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**OAK RIDGE
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MARTIN MARIETTA

Oak Ridge National Laboratory Shipping Containers for Radioactive Materials

R. W. Schaich

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Oak Ridge National Laboratory Shipping Containers for Radioactive Materials

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R. W. Schaich
Radioisotope Department
Operations Division

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Radioisotope Department

OAK RIDGE NATIONAL LABORATORY
SHIPPING CONTAINERS FOR
RADIOACTIVE MATERIALS

R. W. Schaich

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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 173.435, in a Type A package are listed in Table I, where A_1 represents the maximum curie content in Special Form and A_2 represents the maximum curie content in Normal Form.

Table 1. Table of A_1 and A_2 values for radionuclides

Symbol of radionuclide	Element and atomic number	A_1 (Ci)	A_2 (Ci)	Specific Activity (Ci/g)	Symbol of radionuclide	Element and atomic number	A_1 (Ci)	A_2 (Ci)	Specific Activity (Ci/g)
^{227}Ac	Actinium (89)	1000	0.003	7.2×10	^{77}Br	Bromine (35)	70	25	7.1×10^5
^{228}Ac		10	4	2.2×10^6	^{82}Br		6	6	1.1×10^6
^{105}Ag	Silver (47)	40	40	3.1×10^4	^{11}C	Carbon (6)	20	20	8.4×10^3
$^{110\text{m}}\text{Ag}$		7	7	4.7×10^3	^{14}C		1000	60	4.6
^{111}Ag		100	20	1.6×10^5	^{45}Ca	Calcium (20)	1000	25	1.9×10^4
^{241}Am	Americium (95) ¹	8	0.008	3.2	^{47}Ca		20	20	5.9×10^5
^{243}Am		8	0.008	1.9×10^{-1}	^{109}Cd	Cadmium (48)	1000	70	2.6×10^3
^{37}Ar (compressed or uncompressed)	Argon (18)	1000	1000	1.0×10^5	$^{115\text{m}}\text{Cd}$		30	30	2.6×10^4
^{41}Ar (uncompressed)		20	20	4.3×10^7	^{115}Cd		80	20	5.1×10^5
^{41}Ar (compressed)		1	1	4.3×10^7	^{139}Ce	Cerium (58)	100	100	6.5×10^3
^{73}As	Arsenic (33)	1000	400	2.4×10^4	^{141}Ce		300	25	2.8×10^4
^{74}As		20	20	1.0×10^5	^{143}Ce		60	20	6.6×10^5
^{76}As		10	10	1.6×10^6	^{144}Ce		10	7	3.2×10^3
^{77}As		300	20	1.1×10^5	^{249}Cf	Californium (98)	2	0.002	3.1
^{211}At	Astatine (85)	200	7	2.1×10^6	^{250}Cf		7	0.007	1.3×10^2
^{193}Au	Gold (79)	200	200	9.3×10^5	^{252}Cf		2	0.009	6.5×10^2
^{196}Au		30	30	1.2×10^5	^{36}Cl	Chlorine (17)	300	10	3.2×10^{-2}
^{198}Au		40	20	2.5×10^5	^{38}Cl		10	10	1.3×10^3
^{199}Au		200	25	2.1×10^5	^{242}Cm	Curium (96)	200	0.2	3.3×10^3
^{131}Ba	Barium (56)	40	40	8.7×10^4	^{243}Cm		9	0.009	4.2×10
^{133}Ba		40	10	4.0×10^2	^{244}Cm		10	0.01	8.2×10
^{140}Ba		20	20	7.3×10^4	^{245}Cm		6	0.006	1.0×10^{-1}
^7Be	Beryllium (4)	300	300	3.5×10^5	^{246}Cm		6	0.006	3.6×10^{-1}
^{206}Bi	Bismuth (83)	5	5	9.9×10^4	^{248}Cm		2	0.002	
^{207}Bi		10	10	2.2×10^2	^{56}Co	Cobalt (27)	5	5	3.0×10^4
^{210}Bi (RaE)		100	4	1.2×10^5	^{57}Co		90	90	8.5×10^3
^{212}Bi		6	6	1.5×10^7	$^{58\text{m}}\text{Co}$		1000	1000	5.9×10^3
^{249}Bk	Berkelium (97)	1000	1	1.8×10^3	^{58}Co		20	20	3.1×10^4
					^{60}Co		7	7	1.1×10^3

Table I. Table of A_1 and A_2 values for radionuclides (Continued)

Symbol of radionuclide	Element and atomic number	A_1 (Ci)	A_2 (Ci)	Specific Activity (Ci/g)	Symbol of radionuclide	Element and atomic number	A_1 (Ci)	A_2 (Ci)	Specific Activity (Ci/g)
^{51}Cr	Chromium (24)	600	600	9.2×10^4	^3H	Hydrogen (1) see T-Tritium			
^{129}Cs	Cesium (55)	40	40	7.6×10^5	^{181}Hf	Hafnium (72)	30	25	1.6×10^4
^{131}Cs		1000	1000	1.0×10^5	^{197m}Hg	Mercury (80)	200	200	6.6×10^5
^{134m}Cs		1000	10	7.4×10^6	^{197}Hg		200	200	2.5×10^5
^{134}Cs		10	10	1.2×10^3	^{203}Hg		80	25	1.4×10^4
^{135}Cs		1000	25	8.8×10^{-4}	^{164}Ho	Holmium (67)	30	30	6.9×10^5
^{136}Cs		7	7	7.4×10^4	^{123}I	Iodine (53)	50	50	1.9×10^6
^{137}Cs		30	10	9.8×10	^{125}I		1000	70	1.7×10^4
^{64}Cu	Copper (29)	80	25	3.8×10^6	^{126}I		40	10	7.8×10^4
^{67}Cu		200	25	7.9×10^5	^{129}I		1000	2	1.6×10^{-4}
^{165}Dy	Dysprosium (66)	100	20	8.2×10^6	^{131}I		40	10	1.2×10^5
^{166}Dy		1000	200	2.3×10^5	^{132}I		7	7	1.1×10^7
^{169}Er	Erbium (68)	1000	25	8.2×10^4	^{133}I		30	10	1.1×10^6
^{171}Er		50	20	2.4×10^6	^{134}I		8	8	2.7×10^7
^{152m}Eu	Europium (63)	30	30	2.2×10^6	^{135}I		10	10	3.5×10^6
^{152}Eu		20	10	1.9×10^2	^{111}In	Indium (49)	30	25	4.2×10^5
^{154}Eu		10	5	1.5×10^2	^{113m}In		60	60	1.6×10^7
^{155}Eu		400	60	1.4×10^3	^{114m}In		30	20	2.3×10^4
^{18}F	Fluorine (9)	20	20	9.3×10^7	^{115m}In		100	20	6.1×10^6
^{52}Fe	Iron (26)	5	5	7.3×10^6	^{190}Ir	Iridium (77)	10	10	6.2×10^4
^{55}Fe		1000	1000	2.2×10^3	^{192}Ir		20	10	9.1×10^3
^{59}Fe		10	10	4.9×10^4	^{194}Ir		10	10	8.5×10^5
^{67}Ga	Gallium (31)	100	100	6.0×10^5	^{42}K	Potassium (19)	10	10	6.0×10^6
^{68}Ga		20	20	4.0×10^7	^{43}K		20	10	3.3×10^6
^{72}Ga		7	7	3.1×10^6	^{85m}Kr (uncompressed)	Krypton (36)	100	100	8.4×10^6
^{153}Gd	Gadolinium (64)	200	100	3.6×10^3	^{85m}Kr (compressed)		3	3	8.4×10^6
^{159}Gd		300	20	1.1×10^6	^{85}Kr (uncompressed)		1000	1000	4.0×10^2
^{68}Ge	Germanium (32)	20	10	7.0×10^3	^{85}Kr (compressed)		5	5	4.0×10^2
^{71}Ge		1000	1000	1.6×10^5	^{87}Kr (uncompressed)		20	20	2.8×10^7
					^{87}Kr (compressed)		0.6	0.6	2.8×10^7

Table 1. Table of A_1 and A_2 values for radionuclides (Continued)

Symbol of radionuclide	Element and atomic number	A_1 (Ci)	A_2 (Ci)	Specific Activity (Ci/g)	Symbol of radionuclide	Element and atomic number	A_1 (Ci)	A_2 (Ci)	Specific Activity (Ci/g)
^{140}La	Lanthanum (57)	30	30	5.6×10^5	^{231}Pa		2	0.002	4.5×10^{-2}
LSA	Low specific activity material - see §173.403				^{233}Pa		100	100	2.1×10^4
^{177}Lu	Lutetium (71)	300	25	1.1×10^5	^{201}Pb	Lead (82)	20	20	1.7×10^6
MFP	Mixed fission products	10	0.4	---	^{210}Pb		100	0.2	8.8×10
^{28}Mg	Magnesium (12)	6	6	5.2×10^6	^{212}Pb		6	5	1.4×10^6
^{52}Mn	Manganese (25)	5	5	4.4×10^5	^{103}Pd	Palladium (46)	1000	700	7.5×10^4
^{54}Mn		20	20	8.3×10^3	^{109}Pd		100	20	2.1×10^6
^{56}Mn		5	5	2.2×10^7	^{147}Pm	Promethium (61)	1000	25	9.4×10^2
^{99}Mo	Molybdenum (42)	100	20	4.7×10^5	^{149}Pm		100	20	4.2×10^5
^{13}N	Nitrogen (7)	20	10	1.5×10^9	^{210}Po	Polonium (84)	200	0.2	4.5×10^3
^{22}Na	Sodium (11)	8	8	6.3×10^3	^{142}Pr	Praseodymium (59)	10	10	1.2×10^6
^{24}Na		5	5	8.7×10^6	^{143}Pr		300	20	6.6×10^4
$^{93\text{m}}\text{Nb}$	Niobium (41)	1000	200	1.1×10^3	^{191}Pt	Platinum (78)	100	100	2.3×10^5
^{95}Nb		20	20	3.9×10^4	$^{193\text{m}}\text{Pt}$		200	200	2.0×10^5
^{97}Nb		20	20	2.6×10^7	$^{197\text{m}}\text{Pt}$		300	20	1.2×10^7
^{147}Nd	Neodymium (60)	100	20	8.0×10^4	^{197}Pt		300	20	8.8×10^5
^{149}Nd		30	20	1.1×10^7	^{238}Pu	Plutonium (94) ¹	3	0.003	1.7×10
^{59}Ni	Nickel (28)	1000	900	8.1×10^{-2}	^{239}Pu		2	0.002	6.2×10^{-2}
^{63}Ni		1000	100	4.6×10	^{240}Pu		2	0.002	2.3×10^{-1}
^{65}Ni		10	10	1.9×10^7	^{241}Pu		1000	0.1	1.1×10^2
^{237}Np	Neptunium (93)	5	0.005	6.9×10^{-4}	^{242}Pu		3	0.003	3.9×10^{-3}
^{239}Np		200	25	2.3×10^5	^{223}Ra	Radium (88)	50	0.2	5.0×10^4
^{185}Os	Osmium (76)	20	20	7.3×10^3	^{224}Ra		6	0.5	1.6×10^5
^{191}Os		600	200	4.6×10^4	^{226}Ra		10	0.05	1.0
$^{191\text{m}}\text{Os}$		200	200	1.2×10^6	^{228}Ra		10	0.05	2.3×10^2
^{193}Os		100	20	5.3×10^5	^{81}Rb	Rubidium (37)	30	25	8.2×10^6
^{32}P	Phosphorus (15)	30	30	2.9×10^5	^{86}Rb		30	30	8.1×10^4
^{230}Pa	Protactinium (91)	20	0.8	3.2×10^4	^{87}Rb		Unlimited	Unlimited	6.6×10^{-8}
					Rb (natural)		Unlimited	Unlimited	1.8×10^{-8}

