235}U as uranium oxide as a ^{235}U enrichment up to 20% for a maximum ^{235}U content of 3,264 g.
- (iv) Seventeen irradiated ANL-CP-5 fuel assemblies each containing up to 170 grams of ^{235}U as uranium-aluminum alloy at a ^{235}U enrichment up to 93% for a maximum ^{235}U content of 2,890 grams.
- (v) Forty-eight PRNC TRIGA/FLIP irradiated fuel assemblies, cooled for at least 30 days, each containing up to 125 grams ^{235}U as a uranium-zirconium hydride mixture, with a ^{235}U enrichment of 70%, for a maximum ^{235}U content of 6,000 grams.
- (vi) Four irradiated primary ^{99}Mo target capsules, cooled for eight hours after an irradiation period of less than 30 days, each containing up to 20 grams of ^{235}U at 93% ^{235}U enrichment, for a maximum ^{235}U content of 80 grams.

The heat load is $\leq$ 3.75 kw.

(c) Fissile Class

III

B. RADIOACTIVE SOLIDS

ORNL LOOP TRANSPORT CASK

ORNL Loop Transport Cask - Type B

ORNL DWG 75-500

ORNL Loop Transport Cask - Type B

II.B.67

Form AEC-618
(12-73)
10 CFR 71
AECM5201

U.S. ATOMIC ENERGY COMMISSION
CERTIFICATE OF COMPLIANCE
For Radioactive Materials Packages

1a. Certificate Number 5753	1b. Revision No. 1	1c. Package Identification No. USA/5753/BLF (DOE-OR)	1d. Page No. 1	1e. Total No. Pages. 2
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2. PREAMBLE

2a. This certificate is issued to satisfy Sections 173.393a, 173.394, 173.395, and 173.396 of the Department of Transportation Hazardous Materials Regulations (49 CFR 170-189 and 14 CFR 103) and Sections 146-19-10a and 146-19-100 of the Department of Transportation Dangerous Cargo Regulations (46 CFR 146-149), as amended.

2b. The packaging and contents described in item 5 below, meets the safety standards set forth in Subpart C of Title 10, Code of Federal Regulations, Part 71, "Packaging of Radioactive Material for Transport and Transportation of Radioactive Material Under Certain Conditions."

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): Oak Ridge National Laboratory Post Office Box X Oak Ridge, Tennessee 37830	(2) Title and Identification of report or application: Safety Analysis Report for Packaging ORNL Loop Transport Cask Report No.: ORNL/ENG/TM-11	(3) Date: November 1977
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4. CONDITIONS
This certificate is conditional upon the fulfilling of the requirements of Subpart D of 10 CFR 71, as applicable, and the conditions specified in item 5 below.

5. Description of Packaging and Authorized Contents, Model Number, Fissile Class, Other Conditions, and References:

(a) Packaging:

(1) Model No.: ORNL Loop Transport Cask

(2) Description:

Packaging for irradiated experimental capsules and spent fuel elements. Containment consists of the cladding or jackets of fuel elements or capsules or an inner container meeting DOT Specification 2R or special form. The inner cavity is 5 3/4 in. diameter x 68 in. long. The outside dimensions are 24 in. diameter x 89 3/8 in. long. Shielding consists of a minimum thickness of 8 5/16 in. lead with a 1/8 in. thick inner stainless steel liner and an outer shell consisting of a 24 in. schedule 40 carbon steel pipe. Access to the cavity is through:

(i) A sliding door having 8 1/2 in. closure bolts.

(ii) A plug on the opposite end having 8 1/2 in. closure bolts.

Each opening is gasketed with a neoprene gasket. The gross weight of the cask is 16,150 lb. The skid weight is about 1000 lb.

6a. Date of Issuance: October 17, 1977	6b. Expiration Date:
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FOR THE U.S. ATOMIC ENERGY COMMISSION

7a. Address of Issuing Office: Department of Energy Post Office Box E Oak Ridge, Tennessee 37830	7b. Signature, Name, and Title of Approving Official: <i>William H. Travis</i> William H. Travis, Director Safety & Environmental Control Division
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Page 2 - Certificate of Compliance, No. USA/5753/BLF (DOE-OR), Revision 1

(2) Description (continued)

A fire shield consisting of 30 in. diameter mild steel cover 1/8 in. thick and painted with intumescent paint surrounds the cask.

(3) Drawings:

The cask was constructed and modified in accordance with ORNL Drawings M-11109-EL-008-D through -013-D, -020-E, and -021-D.

(b) Contents:

(1) Type and Form of Material

Solid, large quantity of radioactive materials, fissile and non-fissile, increased in metal cladding, meeting special form or packaged in DOT Specification 2R inner container and whose decay heat load does not exceed 450 watts when shipped by Common Carrier. When shipped by exclusive use vehicle, the decay heat will not exceed 1,000 watts.

(2) Maximum Quantity of Material per Package

Fissile material is limited to 1250g. per shipment; however, if the total quantity of fissile material exceeds 800g., the distribution of fissile material is further limited to 200g. per linear ft.

(c) Fissile Class

I

1937

1. The first part of the report deals with the general situation of the country and the progress of the work during the year.

2. The second part deals with the results of the work during the year.

3. The third part deals with the financial statement of the work during the year.

4. The fourth part deals with the conclusions of the work during the year.

5. The fifth part deals with the recommendations of the work during the year.

6. The sixth part deals with the summary of the work during the year.

7. The seventh part deals with the appendix of the work during the year.

8. The eighth part deals with the index of the work during the year.

9. The ninth part deals with the bibliography of the work during the year.

10. The tenth part deals with the list of the work during the year.

B. RADIOACTIVE SOLIDS

HFIR UNIRRADIATED FUEL ELEMENT CASK (Outer)

ORNL HFIR Unirradiated Fuel Element Shipping Container (Outer)
Type B

ORNL HFIR Unirradiated Fuel Element Shipping Container (Outer)
Type B

Form AEC-618
(12-73)
10 CFR 71
AECM 5201

U.S. ATOMIC ENERGY COMMISSION
CERTIFICATE OF COMPLIANCE
For Radioactive Materials Packages

1a. Certificate Number 5797-A	1b. Revision No. 1	1c. Package Identification No. USA/5797-A/BF (ERDA-OR)	1d. Page No. 1	1e. Total No. Pages 2
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2. PREAMBLE

- 2a. This certificate is issued to satisfy Sections 173.393a, 173.394, 173.395, and 173.396 of the Department of Transportation Hazardous Materials Regulations (49 CFR 170-189 and 14 CFR 103) and Sections 146-19-10a and 146-19-100 of the Department of Transportation Dangerous Cargoes Regulations (46 CFR 146-149), as amended.
- 2b. The packaging and contents described in item 5 below, meets the safety standards set forth in Subpart C of Title 10, Code of Federal Regulations, Part 71, "Packaging of Radioactive Material for Transport and Transportation of Radioactive Material Under Certain Conditions."
- 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):

Oak Ridge National Laboratory
Post Office Box X
Oak Ridge, Tennessee 37830

(2) Title and Identification of report or application:

Safety Analysis for the ORNL HFIR
Unirradiated Fuel Element Shipping
Containers

(3) Date:

November 1977

Report No. ORNL/ENG/TM-9

4. CONDITIONS

This certificate is conditional upon the fulfilling of the requirements of Subpart D of 10 CFR 71, as applicable, and the conditions specified in item 5 below.

5. Description of Packaging and Authorized Contents, Model Number, Fissile Class, Other Conditions, and References:

(a) Packaging:(1) Model: Outer HFIR* Unirradiated Fuel Element Shipping Container(2) Description:

Type B Packaging for unirradiated fissile radioactive material described as outer HFIR fuel element containing uranium enriched in the U-235 isotope. A 11-gage carbon steel, right circular cylindrical container, 31.5 in. OD x 45.75 in. long. The inner cavity is 17 7/8 in. ID x 30 1/4 inch long. A 2 in. OD wood post is located 4 1/2 in. off center in the center cavity to prevent loading both an inner and outer element. The space between the outer shell and the inner cavity is filled with laminated Douglas plywood to a minimum thickness of 6 in. The plywood is lined with 1 in. thick polyethylene foam which serves as a shock absorber to protect the fuel element. Closure is provided by sixteen 3/8 in. steel bolts which attach the lid to a 2 x 2 x 1/8 in. angle flange welded to the outer shell. The package gross weight is 1050 lbs.

*High Flux Isotope Reactor

6a. Date of Issuance: September 19, 1977	6b. Expiration Date:
FOR THE U.S. ATOMIC ENERGY COMMISSION	
7a. Address of Issuing Office: U. S. Energy Research & Development Adm. Post Office Box E Oak Ridge, Tennessee 37830	7b. Signature, Name, and Title of Approving Official: <i>William H. Travis</i> William H. Travis, Director Safety & Environmental Control Division

Page 2 - Certificate of Compliance, No. 5797-A, Revision 1

(3) Drawings:

The package is described and fabricated in accordance with Oak Ridge National Laboratory Drawing M-20678-EL-003-D-2.

(b) Contents:

(1) Type and Form

Uranium as U_3O_8 - Al cermet, enriched to 93% U-235 and clad in 10-mil thick aluminum as an outer HFIR unirradiated fuel element. Oak Ridge National Laboratory Drawing D-42126-6 describes the outer fuel element.

(2) Maximum quantity of uranium not to exceed Type B quantities of radioactive material consisting of not more than 6.6 kg of U-235.

(c) Fissile Class:

I

THE SECRETARY OF THE
TREASURY
WASHINGTON, D. C.
JAN 10 1900
TO THE SECRETARY OF THE
NAVY
DEPARTMENT OF THE NAVY
WASHINGTON, D. C.
SIR:
I have the honor to acknowledge the receipt of your letter of the 10th inst. and in reply to inform you that the same has been forwarded to the proper authorities for their consideration.
Very respectfully,
J. D. [Signature]
Assistant Secretary of the Treasury

B. RADIOACTIVE SOLIDS

HFIR UNIRRADIATED FUEL ELEMENT CASK (Inner)

ORNL HFIR Unirradiated Fuel Element Cask (Inner)

ORNL HFIR Unirradiated Fuel Element Cask (Inner)

II.B.80

NRC-618
(12-73)
0 CFR 71

U.S. NUCLEAR REGULATORY COMMISSION
CERTIFICATE OF COMPLIANCE
For Radioactive Materials Packages

1.(a) Certificate Number	1.(b) Revision No.	1.(c) Package Identification No.	1.(d) Pages No.	1.(e) Total No. Pages
5797	0	USA/5797/AF	1	3

2. PREAMBLE

- 2.(a) This certificate is issued to satisfy Sections 173.393a, 173.394, 173.395, and 173.396 of the Department of Transportation Hazardous Materials Regulations (49 CFR 170.189 and 14 CFR 103) and Sections 146-19-10a and 146-19-100 of the Department of Transportation Dangerous Cargoes Regulations (46 CFR 146-149), as amended.
- 2.(b) The packaging and contents described in item 5 below, meets the safety standards set forth in Subpart C of Title 10, Code of Federal Regulations, Part 71, "Packaging of Radioactive Materials for Transport and Transportation of Radioactive Material Under Certain Conditions."
- 2.(c) 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—

3.(a) Prepared by (Name and address): Department of Energy P.O. Box E Oak Ridge, TN 37830	3.(b) Title and identification of report or application: Safety Analysis Report for Packaging: The ORNL HFIR Unirradiated Fuel Element Shipping Containers, ORNL/ENG/TM-9, November 1977, as amended.
	3.(c) Docket No. 71-5797

4. CONDITIONS

This certificate is conditional upon the fulfilling of the requirements of Subpart D of 10 CFR 71, as applicable, and the conditions specified in item 5 below.

5. Description of Packaging and Authorized Contents, Model Number, Fissile Class, Other Conditions, and References:

(a) Packaging

- (1) Models Nos.: Inner HFIR Unirradiated Fuel Element Shipping Container, and Outer HFIR Unirradiated Fuel Element Shipping Container

(2) Description

Packaging for unirradiated fissile radioactive material as fuel elements for the High Flux Isotope Reactor (HFIR). The container is a right circular cylinder with an 11-gauge carbon steel shell. Closure is provided by 16, 3/8-inch diameter steel bolts which attach the lid to the cylindrical steel shell. The steel shell is filled with laminated Douglas fir plywood with a minimum thickness of 6 inches. A central cavity is formed in the plywood, and lined with a 1-inch thickness of polyethylene foam.

The packaging for the inner HFIR fuel element has overall dimensions of 25-inch O.D. by 45-inch high, a 10-7/8-inch diameter by 30-1/4-inch deep cavity, and a 660 pound gross weight.

The packaging for the outer HFIR fuel element has overall dimensions of 31.5-inch O.D. x 45.75-inch high, a 17-3/8-inch diameter by 31-1/8-inch deep cavity, and a 1050 pound gross weight.

- Certificate of Compliance No. 5797 - Revision No. 0, Docket No. 71-5797

5. (a) Packaging (Cont'd)

(3) Drawings

- (i) The packaging for the inner HFIR fuel is constructed in accordance with Oak Ridge National Laboratory Drawing No. M-20978-EL-003, Rev. 6.
- (ii) The packaging for the outer HFIR fuel is constructed in accordance with Oak Ridge National Laboratory Drawing No. M-20978-EL-002, Rev. 6.

(b) Contents

(1) Type and form of material

Uranium as U_3O_8 -Al cermet, enriched up to 93% in the U-235 isotope, and clad in aluminum, 10-mils thick, and:

- (i) For the packaging described in 5(a)(3)(i) the contents are described in Oak Ridge National Laboratory Drawing No. D-42118, Rev. J.
- (ii) For the packaging described in 5(a)(3)(ii) the contents are described in Oak Ridge National Laboratory Drawing No. D-42126, Rev. G.

(2) Maximum quantity of material per package

- (i) For the contents described in 5(b)(1)(i) not more than 2.6 kg of U-235.
- (ii) For the contents described in 5(b)(1)(ii) not more than 6.8 kg of U-235.

(c) Fissile Class

- 6. Prior to delivery to a carrier for transport, the shipper shall ensure that at no point along the proposed shipping route that the ambient temperature will be less than 32°F; or, the shipment shall be made in a heated vehicle such that the package temperature shall not be less than 32°F along the shipping route.
- 7. The package authorized by this certificate is hereby approved for use under general license provisions of 10 CFR §71.12(b).
- 3. Expiration date: September 30, 1984.

B. RADIOACTIVE SOLIDS

ORNL IN-PILE CAPSULE SHIPPING CASK

ORNL Photo 0182-72

ORNL In-Pile Capsule Shipping Cask - Type B

II.B.84

ORNL DWG 74-11905

11.B.85

ORNL In-Pile Capsule Shipping Cask - Type B

Form AEC-618
(12-73)
10 CFR 71
AECM 5201

U.S. ATOMIC ENERGY COMMISSION
CERTIFICATE OF COMPLIANCE
For Radioactive Materials Packages

1a. Certificate Number 5907	1b. Revision No. 1	1c. Package Identification No. USA/5907/BLF (DOE-OR)	1d. Page No. 1	1e. Total No. Pages. 2
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2. PREAMBLE

2a. This certificate is issued to satisfy Sections 173.393a, 173.394, 173.395, and 173.396 of the Department of Transportation Hazardous Materials Regulations (49 CFR 170-189 and 14 CFR 103) and Sections 146-19-10a and 146-19-100 of the Department of Transportation Dangerous Cargoes Regulations (46 CFR 146-149), as amended.

2b. The packaging and contents described in item 5 below, meets the safety standards set forth in Subpart C of Title 10, Code of Federal Regulations, Part 71, "Packaging of Radioactive Material for Transport and Transportation of Radioactive Material Under Certain Conditions."

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): Oak Ridge National Laboratory P. O. Box X Oak Ridge, Tennessee 37830	(2) Title and Identification of report or application: Safety Analysis for the ORNL In-Pile Capsule Shipping Cask Report No: ORNL/ENG/TM-10	(3) Date: November 1977
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4. CONDITIONS
This certificate is conditional upon the fulfilling of the requirements of Subpart D of 10 CFR 71, as applicable, and the conditions specified in item 5 below.

5. Description of Packaging and Authorized Contents, Model Number, Fissile Class, Other Conditions, and References:

(a) Packaging:

(1) Model No.: ORNL In-Pile Capsule Shipping Cask.

(2) Description:

Packaging for irradiated experimental capsules and spent fuel elements. Containment consists of the cladding or jackets of fuel elements or capsules or an inner container meeting DOT Specification 2R or special form. The inner cavity is 4 3/4 in. I.D. x 58 in. long. The cask is 24 in. O.D. x 83 in. long. Shielding consists of 9 1/2 in. of lead between a 1/8 in. thick stainless steel inner liner and a 0.75 in. total thickness, carbon steel outer shell. Access to the cavity is through:

(i) A sliding gate having 12 - 3/8" dia. closure bolts.

(ii) A lower plug having 8 - 3/8" dia. closure bolts.

(iii) An upper plug having 8 - 1/2" dia. closure bolts.

Each opening is gasketed with a neoprene gasket. The cask gross weight is 17,000 lb. The skid weighs 1,000 lb.

6a. Date of Issuance: October 13, 1977	6b. Expiration Date:
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FOR THE U.S. ATOMIC ENERGY COMMISSION

7a. Address of Issuing Office: Department of Energy Post Office Box E Oak Ridge, Tennessee 37830	7b. Signature, Name, and Title of Approving Official: <i>William H. Travis</i> William H. Travis, Director Safety & Environmental Control Division
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Page 2 - Certificate of Compliance, No. USA/5907/BLF (DOE-OR), Revision 1

(3) Drawings:

The cask was constructed in accordance with Pratt & Whitney Drawing CLR-10572-12 and modified in accordance with Oak Ridge National Laboratory Drawings M-11165-EL-001-D through -011-D.

(b) Contents:

(1) Type and Form of Material

Solid, large quantity of radioactive materials, fissile and non-fissile, encased in metal cladding, meeting special form or packaged in DOT Specification 2R inner container and whose decay heat load does not exceed 350 watts when shipped by common carrier. When shipped by exclusive use vehicle, the decay heat load will not exceed 1,200 watts.

(2) Maximum quantity of material per package

Fissile material is limited to 1250g per shipment; however, if the total quantity of fissile material exceeds 800g, the distribution of fissile material is further limited to 250g per linear foot.

(c) Fissile Class

 

II.B.89

B. RADIOACTIVE SOLIDS

ORNL GARDEN CARRIER NO. 2

II.B.90

ORNL Photo 98436A

ORNL Garden Carrier No. 2
Type B

ORNL Garden Carrier No. 2 - Type B

DEPARTMENT OF TRANSPORTATION
HAZARDOUS MATERIALS REGULATIONS BOARD
WASHINGTON, D.C. 20590

SPECIAL PERMIT NO. 6088

This special permit is issued pursuant to 49 CFR 170.15 of the Department of Transportation (DOT) Hazardous Materials Regulations, as amended, and on the basis of the August 11, 1969, petition by Oak Ridge National Laboratory, Oak Ridge, Tennessee.

1. Shipments of fissile and large quantities of radioactive materials, n.o.s., are hereby authorized in the packaging as described in this special permit. This packaging, when constructed and assembled as prescribed herein, with the contents as authorized herein meets the standards prescribed in the DOT regulations, Sections 173.395(c)(2), 173.396(c)(3), and 173.398(c). Shipments must be in accordance with the provisions of the U. S. Atomic Energy Commission (USAEC), Oak Ridge Operations Office approval number 69-014 dated August 4, 1969, and as further provided for herein.
2. Each shipper, under this permit, other than the petitioner named above, shall register his identity with this Board prior to his first shipment, and shall have a copy of this permit in his possession before making any shipment.
3. The packaging authorized by this permit consists of lead-filled, steel cask weldment, which is a right cylinder approximately 25" in diameter by 49" high, weighing about 8500 pounds, with a 7" diameter by 24" deep cavity. Approximately 8 3/16" of lead shielding is provided. Contents are loaded within DOT Specification 2R or equivalent inner containment. The package is identified as the Garden Carrier Number 2 Shipping Cask, and is described on Oak Ridge National Laboratory's drawing number M-12166-CD-037-D and in the attachment to the USAEC Certification.
4. The contents of each package authorized by this permit consist of fissile and large quantities of radioactive material n.o.s., in the form of unirradiated and irradiated fuel elements and contained sections of fuel elements with solid and liquid mixed fission products, or waste products. Liquids will be contained in primary polyethylene or stainless steel bottles within

Continuation of SP 6088

Page 2

the DOT Specification 2R containment vessel. The maximum thermal decay energy of the contents is 100 watts. The fissile content is limited to not more than 500 grams of uranium-235, 350 grams of uranium-233 or plutonium, or 350 grams of any combination thereof.