Table 1. Table of A₁ and A₂ values for radionuclides (Continued)

Symbol of radionuclide	Element and atomic number	A ₁ (Ci)	A ₂ (Ci)	Specific Activity (Ci/g)	Symbol of radionuclide	Element and atomic number	A ₁ (Ci)	A ₂ (Ci)	Specific Activity (Ci/g)
¹⁸⁶ Re	Rhenium (75)	100	20	1.9 × 10 ⁵	⁸⁹ Sr		100	10	2.9 × 10 ⁴
¹⁸⁷ Re		Unlimited	Unlimited	3.8 × 10 ⁻⁸	⁹⁰ Sr		10	0.4	1.5 × 10 ²
¹⁸⁸ Re		10	10	1.0 × 10 ⁶	⁹¹ Sr		10	10	3.6 × 10 ⁶
Re (natural)		Unlimited	Unlimited	2.4 × 10 ⁻⁸	⁹² Sr		10	10	1.3 × 10 ⁷
^{103m} Rh	Rhodium (45)	1000	1000	3.2 × 10 ⁷	T (uncompressed)	Tritium (1)	1000	1000	9.7 × 10 ³
¹⁰⁵ Rh		200	25	8.2 × 10 ⁵	T (compressed)		1000	1000	9.7 × 10 ³
²²² Rn	Radon (86)	10	2	1.5 × 10 ⁵	T (activated luminous paint)		1000	1000	9.7 × 10 ³
⁹⁷ Ru	Ruthenium (44)	80	80	5.5 × 10 ⁵	T (adsorbed on solid carrier)		1000	1000	9.7 × 10 ³
¹⁰³ Ru		30	25	3.2 × 10 ⁴	T (tritiated water)		1000	1000	9.7 × 10 ³
¹⁰⁵ Ru		20	20	6.6 × 10 ⁶	T (other forms)		20	20	9.7 × 10 ³
¹⁰⁶ Ru		10	7	3.4 × 10 ³	¹⁸² Ta	Tantalum (73)	20	20	6.2 × 10 ³
³⁵ S	Sulphur (16)	1000	60	4.3 × 10 ⁴	¹⁶⁰ Tb	Terbium (65)	20	10	1.1 × 10 ⁴
¹²² Sb	Antimony (51)	30	30	3.9 × 10 ⁵	^{96m} Tc	Technetium (43)	1000	1000	3.8 × 10 ⁷
¹²⁴ Sb		5	5	1.8 × 10 ⁴	⁹⁶ Tc		6	6	3.2 × 10 ⁵
¹²⁵ Sb		40	25	1.4 × 10 ³	^{97m} Tc		1000	200	1.5 × 10 ⁴
⁴⁶ Sc	Scandium (21)	8	8	3.4 × 10 ⁴	⁹⁷ Tc		1000	400	1.4 × 10 ⁻³
⁴⁷ Sc		200	20	8.2 × 10 ⁵	^{99m} Tc		100	100	5.2 × 10 ⁶
⁴⁸ Sc		5	5	1.5 × 10 ⁶	⁹⁹ Tc		1000	25	1.7 × 10 ⁻²
⁷⁵ Se	Selenium (34)	40	40	1.3 × 10 ⁴	^{123m} Te	Tellurium (52)	26	3	
³¹ Si	Silicon (14)	100	20	3.9 × 10 ⁷	^{125m} Te		1000	100	1.8 × 10 ⁴
¹⁴⁷ Sm	Samarium (62)	Unlimited	Unlimited	2.0 × 10 ⁻⁸	^{127m} Te		300	20	4.0 × 10 ⁴
¹⁵¹ Sm		1000	90	2.6 × 10	¹²⁷ Te		300	20	2.6 × 10 ⁶
¹⁵³ Sm		300	20	4.4 × 10 ⁵	^{129m} Te		30	10	2.5 × 10 ⁴
¹¹³ Sn	Tin (50)	60	60	1.0 × 10 ⁴	¹²⁹ Te		100	20	2.0 × 10 ⁷
^{119m} Sn		100	100	4.4 × 10 ³	^{131m} Te		10	10	8.0 × 10 ⁵
¹²⁵ Sn		10	10	1.1 × 10 ⁵	¹³² Te		7	7	3.1 × 10 ⁵
^{85m} Sr	Strontium (38)	80	80	3.2 × 10 ⁷					
⁸⁵ Sr		30	30	2.4 × 10 ⁴					
^{87m} Sr		50	50	1.2 × 10 ⁷					

Table 1. Table of A₁ and A₂ values for radionuclides (Continued)

Symbol of radionuclide	Element and atomic number	A ₁ (Ci)	A ₂ (Ci)	Specific Activity (Ci/g)	Symbol of radionuclide	Element and atomic number	A ₁ (Ci)	A ₂ (Ci)	Specific Activity (Ci/g)
²²⁷ Th	Thorium (90)	200	0.2	3.2 × 10 ⁴	¹⁸⁵ W		1000	25	9.7 × 10 ⁻³
²²⁸ Th		6	0.008	8.3 × 10 ²	¹⁸⁷ W		40	20	7.0 × 10 ⁵
²²⁹ Th		3	2		¹²⁷ Xe (uncompressed)	Xenon (54)	70	70	2.8 × 10 ⁴
²³⁰ Th		3	0.003	1.9 × 10 ⁻²	¹²⁷ Xe (compressed)		5	5	2.8 × 10 ⁴
²³¹ Th		1000	25	5.3 × 10 ⁵	^{131m} Xe (compressed)		10	10	1.0 × 10 ⁵
²³² Th		Unlimited	Unlimited	1.1 × 10 ⁻⁷	^{131m} Xe (uncompressed)		100	100	1.0 × 10 ⁵
²³⁴ Th		10	10	2.3 × 10 ⁴	¹³³ Xe (uncompressed)		1000	1000	1.9 × 10 ⁵
Th (natural)		Unlimited	Unlimited	2.2 × 10 ⁻⁷	¹³³ Xe (compressed)		5	5	1.9 × 10 ⁵
Th (irradiated) ²		---	---	---	¹³⁵ Xe (uncompressed)		70	70	2.5 × 10 ⁵
²⁰⁰ Tl	Thallium (81)	20	20	5.8 × 10 ⁵	¹³⁵ Xe (compressed)		2	2	2.5 × 10 ⁵
²⁰¹ Tl		200	200	2.2 × 10 ⁵	⁸⁷ Y	Yttrium (39)	20	20	4.5 × 10
²⁰² Tl		40	40	5.4 × 10 ⁴	⁹⁰ Y		10	10	2.5 × 10 ⁵
²⁰⁴ Tl		300	10	4.3 × 10 ²	^{91m} Y		30	30	4.1 × 10 ⁷
¹⁷⁰ Tm	Thulium (69)	300	10	6.0 × 10 ³	⁹¹ Y		30	30	2.5 × 10 ⁴
¹⁷¹ Tm		1000	100	1.1 × 10 ³	⁹² Y		10	10	9.5 × 10 ⁶
²³⁰ U	Uranium (92)	100	0.1	2.7 × 10 ⁴	⁹³ Y		10	10	3.2 × 10 ⁶
²³² U		30	0.03	2.1 × 10	¹⁶⁹ Yb	Ytterbium (70)	80	80	2.3 × 10 ⁵
²³³ U		100	0.1	9.5 × 10 ⁻³	¹⁷⁵ Yb		400	25	1.8 × 10 ⁵
²³⁴ U		100	0.1	6.2 × 10 ⁻³	⁶⁵ Zn	Zinc (30)	30	30	8.0 × 10 ³
²³⁵ U		100	0.2	2.1 × 10 ⁻⁶	^{69m} Zn		40	20	3.3 × 10 ⁶
²³⁶ U		200	0.2	6.3 × 10 ⁻⁵	⁶⁹ Zn		300	20	5.3 × 10 ⁷
²³⁸ U		Unlimited	Unlimited	3.3 × 10 ⁻⁷	⁹³ Zr	Zirconium (40)	1000	200	3.5 × 10 ⁻³
U (natural)		Unlimited	Unlimited	(see §173.434)	⁹⁵ Zr		20	20	2.1 × 10 ⁴
U (enriched) <20%		Unlimited	Unlimited	(see §173.434)	⁹⁷ Zr		20	20	2.0 × 10 ⁶
20% or greater		100	0.1	(see §173.434)					nuclear-powered pacemakers.
U (depleted)		Unlimited	Unlimited	(see §173.434)					² The values of A ₁ and A ₂ must be calculated in accordance with the procedure specified in §173.433 of this subchapter, taking into account the activity of the fission products and of the uranium-235 in addition to that of the thorium.
U (irradiated) ³		---	---	---					³ The values of A ₁ and A ₂ must be calculated in accordance with the procedure specified in §173.433 of this subchapter, taking into account the activity of the fission products and plutonium isotopes in addition to that of the uranium.
⁴⁸ V	Vanadium (23)	6	6	1.7 × 10 ⁵					
¹⁸¹ W	Tungsten (74)	200	100	5.0 × 10 ³					

Footnotes for Table

¹For shipments solely within the United States the A₁ value is 20 curies for americium and plutonium contained in Am-Be or Pu-Be neutron sources or in

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"

Inner Containment: Duraglas 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.