5. The packaging authorized by this permit meets the requirements for shipment as Fissile Class I. The transport index must be assigned based on external radiation levels.

6. The outside of each package must be plainly and durably marked "DOT SP 6088", in connection with and in addition to the other markings and labels prescribed by the DOT regulations. Each shipping paper issued in connection with shipments made under this permit must bear the notation "DOT SPECIAL PERMIT NO. 6088", in connection with the commodity description thereon.

7. Each package must have its gross weight plainly and durably marked on the outside of the package.

8. This permit authorizes shipments only by motor vehicle, and rail.

9. The shipper is required to furnish an experience report to this Board before expiration of the permit and when any amendment is requested. This report must include the approximate number of packages shipped, and the number of packages involved in any loss of contents. The modes of transportation used for these shipments must also be shown.

10. Prior to each shipment authorized by this permit, the shipper shall notify the consignee of the dates of shipment and expected arrival. The shipper shall notify each consignee of any special loading/unloading instructions prior to his first shipment.

11. Any incident involving loss of contents of the package must be reported to this Board at the earliest feasible moment following the incident.

B. RADIOACTIVE SOLIDS

ORNL URANIUM SHIELDED SHIPPING CASKS

ORNL Photo 2289-78

ORNL Uranium Shielded Shipping Cask - Type B

II.B.96

MODEL L

MODEL M

ORNL Uranium Shielded Shipping Cask - Type B

Form AEC-618
(12-73)
18 CFR 71
AECM 5201

U.S. ATOMIC ENERGY COMMISSION
CERTIFICATE OF COMPLIANCE
For Radioactive Materials Packages

1a. Certificate Number	1b. Revision No.	1c. Package Identification No.	1d. Page No.	1e. Total No. Pages
USA/5595/BL (ERDA-OR)	1	USA/5595/BL (ERDA-OR)	1	2

2. PREAMBLE

- 2a. This certificate is issued to satisfy Sections 173.393a, 173.394, 173.395, and 173.396 of the Department of Transportation Hazardous Materials Regulations (49 CFR 170-189 and 14 CFR 103) and Sections 146-19-10a and 146-19-100 of the Department of Transportation Dangerous Cargoes Regulations (46 CFR 146-149), as amended.
- 2b. The packaging and contents described in item 5 below, meets the safety standards set forth in Subpart C of Title 10, Code of Federal Regulations, Part 71, "Packaging of Radioactive Material for Transport and Transportation of Radioactive Material Under Certain Conditions."
- 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):

Oak Ridge National Laboratory
Post Office Box X
Oak Ridge, Tennessee 37830

(2) Title and Identification of report or application:

Safety Analysis Report for Packaging
for the ORNL Uranium-Shielded Shipping
Casks Report No. ORNL/ENG/TM-4

(3) Date:

November 1977

4. CONDITIONS

This certificate is conditional upon the fulfilling of the requirements of Subpart D of 10 CFR 71, as applicable, and the conditions specified in item 5 below.

5. Description of Packaging and Authorized Contents, Model Number, Fissile Class, Other Conditions, and References:

(a) Packaging:

(1) Model(s): L and M

(2) Description:

Type B Packaging for large quantities of nonfissile radioactive material. The inner containment vessel which consists of a vessel meeting either special form or DOT Specification 2R, is determined by heat load as follows:

Heat Load (Watts)

≤ 3000

> 3000

Inner Containment Vessel

DOT Spec 2R*

Special Forms

*Metallic gasket required.

The inner containment vessels are positioned within right circular cylinders of 1/4 inch thick stainless steel-clad depleted uranium having a plug-type, bolted and gasketed top lid closure.

6a. Date of Issuance: August 30, 1977	6b. Expiration Date:
FOR THE U.S. ATOMIC ENERGY COMMISSION	
7a. Address of Issuing Office:	7b. Signature, Name, and Title of Approving Official:
U. S. Energy Research & Development Adm. Post Office Box E Oak Ridge, Tennessee 37830	<i>William H. Travis</i> William H. Travis, Director Safety & Environmental Control Division

(a) (2) - Description (continued):

Details of the two Models are as follows:

	<u>Model L</u>	<u>Model M</u>
<u>Cavity</u>		
I.D. (in.)	11	11
Height (in.)	17 1/2	17 1/2
<u>Outside Dimensions</u>		
O.D. (in.)*	25 1/2	25
Height (in.)	39 3/4	38
Bottom Lug Plate		
O.D. (in.)	35 5/8	35 1/8
*Excluding 3 in. deep fins		
<u>Minimum U Shield Thickness (in.)</u>	6 3/4	6
<u>Gross Weight** (lbs.)</u>	13,200	11,600
**Including Skid		

Each cask is mounted on a skid and covered with a personnel heat shield.

(3) Drawings

The packagings are as described and fabricated in accordance with the following Union Carbide Corporation, Nuclear Division, Paducah Plant Drawings:

Model L - M-11572-EM-001-E through -003-E

Model M - M-11572-EM-010-E through -014-E

(b) Contents(1) Type and Form of Material

Nonfissile radioactive materials in solid form.

(2) Maximum quantity of radioactive Material limited by the volume and shape of the internal cavity of each cask, internal heat load, and external radiation levels prescribed in DOT Regulations, Title 49 CFR.(3) Maximum decay heat load not to exceed 4000 watts; however, when the heat load exceed 1250 watts transport will be made by exclusive-use vehicle.

B. RADIOACTIVE SOLIDS

ORNL FOAMGLASS SHIPPING CONTAINER

ORNL Photo 0501-74

ORNL Foamglass Shipping Container - Type B

II.B.102

FOAMGLAS SHIPPING CONTAINER

DOE Form EV-418
(11-77)
10 CFR 71

U.S. DEPARTMENT OF ENERGY
CERTIFICATE OF COMPLIANCE
For Radioactive Materials Packages

1a. Certificate Number	1b. Revision No.	1c. Package Identification No.	1d. Page No.	1e. Total No. Pages.
5795	1	USA/5795/BLF(DOE-OR)	1	3

2. PREAMBLE

- 2a. This certificate is issued to satisfy Sections 173.393a, 173.394, 173.395, and 173.396 of the Department of Transportation Hazardous Materials Regulations (49 CFR 170-189).
- 2b. The packaging and contents described in item 5 below, meets the safety standards set forth in Subpart C of Title 10, Code of Federal Regulations, Part 71, "Packaging of Radioactive Material for Transport and Transportation of Radioactive Material Under Certain Conditions."
- 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):

Oak Ridge National Laboratory
Post Office Box E
Oak Ridge, TN 37830

(2) Title and Identification of report or application:

Safety Analysis Report for Pack-
aging (SARP) of the Oak Ridge National Laboratory
Foamglas Shipping Container

(3) Date:

January 1979

Report No.: ORNL-5407/R1

4. CONDITIONS

This certificate is conditional upon the fulfilling of the requirements of Subpart D of 10 CFR 71, as applicable, and the conditions specified in item 5 below.

5. Description of Packaging and Authorized Contents, Model Number, Fissile Class, Other Conditions, and References:

(a) Packaging

- (1) Model: ORNL Foamglas
- (2) Description:

Packaging for fissile material. The containment vessel is a flanged DOT-Specification 2R inside container consisting of a 4.81" I.D. x 18" long Schedule 80 stainless steel pipe (0.375" wall thickness) with a 1/4" thick welded bottom plate. The flange is sealed with a 1/8" thick x 5" I.D. x 10" O.D. silicone gasket. Fissile material is contained inside sealed metal cans within the containment vessel. Void space inside the containment vessel may be filled with crumpled aluminum foil. The containment vessel is supported inside a DOT Specification 17H 55-gallon drum by solid foamed boron silicate glass (foamglas). The outer steel drum is 23" O.D. x 35 1/16" long. It has a 12-gage bolted closure ring with drop forged lugs, one of which is threaded, and has a 5/8" steel bolt and lock nut. The package gross weight is 215 lb.

(3) Drawing:

The packaging is as described and is fabricated in accordance with ORNL
Drawing 68-14352R6.

6a. Date of Issuance:

6b. Expiration Date:

FOR THE U.S. DEPARTMENT OF ENERGY

7a. Address (of DOE Issuing Office)

U. S. Department of Energy
Post Office Box E
Oak Ridge, Tennessee 37830

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

William H. Travis
William H. Travis, Director
Safety & Environmental Control Division

(b) Contents

(1) Type and form of material:

Uranium and plutonium isotopes either singly or in mixture, as metal oxide. Uranium may contain up to 100% ^{233}U , ^{235}U , or ^{238}U . Plutonium in quantities greater than 50g will contain at least 60wt % ^{239}Pu , more ^{240}Pu than ^{241}Pu , and ^{238}Pu will be considered as ^{239}Pu .

(2) Maximum quantity of material per package:

Not to exceed 10 watts thermal decay and for the fissile contents described in 5(b)(1), the assignment of the transport Index for Fissile Class II is consistent with the following limitations of form, mass, H:X ratio, and density:

Mass (kg of X)			
Transport Index	Metal	UO ₂ Oxide H:X ≤ 0.4	UO ₂ Oxide H:X ≤ 3
Uranium-235			
	($\rho = 18.76$ g U/cm ³)	($\rho = 8.02$ g U/cm ³)	($\rho = 4.48$ g U/cm ³)
0.1	17.2 kg	18.8 kg	15.4 kg
0.2	19.5	24.1	18.4
0.3	20.8	28.2	20.4
0.5	23.0	33.8	23.0
1.0	25.6	43.7	27.4
2.0	28.8	56.1	32.8
Plutonium-239			
	($\rho = 19.7$ g Pu/cm ³)	($\rho = 8.73$ g Pu/cm ³)	($\rho = 4.71$ g Pu/cm ³)
0.1	5.3 kg	10.5 kg	9.2 kg
0.2	5.6	11.6	10.7
0.3	5.8	12.4	11.8
0.5	6.2	13.5	13.3
1.0	6.5	14.9	15.6
2.0	7.0	16.5	18.3
Uranium-233			
	($\rho = 18.4$ g U/cm ³)	($\rho = 8.03$ g U/cm ³)	($\rho = 4.46$ g U/cm ³)
0.1	7.5 kg	11.1 kg	8.3 kg
0.2	8.0	12.6	10.1
0.3	8.3	13.7	11.5
0.5	8.8	15.0	13.3
1.0	9.2	17.1	16.2
2.0	9.9	19.3	19.8

II.B.106

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- (c) Fissile Class II and III
- (1) Minimum transport index to be
be shown on label for Class II 0.1
- (2) Maximum Transport Indexes per
shipment for Class III 100
- (d) External radiation levels will conform to US DOT Regulations,
49 CFR 173.393.
- (e) ORNL foamglas containers loaded with Pu in excess of 20 Ci
will be transported in SST's (Safe Secure Trailers) operated
by USDOE-ALO in order to conform to 10 CFR 71.42(b).

B. RADIOACTIVE SOLIDS

Y-12 DT-14 PACKAGING FOR ENRICHED URANIUM

II.B.108

ORNL Photo 2865-78

Y-12 DT-14 Package for Enriched Uranium
Type B

DOE Form EV-418
(11-77)
10 CFR 71U.S. DEPARTMENT OF ENERGY
CERTIFICATE OF COMPLIANCE
For Radioactive Materials Packages

1a. Certificate Number 9852	1b. Revision No. 1	1c. Package Identification No. USA/9852/BF (DOE-OR)	1d. Page No. 1	1e. Total No. Pages. 3
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2. PREAMBLE

2a. This certificate is issued to satisfy Sections 173.393a, 173.394, 173.395, and 173.396 of the Department of Transportation Hazardous Materials Regulations (49 CFR 170-189).

2b. The packaging and contents described in item 5 below, meets the safety standards set forth in Subpart C of Title 10, Code of Federal Regulations, Part 71, "Packaging of Radioactive Material for Transport and Transportation of Radioactive Material Under Certain Conditions."

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): Union Carbide Corporation Nuclear Division Oak Ridge Y-12 Plant Post Office Box Y Oak Ridge, Tennessee 37830	(2) Title and Identification of report or application: Safety Analysis Report for Packaging (Oak Ridge Y-12 Plant Model DT-14 Package for Enriched Uranium) Report No.: Y/DD-244	(3) Date: January 1978
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4. CONDITIONS
This certificate is conditional upon the fulfilling of the requirements of Subpart D of 10 CFR 71, as applicable, and the conditions specified in item 5 below.

5. Description of Packaging and Authorized Contents, Model Number, Fissile Class, Other Conditions, and References:

(a) Packaging:

(1) Model: DT-14

(2) Description:

Packaging for uranium enriched in the U-235 isotope. The primary Containment Vessel consists of either a polyethylene bottle with a normal wall thickness of 1.0 mm (40 mils) or greater or a metal can with a nominal wall thickness of 0.254 mm (10 mils) such as DOT Specification 2A or 2N. The Containment Vessel consists of (i) inner Containment Vessel from Los Alamos M-101 with breech lock closure held in place by at least three set screws, (ii) inner Containment Vessel from Rocky Flats M-102 with breech lock closure held in place by at least three set screws, or (iii) alternate vessel of steel pipe tubing 6.5" I.D. x 0.25" wall thickness x 15.5" long with flange closure utilizing light 3/8" bolts. A 0.25"-gland-diameter neoprene O-ring is required for the top closure for each of the three types of Containment Vessels. Flange bolts are torqued to at least 1 foot-pound. The Containment Vessel is centered and supported within an 18 gauge DOT Spec. 17H - 30 gallon size drum by cane fiberboard insulation with a minimum density of 14 lb/ft³. One-quarter inch plywood discs will be provided as load bearing surface both above and below the inner Containment Vessel. The

6a. Date of Issuance: May 22, 1978	6b. Expiration Date:
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FOR THE U.S. DEPARTMENT OF ENERGY

7a. Address (of DOE Issuing Office) U.S. Department of Energy Post Office Box E Oak Ridge, Tennessee 37830	7b. Signature, Name, and Title (of DOE Approving Official) <i>William H. Travis</i> William H. Travis, Director Safety & Environmental Control Division
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II.B.111

Certificate of Compliance, USA/9852/BF, - 2 -
Revision 1

outer steel drum closure must be at least a 12-gauge bolted ring with drop forged lugs, one of which is threaded, and having a 5/8" steel bolt and locknut. The package gross weight is 210 lb.

(3) Drawings:

- (a) The packaging is as described and fabricated in accordance with the Union Carbide Corporation, Nuclear Division, Oak Ridge Y-12 Plant Drawings (Figures 1, 2, 3 and 4, and Pages 6, 7, 9, and 10 respectively of Report Y/DD-244).

(b) Contents:

(1) Type and form of material.

Enriched uranium at any U-235 enrichment as metal, compounds or solutions.

(2) Maximum quantity of material per package not to exceed Type B quantities of radioactive material and not more than 21 kg of U-235.

(3) Maximum internal heat load not to exceed 10 watts.

(c) Fissile Class:

II and III

- (1) Transport index to be shown on label for Class II based on loading and conditions as follows:

	Metal or Alloys (1)	Mixtures, Compounds, and Solutions (2)					Assigned Transport Index
		<18.75	<8.33	<4.55	<2.05	<1.15	
²³⁵ U Density (g/cm ³) —							
H/ ²³⁵ U Atom Ratio —	0.00	<0.43	<1.22	<10.7	<21.4	Unlimited	
KG. —→	10.0	9.5	7.0	4.7	3.3	0.30	0.1
	14.5	13.3	9.3	5.8	3.9	0.45	0.3
	18.0	16.5	11.2	6.6	4.4	0.58	0.6
	-	19.3	12.8	7.2	4.8	0.70	1.0
	-	21.0	14.0	7.7	5.0	0.75	1.4
	-	-	16.0	8.5	5.5	0.85	2.3
	-	-	-	-	-	1.00	5.0

II.B.112

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Revision 1-

Note: Total material contents within inner Containment Vessel must not exceed 30 kg. Beryllium and deuterium not permitted. Low-density ($\leq 1.0 \text{ g/cm}^3$) packaging material, with no intermingling with fissile material may cushion material within inner Containment Vessel.

- (a) Multiple metal pieces for which any piece has a volume-to-surface ratio less than a one-inch cube ($V/S \leq 0.17 \text{ in}$) shall be securely grouped together in either polyethylene bottle or metal can. Examples of such items are one-half-inch cubes, thin plates measuring $2'' \times 8'' \times 0.42''$, or pieces of undeterminable surface area with a minimum dimension $< 1 \text{ inch}$.

≤ 120 grams of packaging material may be interstitially used for metal pieces. Greater packaging-material masses require that the restrictions on mixtures, compounds, and solutions be observed.

Alloying material masses shall be assumed to be ^{235}U , except where alloying reduces the actual ^{235}U density below 8.33 g/cm^3 . Alloys with ^{235}U densities $\leq 8.33 \text{ g/cm}^3$ may be packaged as mixtures, compounds, and solutions.

- (b) Uranium hydrides with densities $> 4.55 \text{ g/cm}^3$ not permitted. A water-tight polyethylene bottle with a 1-mm minimum wall thickness shall be used to contain solutions or dry compounds. Dry compounds may be placed in water-tight metal cans.

- (2) Maximum transport index per shipment for Class III

100

B. RADIOACTIVE SOLIDS

ORNL UNIRRADIATED FUEL SHIPPING CONTAINER

	OVERALL LENGTH (in.)	OUTSIDE DIA. (in.)
ORR	56 ³ / ₈	24 ¹ / ₂
BNL	75 ¹ / ₂	24 ¹ / ₂
NBS	87 ¹ / ₈	26

ORNL Unirradiated Fuel Shipping Container - Type B

DOE Form EV-618
(11-77)
10 CFR 71U.S. DEPARTMENT OF ENERGY
CERTIFICATE OF COMPLIANCE
For Radioactive Materials Packages

1a. Certificate Number	1b. Revision No.	1c. Package Identification No.	1d. Page No.	1e. Total No. Pages
9853	0	USA/9853/BF	1	3

2. PREAMBLE

- 2a. This certificate is issued to satisfy Sections 173.393a, 173.394, 173.395, and 173.396 of the Department of Transportation Hazardous Materials Regulations (49 CFR 170-189).
- 2b. The packaging and contents described in item 5 below, meets the safety standards set forth in Subpart C of Title 10, Code of Federal Regulations, Part 71, "Packaging of Radioactive Material for Transport and Transportation of Radioactive Material Under Certain Conditions."
- 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):

Oak Ridge National Laboratory
Post Office Box X
Oak Ridge, Tennessee 37830

(2) Title and Identification of report or application:

Safety Analysis Report for Pack-
aging: The Unirradiated Fuel Shipping
Container

(3) Date:

Aug 1979

Report: ORNL/ENG/TM-15

4. CONDITIONS

This certificate is conditional upon the fulfilling of the requirements of Subpart D of 10 CFR 71, as applicable, and the conditions specified in item 5 below.

5. Description of Packaging and Authorized Contents, Model Number, Fissile Class, Other Conditions, and References:

a. Packaging:

- (1) Model: ORNL Unirradiated Fuel Shipping Container
- (2) Description:

Packaging for unirradiated fissile material as fuel elements. The fuel elements are positioned in a basket consisting of seven square cavities fabricated from 16 gauge plate and a base fabricated from eleven gauge plate. The plate is Type 300 stainless steel. Eight 3/8" nuts and bolts retain the basket lid, which is made from 0.125" thick aluminum, in place. The basket is positioned inside a cylindrical outer shell. The outer shell and lid are fabricated from eleven gauge plate and the base is 1/4" thick plate. The plate for the shell is Type 300 stainless steel. The outer lid is held in place by six 5/8" nuts and bolts. The basket is supported on 2" x 6" timbers inside the outer shell. The remaining space around the basket is filled with phenolic foam insulation.