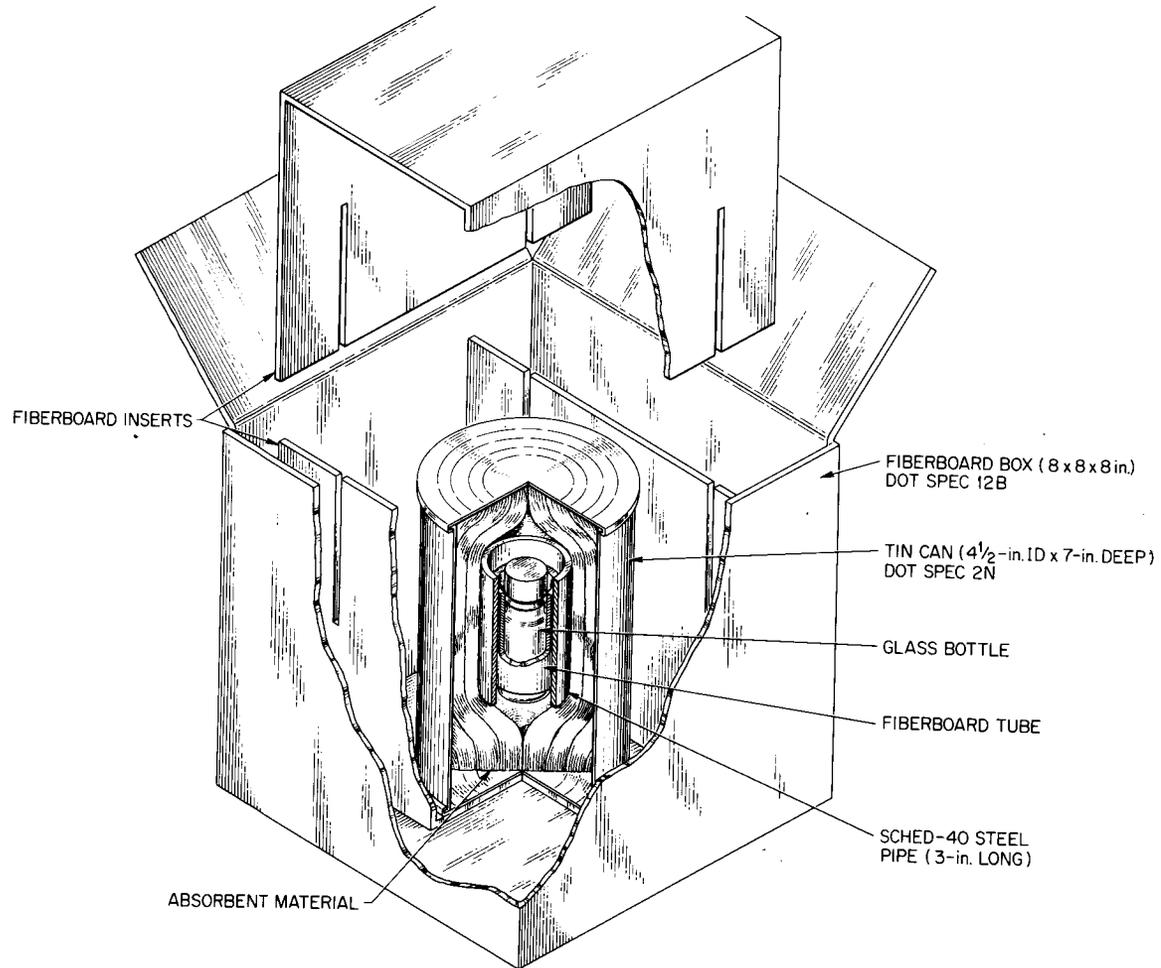
Weight: 3 lbs.

Radioactive Materials: All TYPE A quantities of radioactive liquids or solids requiring minimal shielding (liquids in Duraglas 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.5

DOT-IAEA TYPE A

ORNL SHIPPING CONTAINERS

A. Radioactive Liquids and Solids

2. Shielded - Non-Returnable

Size: 8" x 8" x 8"

Inner Containment: Duraglas bottle (15 to 200 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.

Weight: 0.5 in. lead shielding - 22 lbs.

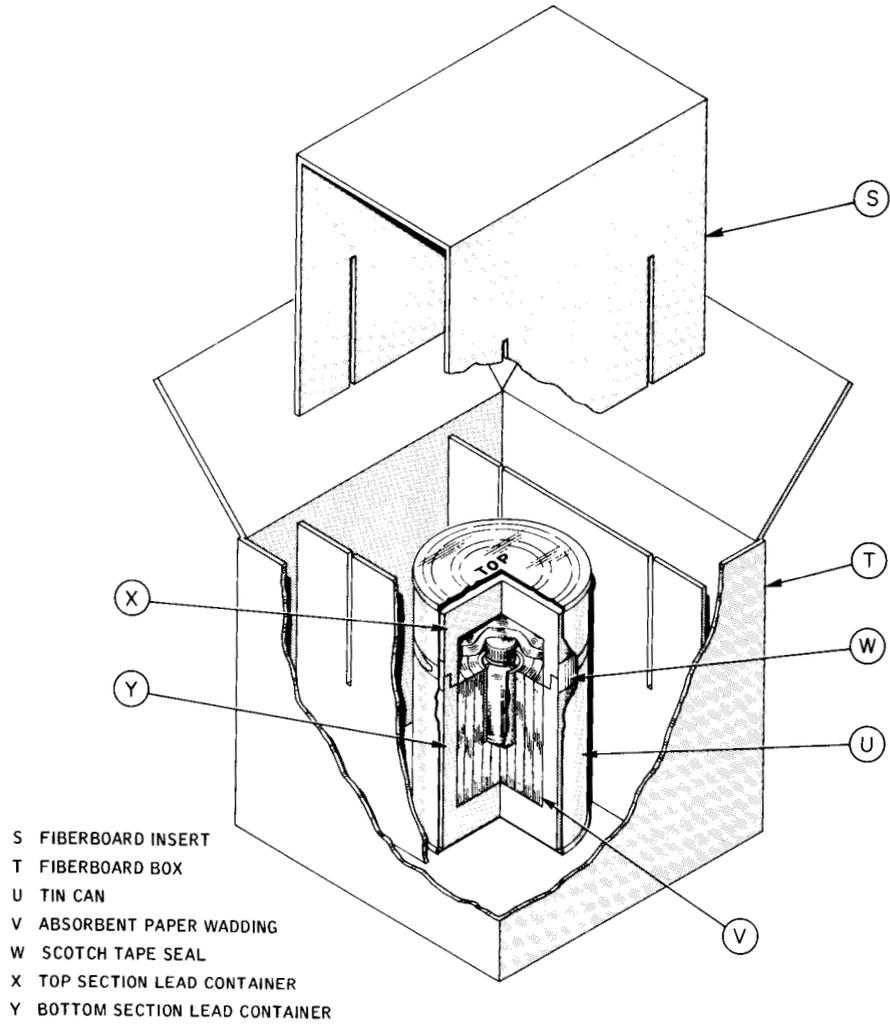
1.0 in. lead shielding - 30 lbs.

1.2 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 Duraglas bottles only).



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



DISPOSABLE CONTAINER FOR RADIOACTIVE
LIQUID AND SOLID SHIPMENTS

Limited to DOT Type A Quantities

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: Duraglas bottle (15 to 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 shielding - 40 lbs.

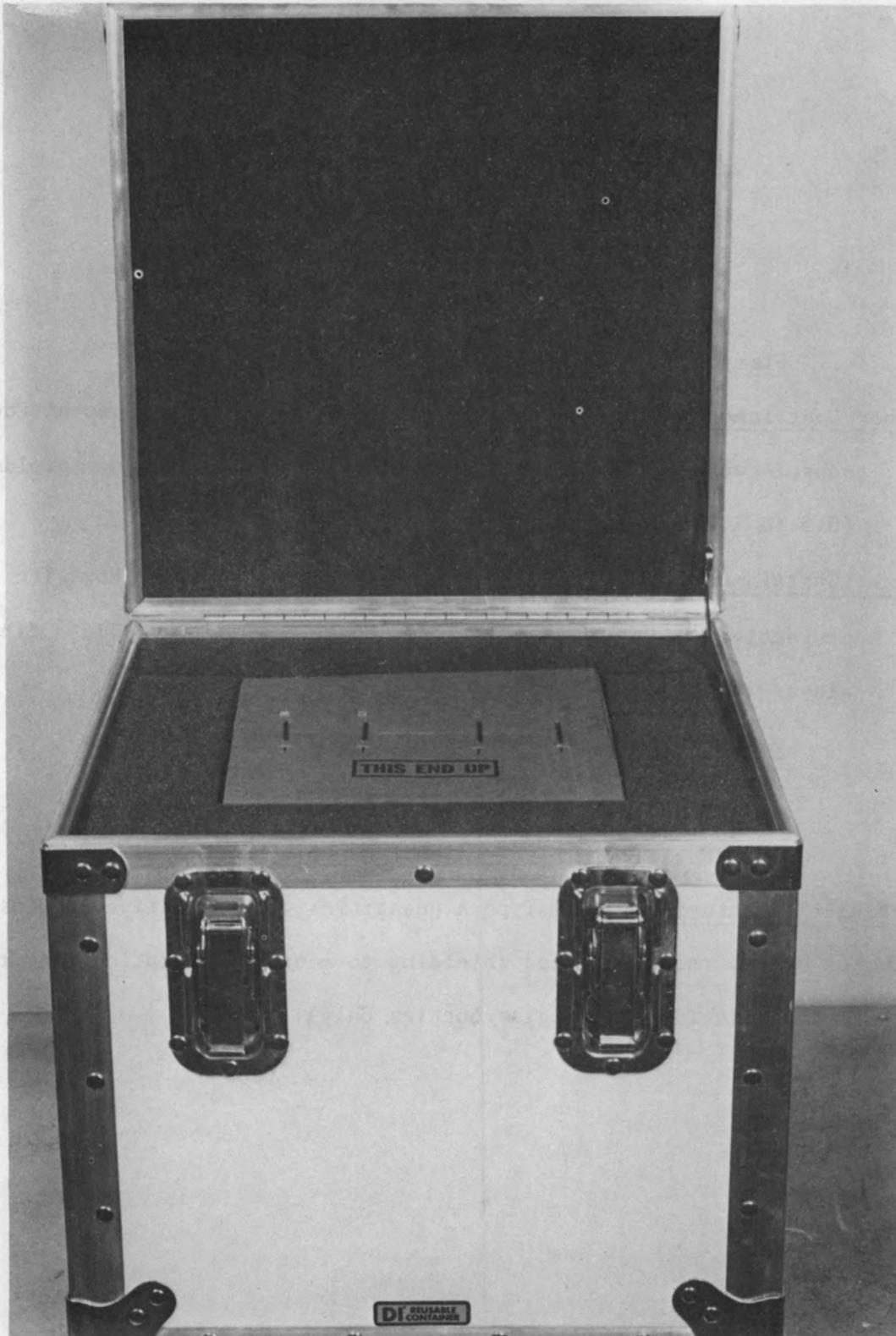
1.0 in. lead shielding - 48 lbs.

1.2 in. lead shielding - 51 lbs.

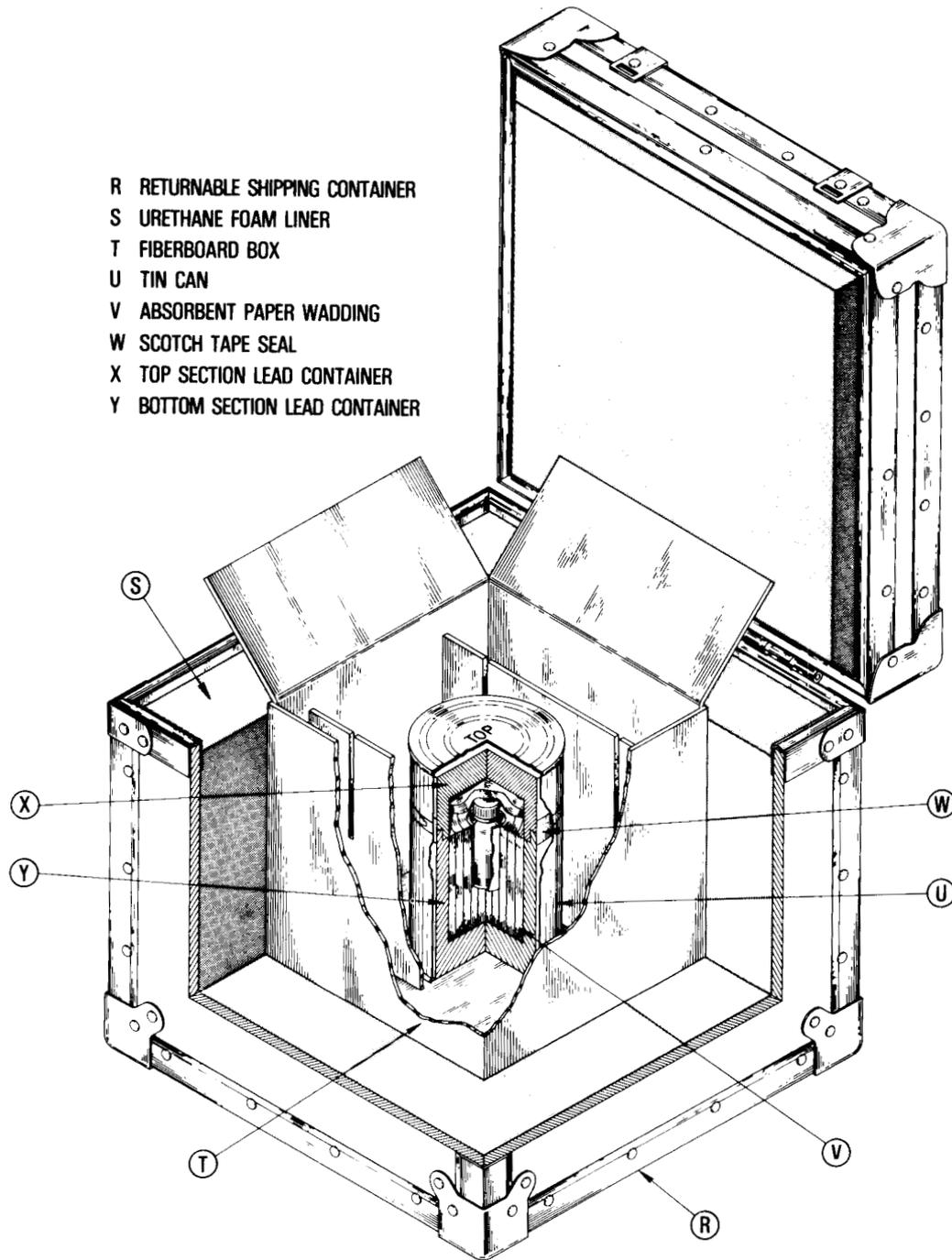
Radioactive Materials: All Type A quantities of radioactive liquids or solids requiring lead shielding to meet DOT radiation requirements (liquids in Duraglas bottles only).

I.A.10

ORNL Photo 0176-81



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



DOT-IAEA Type A Returnable Container

I.A.13

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: Duraglas bottle (15 to 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 shielding - 136 lbs.

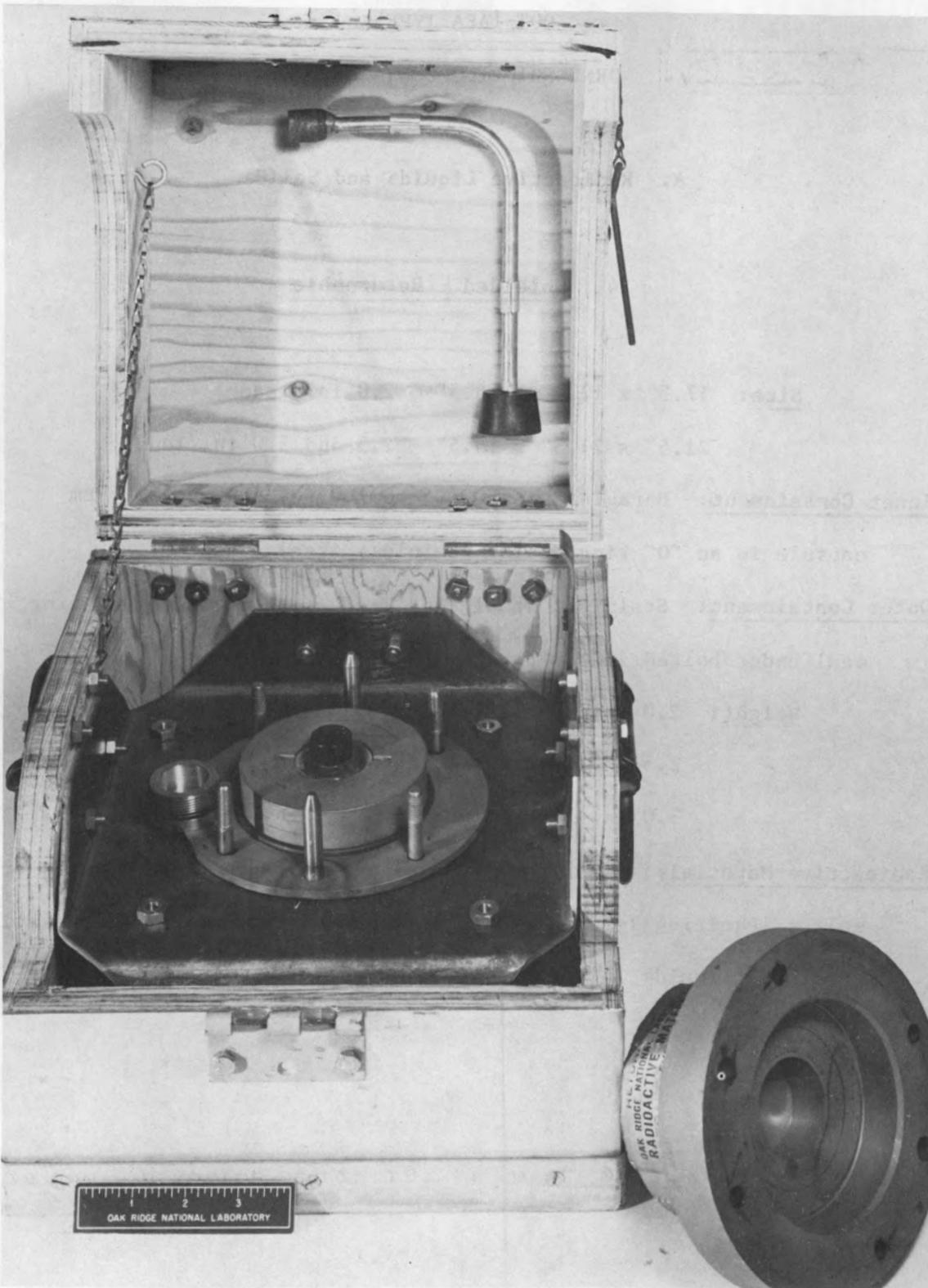
2.5 in. lead shielding - 198 lbs.

3.0 in. lead shielding - 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 Duraglas bottles only).

I.A.14

ORNL Photo 93392



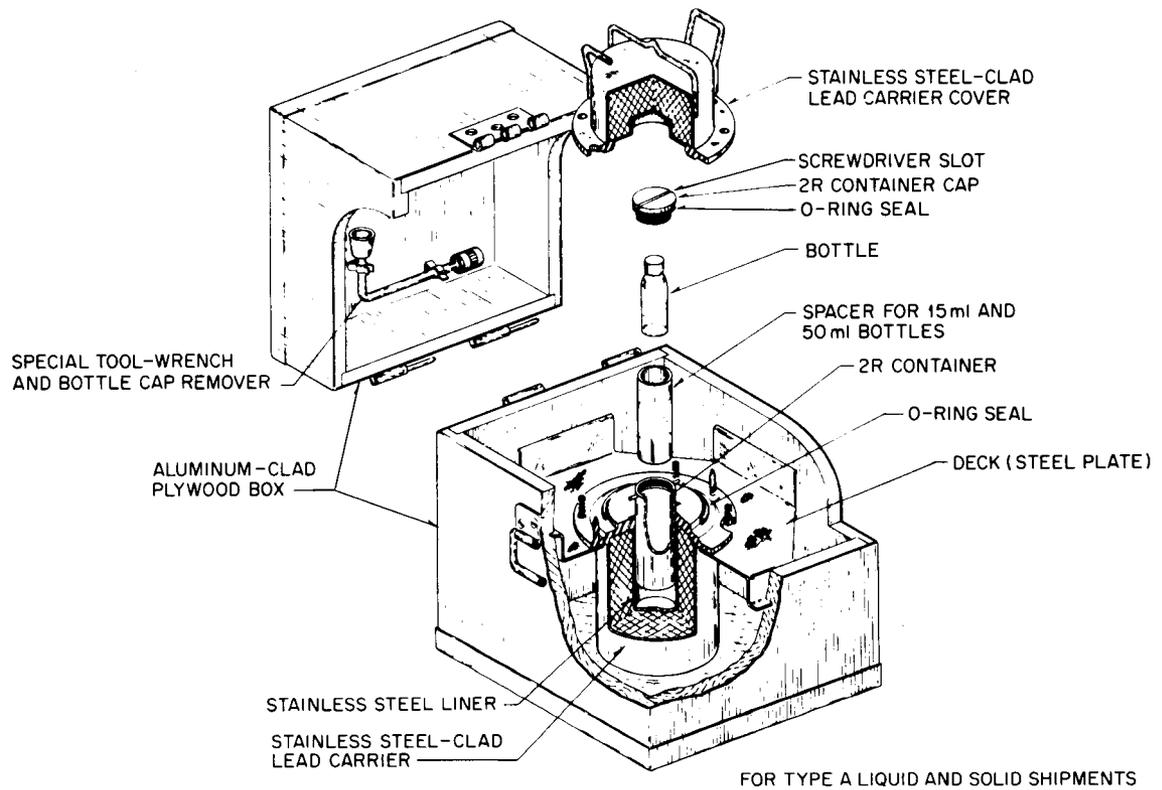
ORNL Returnable Type A Container

I.A.15

ORNL-DWG 75-16833

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 1½ 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

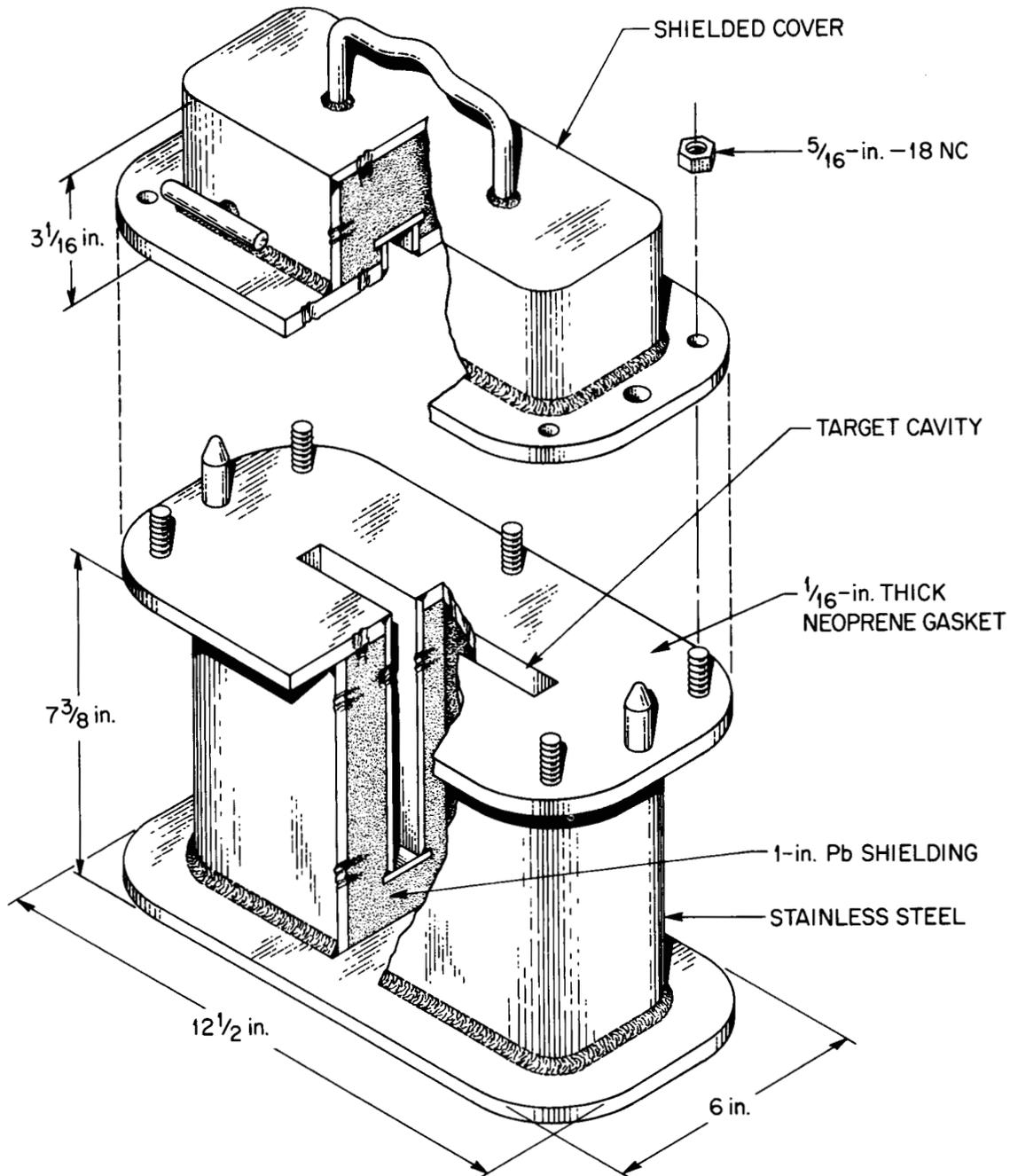
Size: 12 3/8" x 12 1/2" x 6"