There are different types of packages. Table I describes the details of each design.

b. Contents:

- (1) Type and form of material

The uranium is enriched to ~93% ²³⁵U and is in the oxide form. It is

6a. Date of Issuance	JUN 4 1979	6b. Expiration Date:	
FOR THE U.S. DEPARTMENT OF ENERGY			
7a. Address (of DOE Issuing Office)	7b. Signature, Name, and Title (of DOE Approving Official)		
U. S. Department of Energy Post Office Box E Oak Ridge, Tennessee 37830	William H. Travis, Director Safety and Environmental Control Division		

III. COMMERCIAL PACKAGES SHIPPED FROM ORNL

(NRC or DOT Approved)

TECHNICAL OPERATIONS

Technical Operations Iridium-192 Cask
Type B

SPECIFICATIONS

SIZE — 21 in. W x 21 in. L x 20 in. H
 WT. OF DEPLETED URANIUM — 209 LBS.
 TOTAL WEIGHT — 370 LBS.

TECHNICAL OPERATIONS INC.
 MODEL 702
 IRIIDIUM-192 SHIPPING CONTAINER

III.4

Form NRC 618
(12-73)
10 CFR 71

U.S. NUCLEAR REGULATORY COMMISSION CERTIFICATE OF COMPLIANCE For Radioactive Materials Packages

1.(a) Certificate Number 6613	1.(b) Revision No. 0	1.(c) Package Identification No. USA/6613/B()	1.(d) Pages No. 1	1.(e) Total No. Pages 3
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2. PREAMBLE

- 2.(a) This certificate is issued to satisfy Sections 173.393a, 173.394, 173.395, and 173.396 of the Department of Transportation Hazardous Materials Regulations (49 CFR 170-189 and 14 CFR 103) and Sections 146-19-10a and 146-19-100 of the Department of Transportation Dangerous Cargoes Regulations (46 CFR 146-149), as amended.
- 2.(b) The packaging and contents described in item 5 below, meets the safety standards set forth in Subpart C of Title 10, Code of Federal Regulations, Part 71, "Packaging of Radioactive Materials for Transport and Transportation of Radioactive Material Under Certain Conditions."
- 2.(c) 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—

3.(a) Prepared by (Name and address):

Technical Operations, Inc.
Northwest Industrial Park
Burlington, Massachusetts 01803

3.(b) Title and Identification of report or application:

Technical Operations, Inc. application dated
October 14, 1971, as supplemented.

3.(c) Docket No. 71-6613

4. CONDITIONS

This certificate is conditional upon the fulfilling of the requirements of Subpart D of 10 CFR 71, as applicable, and the conditions specified in item 5 below.

5. Description of Packaging and Authorized Contents, Model Number, Fissile Class, Other Conditions, and References:

(a) Packaging

- (1) Model No.: 702
- (2) Description

The cask system overall dimensions are 21" x 21" x 20". The shielding container is a stainless steel-depleted uranium-stainless steel stepped annulus closed at one end and with a lid closure at the other. The base plate is square in shape and extends outside the annulus to provide a base for the twenty-four fins and space for placing four tie down bolts. The top cover is equipped with an eye bolt and two drain and vent plugs, is secured to the main body of the cask by four stainless steel 3/8-inch bolts. The top cover is sealed with a 0.0625 inch thick rubber gasket. The annulus formed by the stainless steel shells is filled with depleted uranium. Copper sheets are placed between the uranium-stainless steel interfaces. Connecting the outer and inner shell assemblies at the top of the cask is a 5/8-inch thick stainless steel flange ring.

The flange ring has four holes to accommodate the cask cover bolts. The skid is made of 1/4-inch thick hot rolled steel plate reinforced with 1/4-inch plates at points where the cask and the cage

III.5

Page 2 - Certificate No. 6613 - Revision No. 0 - Docket No. 71-6613

will be bolted to it. The cask is mounted on the skid with four 1/2-inch bolts and a tie down system consisting of four 1/2-inch diameter threaded rods, base supports and top brackets. The cage is constructed of 1 1/4-inch square steel tubing and perforated 18 gauge steel sheets tack welded to the tubular frame. Maximum gross weight of the packaging is 370 pounds.

(3) Drawings

The cask and other system components are constructed in accordance with the following Technical Operations, Inc. Drawings Nos. and Bill of Materials Nos.: D70202, Rev. D; B/M 70202, Sheets 1 and 2, Rev. none; B708, Rev. E; A70201-1, Rev. none; A70205-2, Rev. none; C70205-1, Rev. none; C70201, Rev. none; C70205, Rev. none; B70203, Rev. none; B/M 70203, Rev. none; A70202-1, Rev. A; D70206, Rev. none; and D70204, Rev. A.

(b) Contents

(1) Type and form of material

Metallic iridium 192.

(2) Maximum quantity of material per package

10,000 curies.

(3) Maximum decay heat per package

100 watts.

6. The 10,000 curies of iridium 192, in metallic form, shall be enclosed in steel special form capsules shown in Drawing No. B708, Rev. E, which are assembled with a new copper gasket and closed with a minimum torque of 15 ft-lb.
7. The package authorized by this certificate is hereby approved for use under the general license provisions of Paragraph 71.12(b) of 10 CFR Part 71.
8. Expiration date: March 31, 1982.

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REFERENCES

Technical Operations, Inc. applicated dated October 14, 1971.

Supplements dated: January 10 and February 11, 1972.

FOR THE U.S. NUCLEAR REGULATORY COMMISSION

RH Odgaard
for Charles E. MacDonald, Chief
Transportation Branch
Division of Fuel Cycle and
Material Safety

Date: JUN 13 1977

III. COMMERCIAL PACKAGES SHIPPED FROM ORNL

(NRC or DOT Approved)

GENERAL ELECTRIC COMPANY

General Electric Shipping Container
Type B

GENERAL ELECTRIC - MODEL 8500 SHIELDED CONTAINER

III.10

Form NRC-618
(12-73)
10 CFR 71

U.S. NUCLEAR REGULATORY COMMISSION CERTIFICATE OF COMPLIANCE For Radioactive Materials Packages

1.(a) Certificate Number	1.(b) Revision No.	1.(c) Package Identification No.	1.(d) Pages No.	1.(e) Total No. Pages
6697	5	USA/6697/B()	1	3

2. PREAMBLE

- 2.(a) This certificate is issued to satisfy Sections 173.393a, 173.394, 173.395, and 173.396 of the Department of Transportation Hazardous Materials Regulations (49 CFR 170-189 and 14 CFR 103) and Sections 146-19-10a and 146-19-100 of the Department of Transportation Dangerous Cargoes Regulations (46 CFR 146-149), as amended.
- 2.(b) The packaging and contents described in item 5 below, meets the safety standards set forth in Subpart C of Title 10, Code of Federal Regulations, Part 71, "Packaging of Radioactive Materials for Transport and Transportation of Radioactive Material Under Certain Conditions."
- 2.(c) 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—

<p>3.(a) Prepared by (Name and address):
General Electric Company
P. O. Box 460
Pleasanton, California 94566</p>	<p>3.(b) Title and identification of report or application:
General Electric Company application dated
November 29, 1979.</p>
3.(c) Docket No. 71-6697	

4. CONDITIONS

This certificate is conditional upon the fulfilling of the requirements of Subpart D of 10 CFR 71, as applicable, and the conditions specified in item 5 below.

5. Description of Packaging and Authorized Contents, Model Number, Fissile Class, Other Conditions, and References:

(a) Packaging

- (1) Model No.: GE-8500
- (2) Description

The packaging is a steel, uranium shielded shipping cask surrounded by a laminated plywood protective jacket.

The inner shielded cask is an upright circular cylinder, consisting of an inner shell, 2-7/8 inches ID x 6-1/8 inches high, made of 1/8-inch thick stainless steel which is surrounded by 1-13/16 inches of depleted uranium and enclosed in a 7-inch OD x 10-1/2-inch high x 1/8-inch thick stainless steel outer shell.

Closure is by means of six, 3/8-inch diameter bolts and a 1/8-inch thick neoprene rubber gasket between body and lid. The shielded cask is positioned in a two-piece protective jacket of solid plywood laminations which is bolted to a rectangular pallet made of aluminum. The protective jacket is 15-1/4 inches OD x 20-1/2 inches high and together with the pallet, weighs 80 pounds. The cavity of the shielded cask contains a leak tight, 2R type, steel insert, shown on GE Drawing No.161F443, Rev. 5 or 135C5982, Rev. 4, or 106D3830, Rev. 8 (the latter to be used with the liner shown on 153C4613, Rev. 1). The gross weight of the loaded package is approximately 285 pounds.

Page 2 - Certificate No. 6697 - Revision No. 5 - Docket No. 71-6697

5. (a) Packaging (continued)

(3) Drawings

The package is constructed in accordance with the following General Electric Company Drawing Nos.: 277E696, Rev. 6; 277E712, Rev. 6; 174F482, Rev. 5; 289E795, Rev. 3; 195F169, Rev. 2; 289E796, Rev. 5; 161F443, Rev. 5; or 135C5982, Rev. 4; or 106D3830, Rev. 8 with 153C4613, Rev. 1.

(b) Contents

(1) Type and form of material

Radioactive materials as solids.

(2) Maximum quantity of material per package

Greater than Type A quantities of radioactive material with the decay heat load not exceeding 50 watts. Plutonium in excess of twenty (20) curies per package must be in the form of metal, metal alloy or reactor fuel elements.

6. Prior to each shipment, the package lid Neoprene gasket shall be inspected. The gasket shall be replaced with a new Neoprene gasket if inspection shows any defects or every twelve (12) months, whichever occurs first. In each shipment, a new Viton O-ring shall be used to seal the 2R type insert.
7. The 2R type insert shall be pretested to ensure leak tightness prior to each use in accordance with Attachment D of General Electric's letter dated November 29, 1979.
8. The radiation dose level shall not exceed 1000 millirem per hour, at a distance of 3 feet from the surface of the depleted uranium cask, when the wooden protective jacket is not in place.
9. The package authorized by this certificate is hereby approved for use under the general license provisions of 10 CFR §71.12(b).
10. Expiration date: February 28, 1985.