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

I.B.3

ORNL Photo 2415-78



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

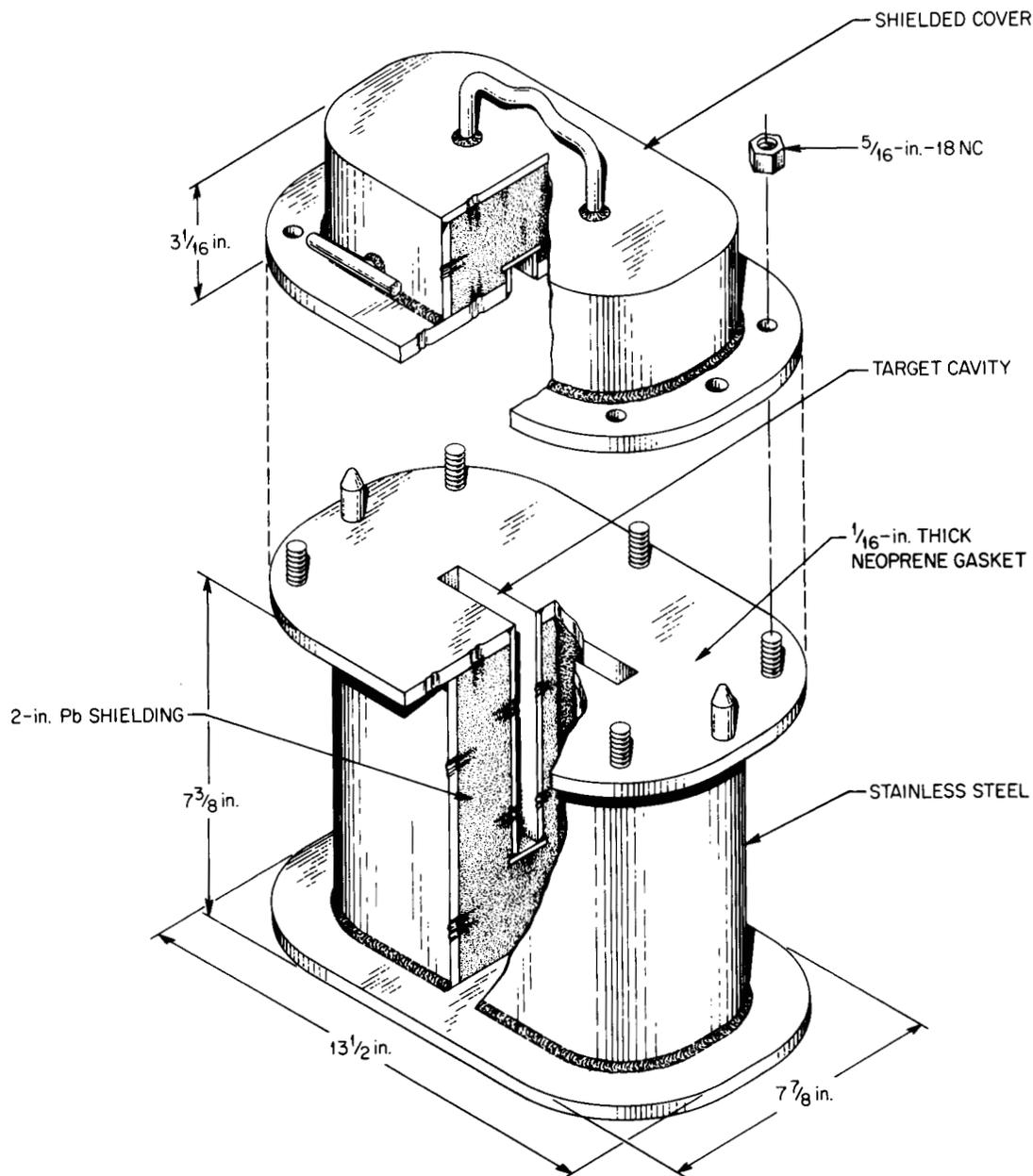
Size: 13 1/2" x 13 1/2" x 7 7/8"

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.



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

I.B.7

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.

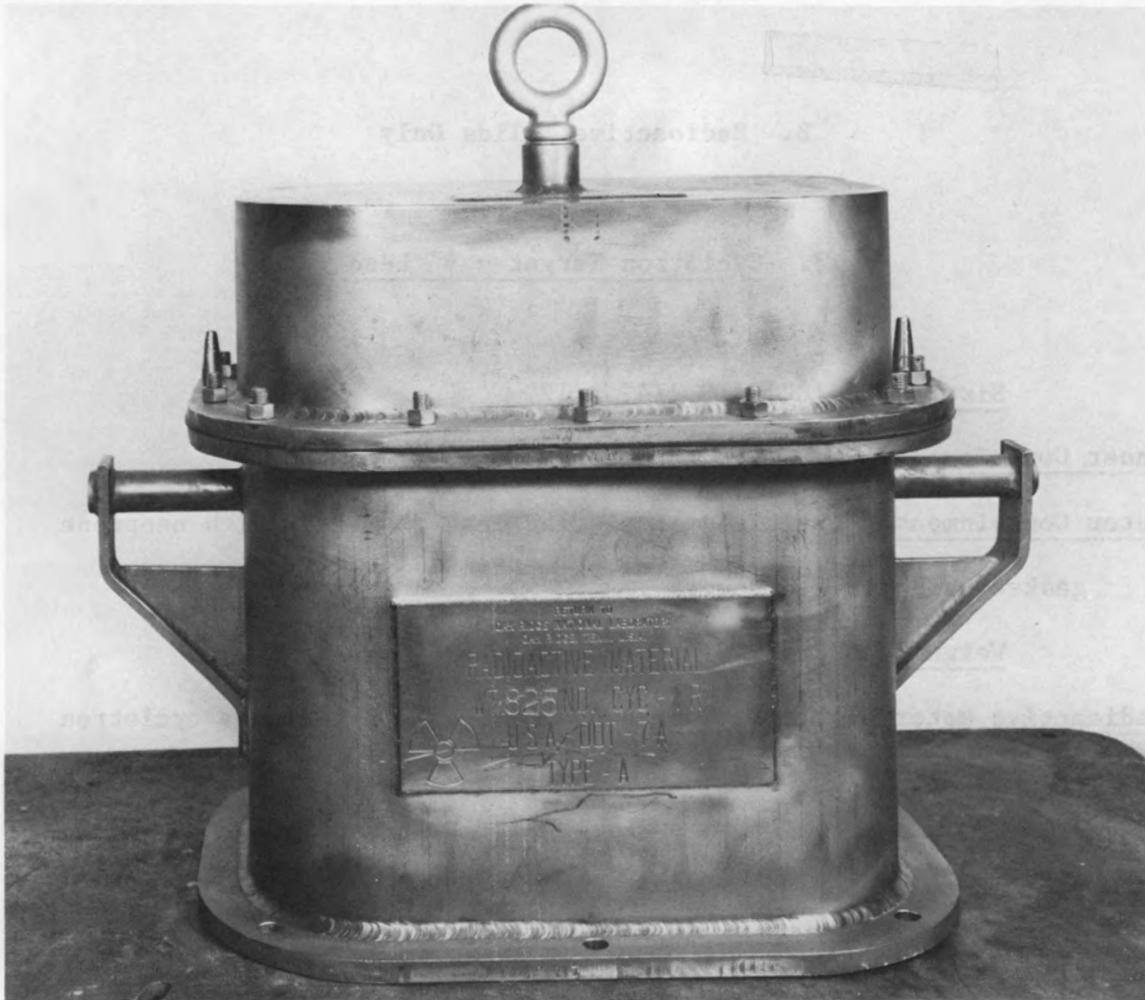
Outer Containment: Stainless steel clad lead container with neoprene gasket under shield cover.

Weight: 400 lbs.

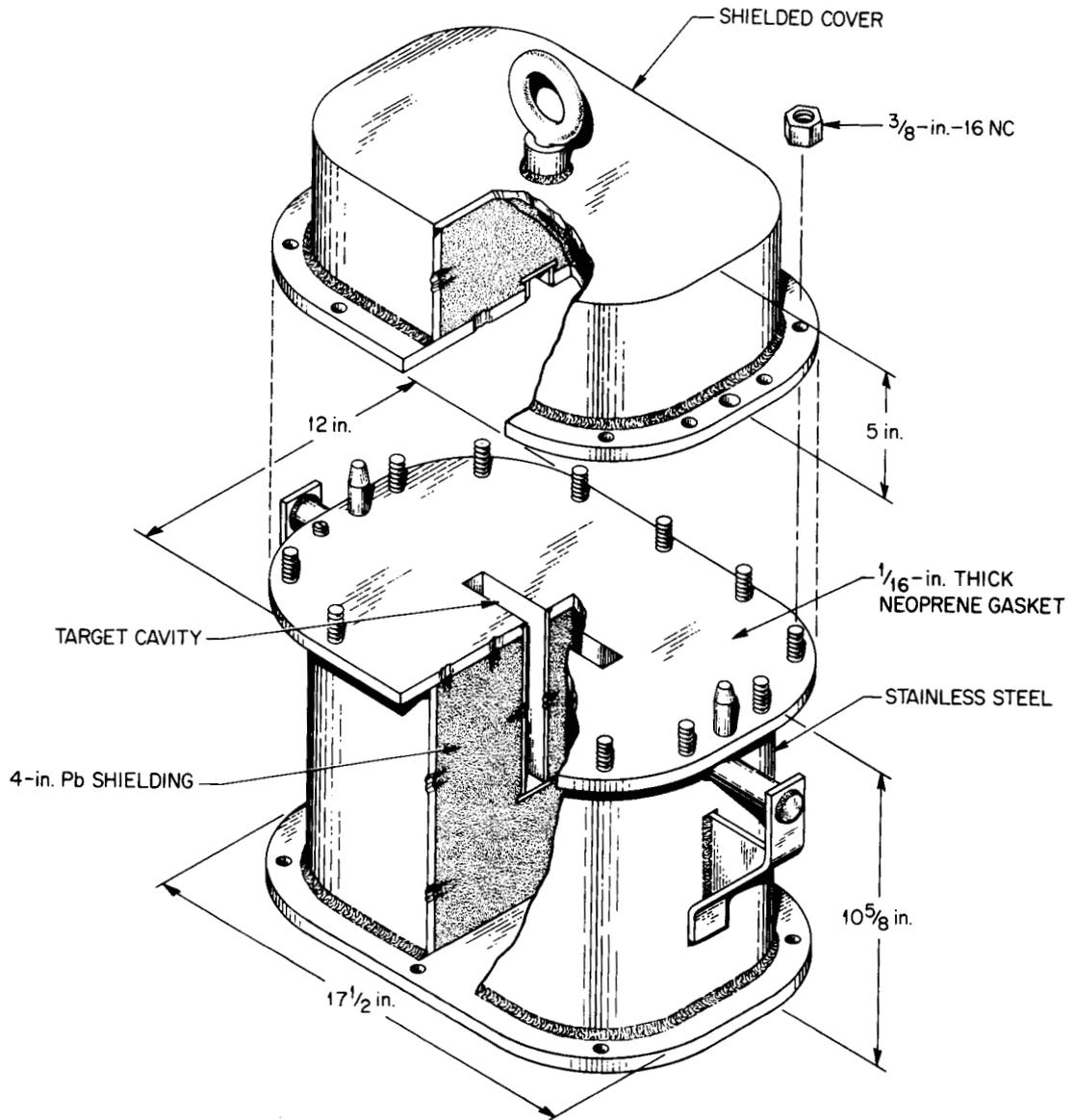
Radioactive Materials: All Type A quantities produced on a cyclotron target.

I.B.8

ORNL Photo 6386-76



ORNL Cyclotron Target Type A Container



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

I.B.11

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.

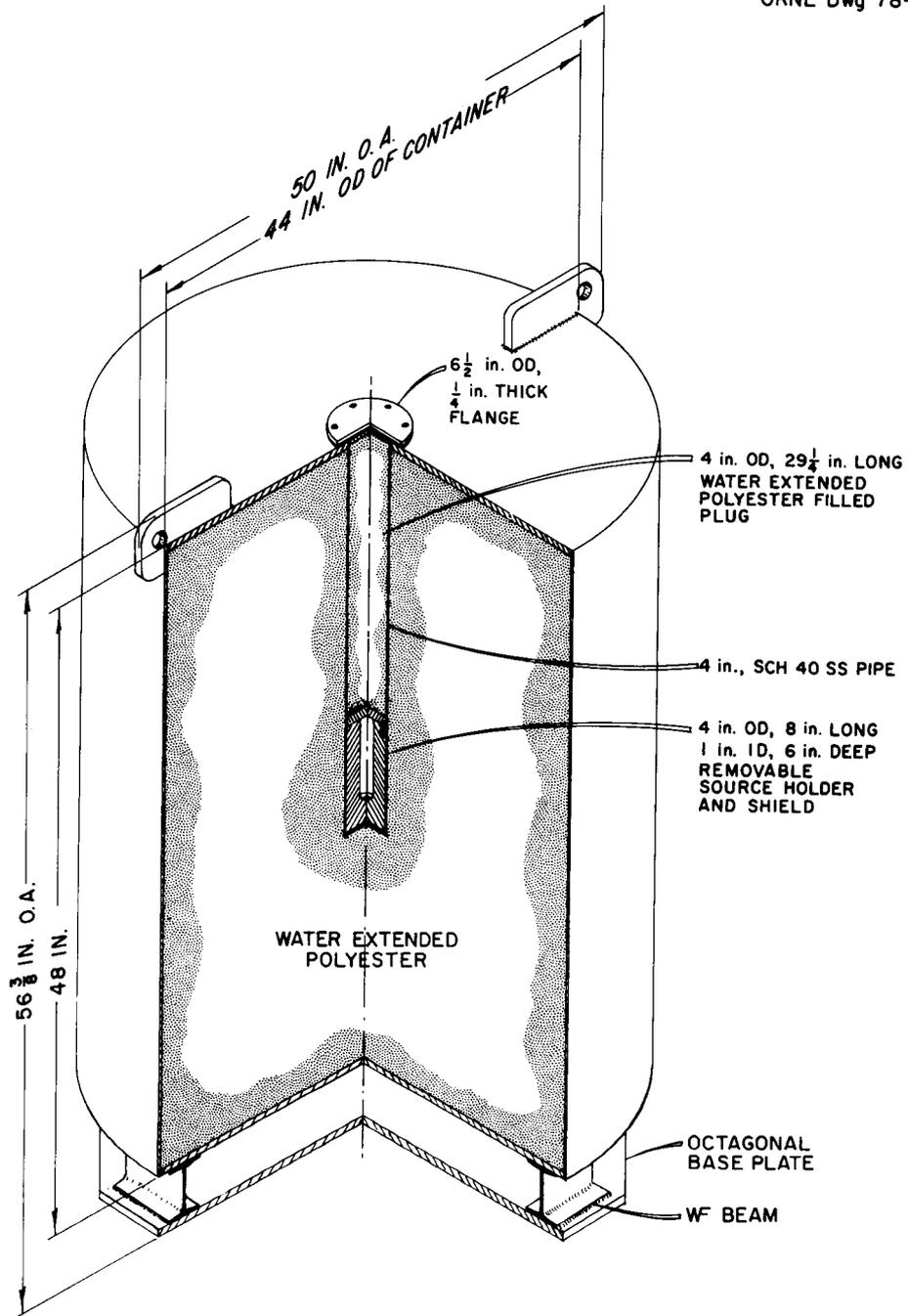
Weight: 3700 lbs.

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



I.B.12

TRU Neutron Shipping Container - Type A



TRU NUCLEAR SHIPPING CONTAINER (TYPE A)

(ATKINSON STEEL CO., SERIAL No. 241)

Gross wt. 3700 lbs

I.C.1

DOT-IAEA TYPE A
ORNL SHIPPING CONTAINERS

C. Radioactive Gases

1. Shielded - Non-Returnable

Size: 8" x 8" x 8"

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.

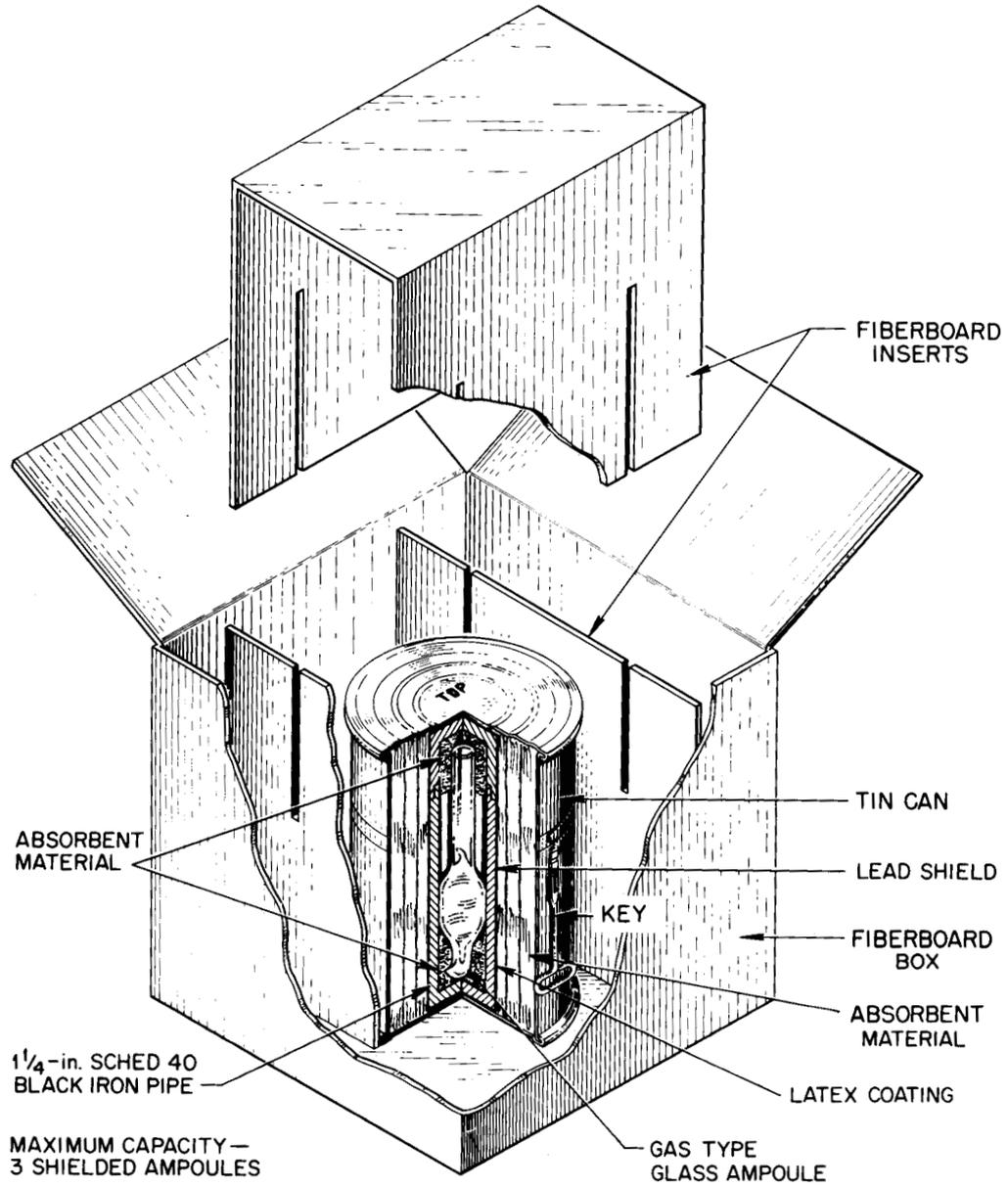
Outer Containment: DOT SPEC 2N tin can in cardboard (12B) box with protective cardboard inserts.