III. COMMERCIAL PACKAGES SHIPPED FROM ORNL

(NRC or DOT Approved)

J. L. SHEPHERD AND ASSOCIATES

III.14

Form NRC-618
(12-73)
10 CFR 71

U.S. NUCLEAR REGULATORY COMMISSION CERTIFICATE OF COMPLIANCE For Radioactive Materials Packages

1.(a) Certificate Number 6280	1.(b) Revision No. 1	1.(c) Package Identification No. USA/6280/B()	1.(d) Pages No. 1	1.(e) Total No. Pages 2
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2. PREAMBLE

- 2.(a) This certificate is issued to satisfy Sections 173.393a, 173.394, 173.395, and 173.396 of the Department of Transportation Hazardous Materials Regulations (49 CFR 170-189 and 14 CFR 103) and Sections 146-19-10a and 146-19-100 of the Department of Transportation Dangerous Cargoes Regulations (46 CFR 146-149), as amended.
- 2.(b) The packaging and contents described in item 5 below, meets the safety standards set forth in Subpart C of Title 10, Code of Federal Regulations, Part 71, "Packaging of Radioactive Materials for Transport and Transportation of Radioactive Material Under Certain Conditions."
- 2.(c) 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—

3.(a) Prepared by (Name and address): J. L. Shepherd and Associates 703 South Pacific Avenue Glendale, California 91204	3.(b) Title and identification of report or application: J. L. Shepherd and Associates application dated May 5, 1972, as supplemented. 3.(c) Docket No. 71-6280
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4. CONDITIONS

This certificate is conditional upon the fulfilling of the requirements of Subpart D of 10 CFR 71, as applicable, and the conditions specified in item 5 below.

5. Description of Packaging and Authorized Contents, Model Number, Fissile Class, Other Conditions, and References:

(a) Packaging

(1) Model No.: A-0109 Irradiator in A-0117 Overpack

(2) Description

The packaging consists of an inner, lead-filled, steel weldment (Model A-0109 irradiator) enclosed within an outer protective enclosure (Model A-0117 overpack). The irradiator is a right cylinder, 31 inches diameter by 36 inches high, with a bolted top plug closure. The overpack is a double-walled steel cylinder enclosing a shock absorbing and thermal insulation core of glue-bonded layers of balsa wood (11 lbs/cu. ft. density, 12 inches thick on the sides). The irradiator is held in place in the overpack by steel spacers attached to a 1/2 inch thick steel plate at each end. The void between the irradiator and inside wall of the overpack is filled with hardwood spacers. The overpack cover is secured by 30-5/8 inch diameter bolts. The dimensions of the package are 50.5 inches diameter by 73 inches long. The weight of the shielded irradiator is 7,000 lbs. and the weight of the overpack is 3,400 lbs., totaling 10,400 lbs.

(3) Drawings

The overpack and irradiator are constructed in accordance with J. L. Shepherd and Associates Drawings Nos.: A-0109-A1, A-0109-10, A-0109-20, A-0117B, A-0117C, and A-0117-C1.

5. (b) Contents

(1) Type and form of material

Cobalt 60 as cobalt wire encapsulated and heliarc welded in a stainless steel tube. The source is further encapsulated in an annular capsule approximately 6 inches in diameter by 6.43 inches long and sealed by heliarc welding. The cobalt 60 must meet the special form requirements of 10 CFR 71.

(2) Maximum quantity of material per package

30,000 curies

6. The overpack must be modified by the addition of not less than 14-1/4 inch diameter vent holes in the outer shell (two each in the top cap and cap side, two in the bottom, and in two side tiers of 4 holes each, at 90° separation, with each tier located about one foot from each end). The holes must be sealed to prevent the inleakage of water but not so as to affect their capability of venting in the event of fire.
7. The package authorized by this certificate is hereby approved for use under the general license provisions of Paragraph 71.12(b) of 10 CFR Part 71.
8. Expiration date: November 30, 1979.

REFERENCES

J. L. Shepherd and Associates' application dated May 5, 1972.

Supplement dated: June 27, 1972.

FOR THE U.S. NUCLEAR REGULATORY COMMISSION

Charles E. MacDonald, Chief
Transportation Branch
Division of Fuel Cycle and
Material Safety

Date: MAR 29 1977

III. COMMERCIAL PACKAGES SHIPPED FROM ORNL

(NRC or DOT Approved)

GAMMA INDUSTRIES

Gamma Industries DOT 20WC-1
Type B

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OPERATIONS DIVISION

Radioisotope Department

MASTER

OAK RIDGE NATIONAL LABORATORY
SHIPPING CONTAINERS FOR
RADIOACTIVE MATERIALS

R. W. Schaich

Date Published: May 1980

NOTICE This document contains information of a preliminary nature. It is subject to revision or correction and therefore does not represent a final report.

OAK RIDGE NATIONAL LABORATORY
Oak Ridge, Tennessee 37830
operated by
UNION CARBIDE CORPORATION
for the
DEPARTMENT OF ENERGY

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National Technical Information Service
U.S. Department of Commerce
5285 Port Royal Road, Springfield, Virginia 22161
NTIS price codes—Printed Copy: A10 Microfiche A01

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Revised 3/1/81

I. ORNL TYPE A PACKAGES

Oak Ridge National Laboratory (ORNL) shipping containers for radioactive materials which meet the requirements of the Code of Federal Regulations No. 49 [Department of Transportation (DOT)], and the International Atomic Energy Agency (IAEA) Safety Series No. 6 (1973) for Type A packaging are divided into three categories.

- A. Radioactive Liquids and Solids
- B. Radioactive Solids
- C. Radioactive Gases

The quantities of radioactive material that are approved for shipment by the CFR-49, Transportation, Part 173.389e, in a Type A package are listed in the following chart.

Transport group (see § 173.389(h))	Type A quantity (in curies)
I.....	0.001
II.....	0.05
III.....	3
IV.....	20
V.....	20
VI and VII.....	1,000
Special form.....	20 ^a

^a Except that for Californium-252 the Type A quantity limit for special form is 2 curies.

The transport group for each radionuclide can be determined from the following chart (CFR-49, Part 173.390a).

III. CLASSIFICATION OF RADIOACTIVE MATERIAL

Table I. Classification of Radionuclides into Groups for Transportation Purposes

Element ¹	Radionuclide ³	Transport Group							Element ¹	Radionuclide ³	Transport Group						
		I	II	III	IV	V	VI	VII			I	II	III	IV	V	VI	VII
Actinium (89)....	Ac-227.....	X	...	...	...	...	...	...	Californium (98)..	Cf-249.....	X	...	...	...	...	...	...
	Ac-228.....	X	...	...	...	...	...	...		Cf-250.....	X	...	...	...	...	...	...
Aluminum (13)....	Al-26.....	...	X	...	...	...	...	...		Cf-252.....	X	...	...	...	...	...	...
Americium (95)...	Am-241.....	X	...	...	...	...	...	...	Carbon (6).....	C-14.....	...	...	...	X	...	...	...
	Am-243.....	X	...	...	...	...	...	...		Cerium (58).....	Ce-139.....	...	...	X	...	...	...
Antimony (51)....	Sb-122.....	...	...	...	X	...	...	...			Ce-141.....	...	...	...	X	...	...
	Sb-124.....	...	...	X	...	...	...	...			Ce-143.....	...	...	...	X	...	...
	Sb-125.....	...	...	X	...	...	...	...			Ce-144.....	...	...	X	...	...	...
Argon (18).....	Ar-37.....	...	...	...	...	...	X	...	Cesium (55).....	Cs-131.....	...	...	...	X	...	...	...
	Ar-41.....	...	X	...	...	...	...	...		Cs-132.....	...	...	...	X	...	...	...
	Ar-41 (uncompressed) ² .	...	...	...	...	X	...	...		Cs-134m.....	...	...	...	X	...	...	...
Arsenic (33).....	As-73.....	...	...	...	X	...	...	...		Cs-134.....	...	...	...	X	...	...	...
	As-74.....	...	...	...	X	...	...	...		Cs-135.....	...	...	...	X	...	...	...
	As-76.....	...	...	...	X	...	...	...		Cs-136.....	...	...	...	X	...	...	...
	As-77.....	...	...	...	X	...	...	...	Chlorine (17)....	Cs-137.....	...	...	...	X	...	...	...
Astatine (85)....	At-211.....	...	...	X	...	...	...	...		Cl-36.....	...	...	...	X	...	...	...
Barium (56).....	Ba-131.....	...	...	...	X	...	...	...	Chromium (24)....	Cl-38.....	...	...	...	X	...	...	...
	Ba-133.....	...	X	...	...	...	...	...		Cr-51.....	...	...	...	X	...	...	...
	Ba-140.....	...	...	X	...	...	...	...	Cobalt (27).....	Co-56.....	...	...	X	...	...	...	...
Berkelium (97)...	Bk-249.....	X	...	...	...	...	...	...		Co-57.....	...	...	...	X	...	...	...
Beryllium (4)....	Be-7.....	...	...	...	X	...	...	...		Co-58m.....	...	...	...	X	...	...	...
	Bi-205.....	...	...	X	...	...	...	...		Co-58.....	...	...	...	X	...	...	...
Bismuth (83)....	Bi-206.....	...	...	...	X	...	...	...		Co-60.....	...	...	X	...	...	...	...
	Bi-207.....	...	...	X	...	...	...	...	Copper (29).....	Cu-64.....	...	...	...	X	...	...	...
	Bi-210.....	...	X	...	...	...	...	...		Curium (96).....	Cm-242.....	X	...	...	...	...	...
	Bi-212.....	...	...	X	...	...	...	...			Cm-243.....	X	...	...	...	...	...
Bromine (35)....	Br-77.....	...	...	X	...	...	...	...		Cm-244.....	X	...	...	...	...	...	...
	Br-82.....	...	...	...	X	...	...	...	Dysprosium (66)...	Cm-245.....	X	...	...	...	...	...	...
Cadmium (48)....	Cd-109.....	...	...	...	X	...	...	...		Cm-246.....	X	...	...	...	...	...	...
	Cd-115m.....	...	...	X	...	...	...	...		Dy-154.....	...	...	X	...	...	...	...
	Cd-115.....	...	...	...	X	...	...	...		Dy-157.....	...	...	X	...	...	...	...
Calcium (20)....	Ca-45.....	...	...	...	X	...	...	...	Erbium (68).....	Dy-165.....	...	...	...	X	...	...	...
	Ca-47.....	...	...	...	X	...	...	...		Dy-166.....	...	...	...	X	...	...	...
		...	...	...	...	...	...	...		Er-169.....	...	...	...	X	...	...	...
		...	...	...	...	...	...	...		Er-171.....	...	...	...	X	...	...	...