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.5

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

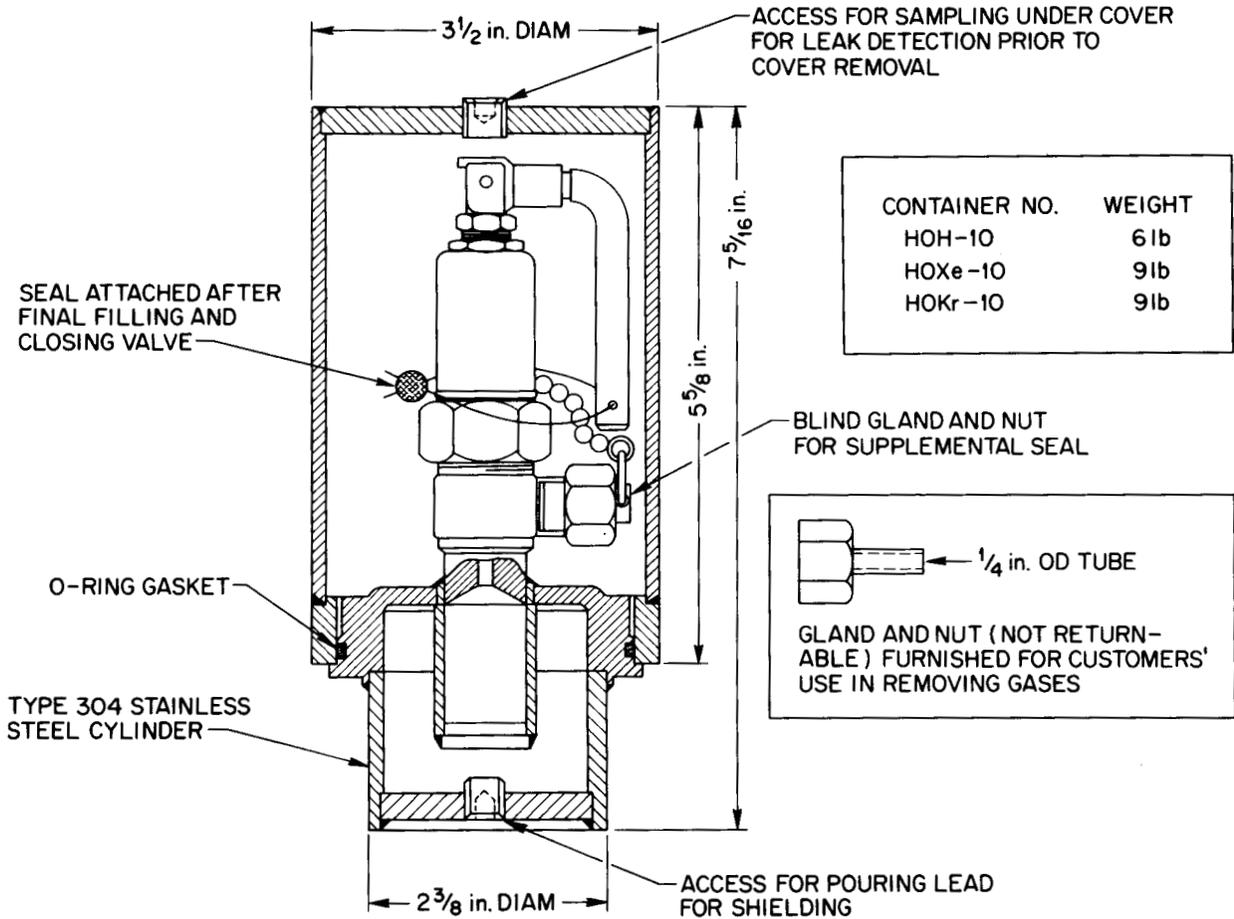
Inner Containment: Stainless steel cylinder (10 cc volume) with a bellows sealed valve.

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

I.C.7

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 (Page I.C.10)

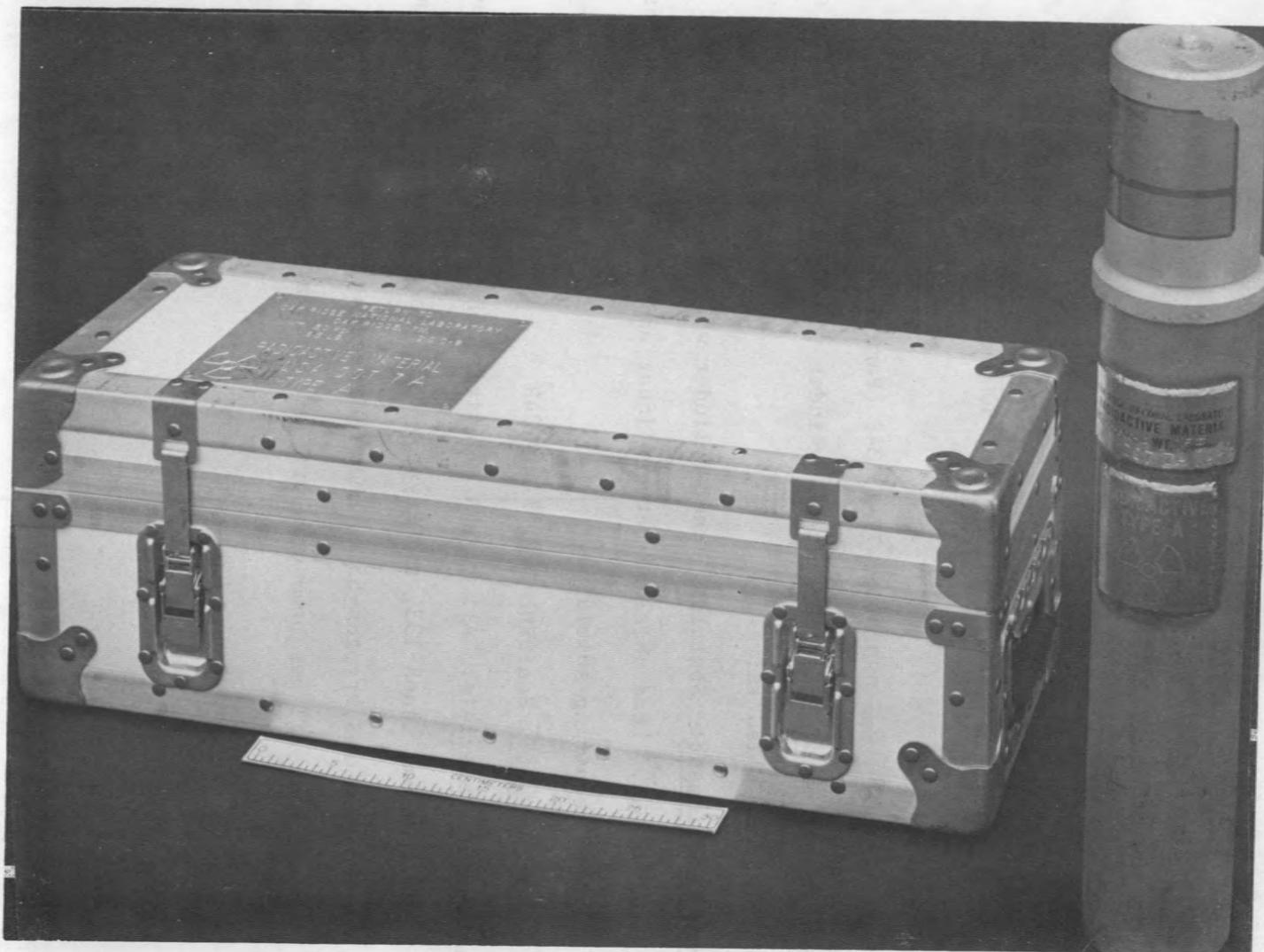
Inner Containment: Stainless steel cylinder (50-500 cc volume) with a bellows sealed valve.

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 Photo 5113-81



ORNL Gas Container - Type A

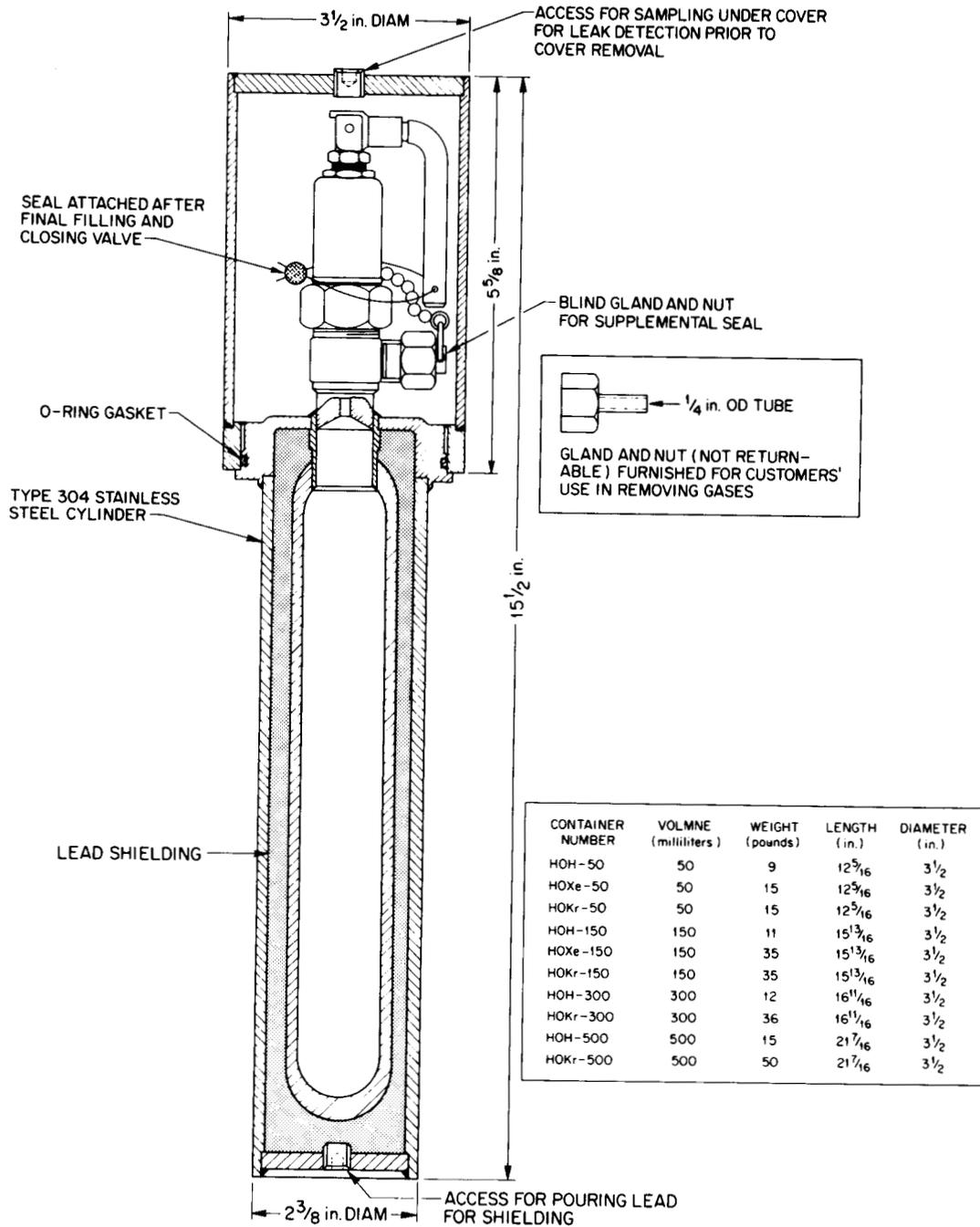
I.C.8



ORNL Gas Container - Type A

I.C.10

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 ¹¹ / ₁₆	3 ¹ / ₂
HOKr-300	300	36	16 ¹¹ / 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.