ORNL-DWG 76-13675R

TYPICAL ASSEMBLY DETAIL, 10 gal SIZE DOT-6M
WEIGHT-60 lbs, TYPE B

Form NRC-618
(12-73)
10 CFR 71

U.S. NUCLEAR REGULATORY COMMISSION
CERTIFICATE OF COMPLIANCE
For Radioactive Materials Packages

1.(a) Certificate Number 5908	1.(b) Revision No. 8	1.(c) Package Identification No. USA/5908/B()F	1.(d) Pages No. 1	1.(e) Total No. Pages 3
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2. PREAMBLE

- 2.(a) This certificate is issued to satisfy Sections 173.393a, 173.394, 173.395, and 173.396 of the Department of Transportation Hazardous Materials Regulations (49 CFR 170-189 and 14 CFR 103) and Sections 146-19-10a and 146-19-100 of the Department of Transportation Dangerous Cargoes Regulations (46 CFR 148-149), as amended.
- 2.(b) The packaging and contents described in item 5 below, meets the safety standards set forth in Subpart C of Title 10, Code of Federal Regulations, Part 71, "Packaging of Radioactive Materials for Transport and Transportation of Radioactive Material Under Certain Conditions."
- 2.(c) 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--

3.(a) Prepared by (Name and address): The Babcock & Wilcox Company 609 N. Warren Avenue Apollo, PA 15613	3.(b) Title and identification of report or application: Nuclear Materials and Equipment Corporation application dated May 3, 1974, as supplemented. 3.(c) Docket No. 71-5908
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4. CONDITIONS

This certificate is conditional upon the fulfilling of the requirements of Subpart D of 10 CFR 71, as applicable, and the conditions specified in item 5 below.

5. Description of Packaging and Authorized Contents, Model Number, Fissile Class, Other Conditions, and References:

(a) Packaging

(1) Model No.: DOT-6M Type B

(2) Description

Metal packaging as described and constructed in accordance with DOT Specification 6M (49 CFR §178.104).

(b) Contents

(1) Type and form of material

(i) Solid radioactive materials which will not decompose at temperatures up to 250°F. Carbide compounds are not authorized; or

(ii) UO₂ or UO₂ mixtures in the form of powder or compact pellets; or

(iii) Plutonium nitrate or uranyl nitrate solution in flame sealed glass ampoules or screw top plastic vials, each within one or more additional plastic vials with taped lids, and within a sealed product can or polyethylene bottle containing a sufficient amount of vermiculite to absorb twice the liquid contents present; or

(b) Contents (continued)

(1) Type and form of material (continued)

- (iv) Plutonium sources in excess of twenty (20) curies per package must be at least double encapsulated in a metal capsule such that the sources meet special form criteria defined in 10 CFR §71.4(o).

Inner and outer capsules are individually leak tested during fabrication per ANSI N542-1977, procedure A2.2.3 (He pressure bubble test), or equivalent.

(2) Maximum quantity of material per package and fissile class

- (i) For the material described in 5.(b)(1)(i), the maximum fissile material and maximum hydrogen per package for Fissile Class I is as follows:

<u>Fissile Material</u>	<u>Maximum fissile material per package, kilograms</u>	<u>Hydrogen Material per package, grams</u>
U-235	1.6	20
Pu	0.9*	11
U-233	0.5	6.4

*Because of the 10 watt thermal decay heat limitation, the limit for Pu-238 is 0.02 kilograms. Plutonium in excess of twenty (20) curies per package must be in the form of metal, metal alloy or reactor fuel elements.

- (ii) For the material described in 5.(b)(1)(i) the maximum U-235 loading for uranium bearing materials with an H/X < 3 and the minimum transport index to be assigned to each package for Fissile Class II is as follows

<u>Maximum Kgs U-235</u>	<u>Minimum Transport Index</u>
4.2	0.1
5.4	0.2
7.3	0.5
9.1	1.0

- (iii) For the material described in 5.(b)(1)(ii) the maximum quantity of U-233 is 500 grams at an H/U ratio not to exceed 20, as Fissile Class III with a limit of 51 packages per shipment. The package size shall not be less than 55 gallons.
- (iv) For the material described in 5.(b)(1)(iii) the maximum quantity of material is not to exceed 20 Ci radioactivity and 40 ml of solution. Fissile material shall not exceed 10 grams.
- (v) For the material described in 5.(b)(1)(iv) the maximum quantity of plutonium is 100 Ci.

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6. Two steel through bolts may be installed between the lid and bottom of the steel drums.
7. Venting may be provided by a 1-inch diameter hole in the drum lid backed by a minimum 1/2-inch thick Cerafelt refractory pad.
8. Maximum decay heat per package shall not exceed ten (10) watts.
9. The package authorized by this certificate is hereby approved for use under the general license provisions of 10 CFR §71.12(b).
10. Expiration date: February 28, 1986.

REFERENCES

References Required for All Contents Except Contents Described in 5.(b)(1)(iv)

Nuclear Materials and Equipment Corporation application dated May 3, 1974.

Additional References Required for Contents Described in 5.(b)(1)(ii)

Westinghouse Electric Corporation supplement (WAPD-RS(CC)-620) dated May 8, 1973.

DOE, NR supplement dated March 28, 1979.

Additional Reference Required for Contents Described in 5.(b)(1)(iii) and 5.(b)(2)(iv)

Allied Chemical Corporation, Report No. ICP-1061, December 1974.

Reference Required for Contents Described in 5.(b)(1)(iv)

Monsanto Research Corporation application dated January 10, 1980.

FOR THE U.S. NUCLEAR REGULATORY COMMISSION

Charles E. MacDonald, Chief
Transportation Certification Branch
Division of Fuel Cycle and
Material Safety

Date: FEB 03 1981

Revised 9/1/81

- c. This certificate does not relieve any consignor or carrier from compliance with any requirement of the Government of any country through or into which the package is to be transported.

V. Marking and Labeling - The package must bear the marking USA/5787/B()F as well as the other marking and labels prescribed by the USA Regulations.

VI. Expiration Date - This certificate, unless renewed, expires on January 31, 1981.

This certificate is issued in accordance with the requirements of the IAEA and USA Regulations and in response to the November 25, 1975, petition by the U. S. Energy Research & Development Administration, Oak Ridge, Tennessee, and in consideration of the associated information provided in USERDA, Oak Ridge Certificate AEC-OR USA/5787/BLF (Appendix A).

Certified by:

R. R. Rawl, Health Physicist
Office of Hazardous Materials Regulation
U. S. Department of Transportation
Washington, D. C. 20590

(Date)

¹"Safety Series No. 6, Regulations for the Safe Transport of Radioactive Materials, 1967 Edition" published by the International Atomic Energy Agency (IAEA), Vienna, Austria.

²Title 49, Code of Federal Regulations, Parts 100-199, USA.

This certificate supersedes in its entirety DOT Special Permit 5787 with respect to international shipments.

Revision 1 issued to extend expiration date in response to the January 19, 1979, petition by the Department of Energy, Oak Ridge, TN.

U.S. DEPARTMENT OF ENERGY
CERTIFICATE OF COMPLIANCE
For Radioactive Materials Packages

1a. Certificate Number 5787	1b. Revision No. 1	1c. Package Identification No. USA/5787/BLF(DOE-OR)	1d. Page No. 1	1e. Total No. Pages. 2
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2. PREAMBLE

- 2a. This certificate is issued to satisfy Sections 173.393a, 173.394, 173.395, and 173.396 of the Department of Transportation Hazardous Materials Regulations (49 CFR 170-189).
- 2b. The packaging and contents described in item 5 below, meets the safety standards set forth in Subpart C of Title 10, Code of Federal Regulations, Part 71, "Packaging of Radioactive Material for Transport and Transportation of Radioactive Material Under Certain Conditions."
- 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):

Oak Ridge National Laboratory
Post Office Box X
Oak Ridge, Tennessee 37830

(2) Title and Identification of report or application:

Safety Analysis Report for
Packaging (SARP) of the Oak
Ridge National Laboratory Shipping Cask D-38
Report ORNL-5406

(3) Date:

April 1978

4. CONDITIONS

This certificate is conditional upon the fulfilling of the requirements of Subpart D of 10 CFR 71, as applicable, and the conditions specified in item 5 below.

5. Description of Packaging and Authorized Contents, Model Number, Fissile Class, Other Conditions, and References:

(a) Packaging:

(1) Model: D-38 Shipping Cask

(2) Description:

Packaging for transport of fissile and large quantities of radioactive material as solids including mixed fission products, fuel elements, and waste, which are contained within inner DOT Special Form Containers or meet Special Form encapsulation. Plutonium is doubly contained.

The inner cavity of the cask is a 300 Series Stainless Steel Schedule 40 pipe with inside dimensions 6-1/16 in. diameter x 13-13/16 in. high. The outer shell is a 300 Series Stainless Steel Schedule 30 pipe 20-1/2 in. high. Shielding consists of depleted uranium metal with a thickness of 2-3/4 in. The top opening plug is held in place by eighteen 1/3-in. studs equipped with nuts. The plug is sealed with a neoprene gasket. The cask is mounted on a 14-in. square x 5/8-in. thick base plate. Six of the studs are extra long so that a protective shroud may be utilized during transport. The cask is bolted with four 1-in. bolts to a 3-ft. square pallet.

The gross weight of the package is 1525 lb.

6a. Date of Issuance: July 24, 1981

6b. Expiration Date:

FOR THE U.S. DEPARTMENT OF ENERGY

7a. Address (of DOE Issuing Office)

U.S. Department of Energy
Post Office Box E
Oak Ridge, Tennessee 37830

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

HW Hillis
for William H. Travis, Director
Safety & Environmental Control Division

Revised 9/1/81

(3) Drawings

The cask is described and fabricated in accordance with Union Carbide Corporation, Nuclear Division, Oak Ridge National Laboratory drawings:

M-12133-CD-126E. Rev. 12 and M-12166-CD-022 Rev. 1.

(b) Contents:

Type and form of material:

- (1) Solid, large quantity of radioactive materials, fissile and nonfissile, packaged in DOT Specification 2R inner Container(s) or meeting Special Form. Plutonium will be doubly contained inside the cask. Dry heat load does not exceed 80 watts. Heat loads in excess of 20 watts are shipped "exclusive-use" of vehicle.
- (2) External radiation levels will be within the levels prescribed by DOT Regulations, Title 49 CFR 173.393.
- (3) Specific limits of contents:
 - (i) 500 g of ^{235}U ,
 - (ii) 350 g of ^{233}U or ^{239}Pu ,
 - (iii) 350 g of any combination of (i) or (ii) above.

(c) Fissile Class:

I

NOTE: BOTTOM END OF CASK LIFTING DEVICES RAISED TO ALLOW
SLIDING DOORS TO BE SHOWN SHIFTED 90°.

ORNL Garden Carrier No. 2 - Type B

II.B.92

DOE Form EV-618
(11-77)
10 CFR 71U.S. DEPARTMENT OF ENERGY
CERTIFICATE OF COMPLIANCE
For Radioactive Materials Packages

1a. Certificate Number 6088	1b. Revision No. 1	1c. Package Identification No. USA/6088/BLF(DOE-OR)	1d. Page No. 1	1e. Total No. Pages. 2
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2. PREAMBLE

- 2a. This certificate is issued to satisfy Sections 173.393a, 173.394, 173.395, and 173.396 of the Department of Transportation Hazardous Materials Regulations (49 CFR 170-189).
- 2b. The packaging and contents described in item 5 below, meets the safety standards set forth in Subpart C of Title 10, Code of Federal Regulations, Part 71, "Packaging of Radioactive Material for Transport and Transportation of Radioactive Material Under Certain Conditions."
- 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):

Oak Ridge National Laboratory
Post Office Box X
Oak Ridge, Tennessee 37830

(2) Title and Identification of report or application:

Safety Analysis Report for
Packaging (SARP) of the Oak Ridge
National Laboratory Garden Carrier No. 2, Revision 1,
Report ORNL-5408/R1

(3) Date:

August 1979

4. CONDITIONS

This certificate is conditional upon the fulfilling of the requirements of Subpart D of 10 CFR 71, as applicable, and the conditions specified in item 5 below.

5. Description of Packaging and Authorized Contents, Model Number, Fissile Class, Other Conditions, and References:

(a) Packaging

- (1) Model: ORNL Garden Carrier No. 2.
- (2) Description: A 304L stainless steel encased lead shipping cask.

Packaging for solid radioactive materials as whole or sectioned unirradiated and irradiated fuel elements, fission products, and wastes. The 25 in. ODx45 in. high cylindrical cask consists of lead, 8-3/16 in. thick, encased in 304L stainless steel. The inner cavity is 7 in. IDx24 in. high. Access to the cavity is through a plug equipped with an O-ring for top loading and two sliding drawers for bottom opening. Side cover plates for the drawers and the bottom cover plate, which are equipped with gaskets, are bolted to the cask body. The O-ring and gaskets are made of neoprene.

The radioactive material is contained within a DOT Specification 2R container as specified, which is positioned within an inner container made of 304L stainless steel 5 in. diameter schedule 10 pipe. The overall dimensions are 6-7/8 in. OD 23-1/2 in. high and the inside dimensions are 5.36 in. dia. x 20-11/16 in. high. The inner container is covered with a 10-bolt flange equipped with an O-ring made of neoprene or Silastic.

During shipment, the cask is bolted with 8 1-1/2 in. x 5-1/2 in. long bolts to a 5 ft. x 5 ft. x 7-1/4 in. high skid. The cask is covered with a 43 in. OD x 52 in. high fire shield consisting of a 2 in. thickness of Kaowood insulation

6a. Date of Issuance: June 30, 1981

6b. Expiration Date:

FOR THE U.S. DEPARTMENT OF ENERGY

7a. Address (of DOE Issuing Office)

U.S. Department of Energy
Post Office Box E
Oak Ridge, Tennessee 37830

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

AWH
for William H. Travis, Director
Safety & Environmental Control Division

Revised 9/1/81

(Babcock & Wilcox ceramic fiber insulation) encased in steel plate--1/2 in. thick outside and 3/16 in. inside. The void between the top of the cask and inside of the fire shield is partially filled with an annular ring of maple wood. Two maple wood pads fastened to the inside of fire shield are positioned over the drawer cover plates. The fire shield is aligned on the skid by 2 locating pins and is attached to the skid by 8 1-1/2 in. dia. x 3-1/2 in. long bolts.

(3) Drawings:

The cask, skid, fire shield, and inner flanged container and modifications are described in Oak Ridge National Laboratory Drawings:

M-11332-EM-010-E-4
M-11332-EM-011-E-3
M-11332-EM-012-E-2
M-11332-EM-013-E-0
M-11332-EM-014-E-2
M-11332-EM-015-E-1
M-11332-EM-016-E-0
M-11332-EM-017-D-0
M-11332-EM-018-E-4
M-11332-EM-019-D-0
M-11332-EM-020-D-4
M-12124-CB-043-D-2
M-12166-CD-037-D-2
M-12166-CD-043-E-1

(b) Contents

(1) Type and Form of Material:

Solid, fissile, and large quantity of radioactive materials in the form of unirradiated or irradiated fuel elements, whole or sections, solid fission products, and wastes. The radioactive materials are contained within a DOT Specification 2R inner container as specified in Report ORNL-5408/R1.

(2) Maximum quantity per package:

- (a) 500 g of ²³⁵U or
- (b) 350 g of ²³³U or Pu or
- (c) 350 g of any combination of fissile material.

(3) Other limitations:

- (a) Maximum heat load--100 W.
- (b) External radiation dose rates--limited to DOT Regulations, 49 CFR 173.393.

(c) Fissile Class: I

III. COMMERCIAL PACKAGES SHIPPED FROM ORNL

(NRC or DOT Approved)

J. L. SHEPHERD AND ASSOCIATES

III.14
U.S. NUCLEAR REGULATORY COMMISSION
CERTIFICATE OF COMPLIANCE
For Radioactive Materials Packages

1.(a) Certificate Number	1.(b) Revision No.	1.(c) Package Identification No.	1.(d) Pages No.	1.(e) Total No. Pages
6280	2	USA/6280/B()	1	2

2. PREAMBLE

- 2.(a) This certificate is issued to satisfy Sections 173.393a, 173.394, 173.395, and 173.396 of the Department of Transportation Hazardous Materials Regulations (49 CFR 170-189 and 14 CFR 103) and Sections 146-19-10a and 146-19-100 of the Department of Transportation Dangerous Cargoes Regulations (46 CFR 146-149), as amended.
- 2.(b) The packaging and contents described in item 5 below, meets the safety standards set forth in Subpart C of Title 10, Code of Federal Regulations, Part 71, "Packaging of Radioactive Materials for Transport and Transportation of Radioactive Material Under Certain Conditions."
- 2.(c) 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—

3.(a) Prepared by (Name and address):

J. L. Shepherd and Associates
740 Salem Street
Glendale, CA 91203

3.(b) Title and identification of report or application:

J. L. Shepherd and Associates application
dated September 5, 1979.

3.(c) Docket No. 71-6280

4. CONDITIONS

This certificate is conditional upon the fulfilling of the requirements of Subpart D of 10 CFR 71, as applicable, and the conditions specified in item 5 below.

5. Description of Packaging and Authorized Contents, Model Number, Fissile Class, Other Conditions, and References:

(a) Packaging

(1) Model No.: A-0109 Irradiator in A-0117 Overpack

(2) Description

The packaging consists of an inner, lead-filled, steel weldment (Model A-0109 irradiator) enclosed within an outer protective enclosure (Model A-0117 overpack). The irradiator is a right cylinder, 37 inches diameter by 36 inches high, with a bolted top plug closure. The overpack is a double-walled steel cylinder enclosing a shock absorbing and thermal insulation core of glue-bonded layers of balsa wood (11 lbs/cu. ft. density, 12 inches thick on the sides). The irradiator is held in place in the overpack by steel spacers attached to a 1/2 inch thick steel plate at each end. The void between the irradiator and inside wall of the overpack is filled with hardwood spacers. The overpack cover is secured by 30-5/8 inch diameter bolts. The dimensions of the package are 50.5 inches diameter by 73 inches long. The weight of the shielded irradiator is 7,000 lbs. and the weight of the overpack is 3,400 lbs., totaling 10,400 lbs.

(3) Drawings

The overpack and irradiator are constructed in accordance with J. L. Shepherd and Associates Drawings Nos.: A-0109-A1, A-0109-10, A-0109-20, A-0117B, A-0117C, and A-0117-C1.

Revised 9/1/81

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5. (b) Contents

(1) Type and form of material

Cobalt 60 as cobalt wire encapsulated and heliarc welded in a stainless steel tube. The source is further encapsulated in an annular capsule approximately 6 inches in diameter by 6.43 inches long and sealed by heliarc welding. The cobalt 60 must meet the special form requirements of 10 CFR 71.

(2) Maximum quantity of material per package

30,000 curies

6. The overpack must be modified by the addition of not less than 14-1/4 inch diameter vent holes in the outer shell (two each in the top cap and cap side, two in the bottom, and in two side tiers of 4 holes each, at 90° separation, with each tier located about one foot from each end). The holes must be sealed to prevent the inleakage of water but not so as to affect their capability of venting in the event of fire.
7. The package authorized by this certificate is hereby approved for use under the general license provisions of Paragraph 71.12(b) of 10 CFR Part 71.
8. Expiration date: November 30, 1984.

REFERENCES

J. L. Shepherd and Associates' application dated September 5, 1979.

FOR THE U.S. NUCLEAR REGULATORY COMMISSION

Charles E. MacDonald, Chief
Transportation Certification Branch
Division of Fuel Cycle and
Material Safety

Date: NOV 30 1979

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