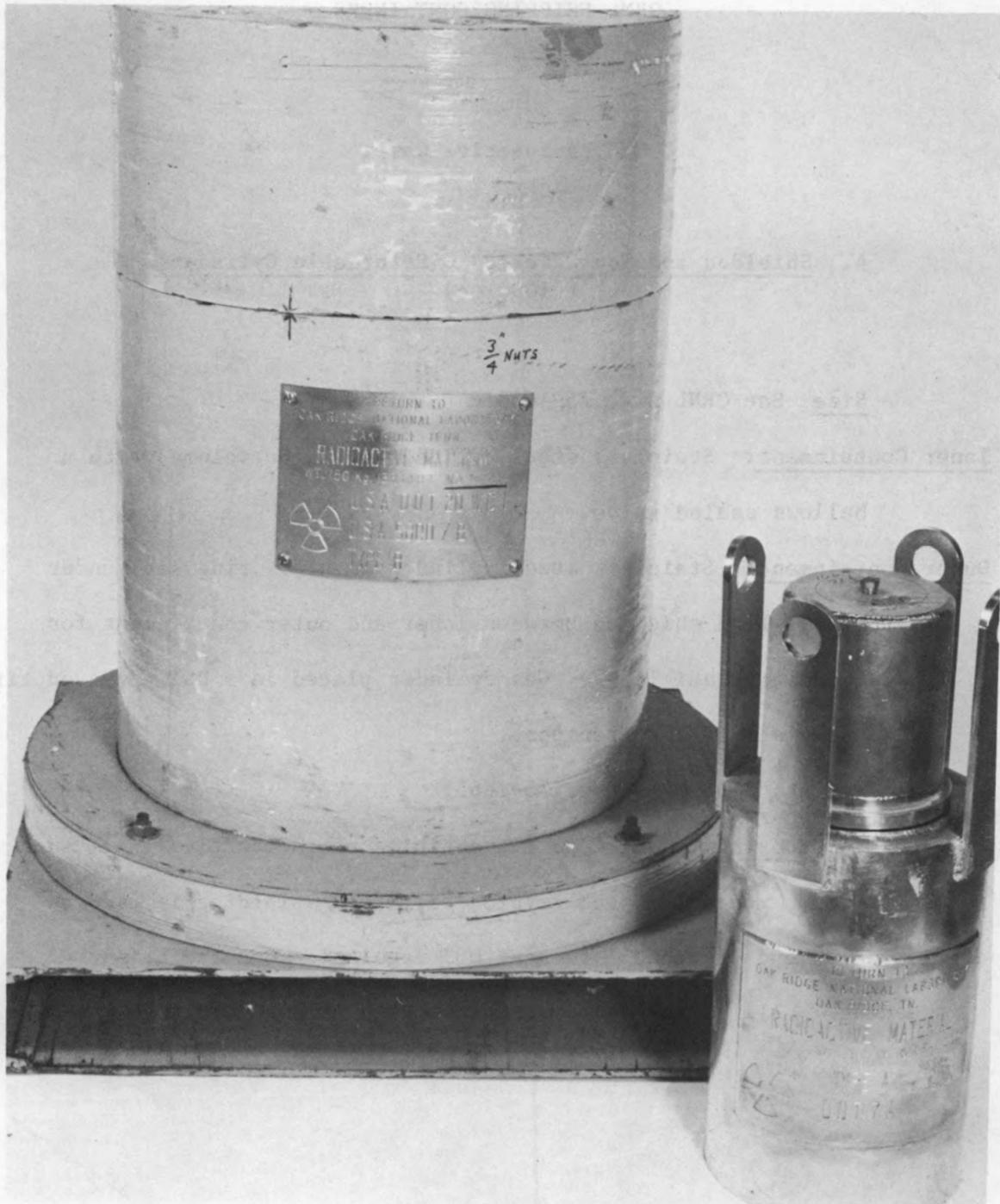
Outer Containment: Stainless steel cylinder with "O" ring seal under valve cap. Lead shielded between inner and outer containment for gases requiring shielding. Gas cylinder placed in a DOT approved fire and impact shield for transport.

Weight: See ORNL Dwg. 75-16651R

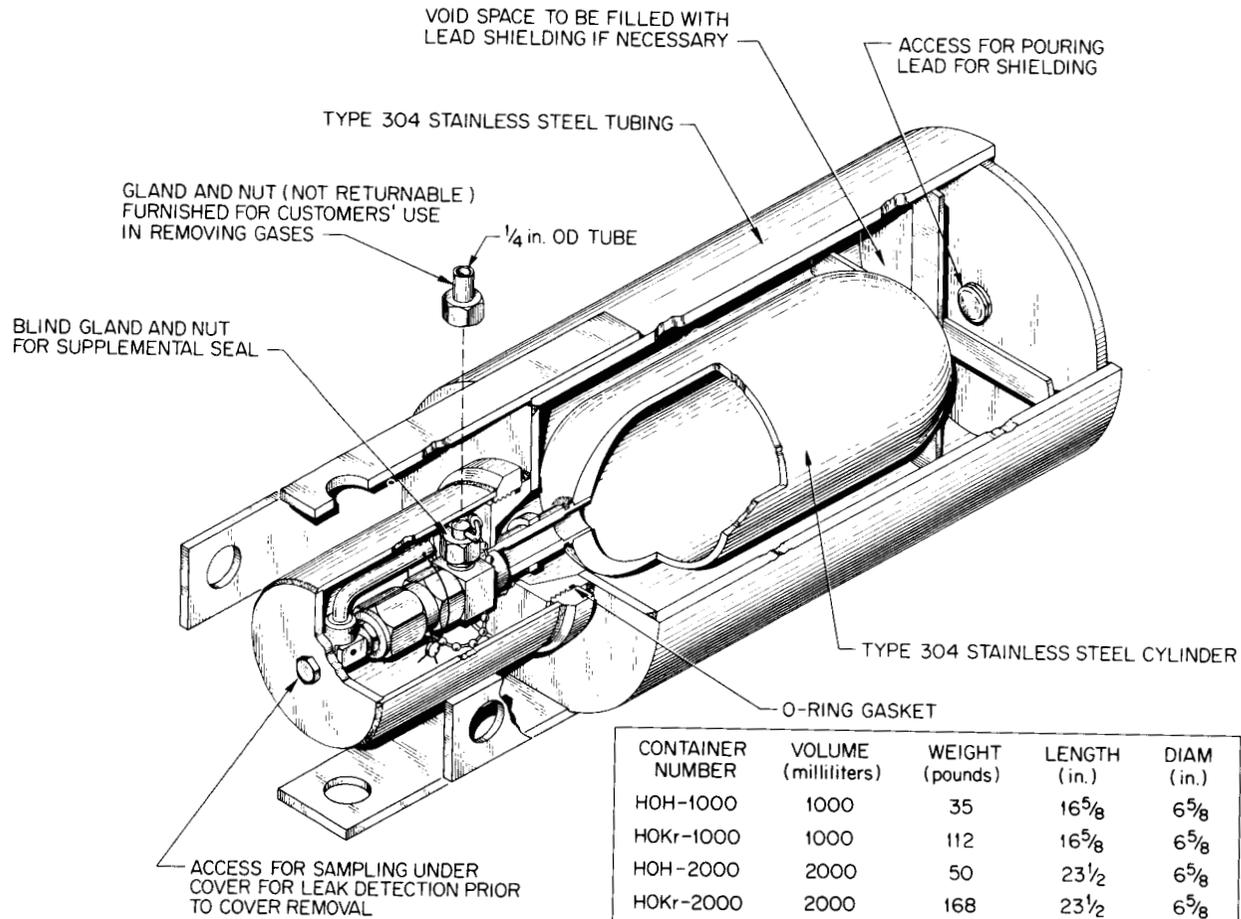
Radioactive Materials: All Type A quantities of radioactive gases such as tritium, xenon-133, and krypton-85. Lead shielding is used on xenon-133 and krypton-85 to meet DOT regulations on radiation readings. All gas pressures are less than atmospheric.

I.C.12

ORNL Photo 0174-81



ORNL Gas Package - Type A



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

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" (Plastic box)

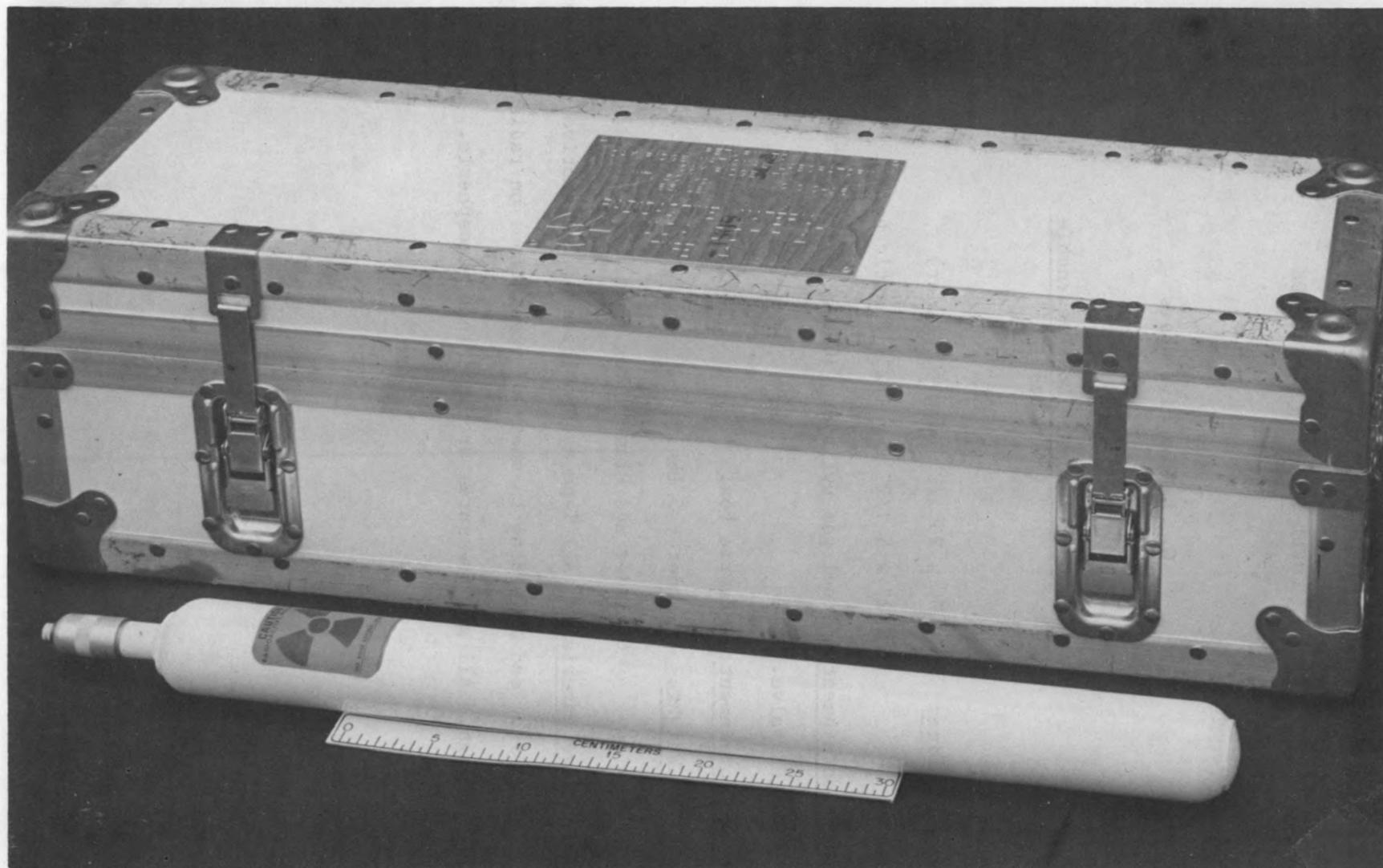
Inner Containment: Steel gas cylinder (1000 cc) with an "O" ring
sealed valve.

Outer Containment: Plastic box.

Weight: Cylinder - 3 lbs.

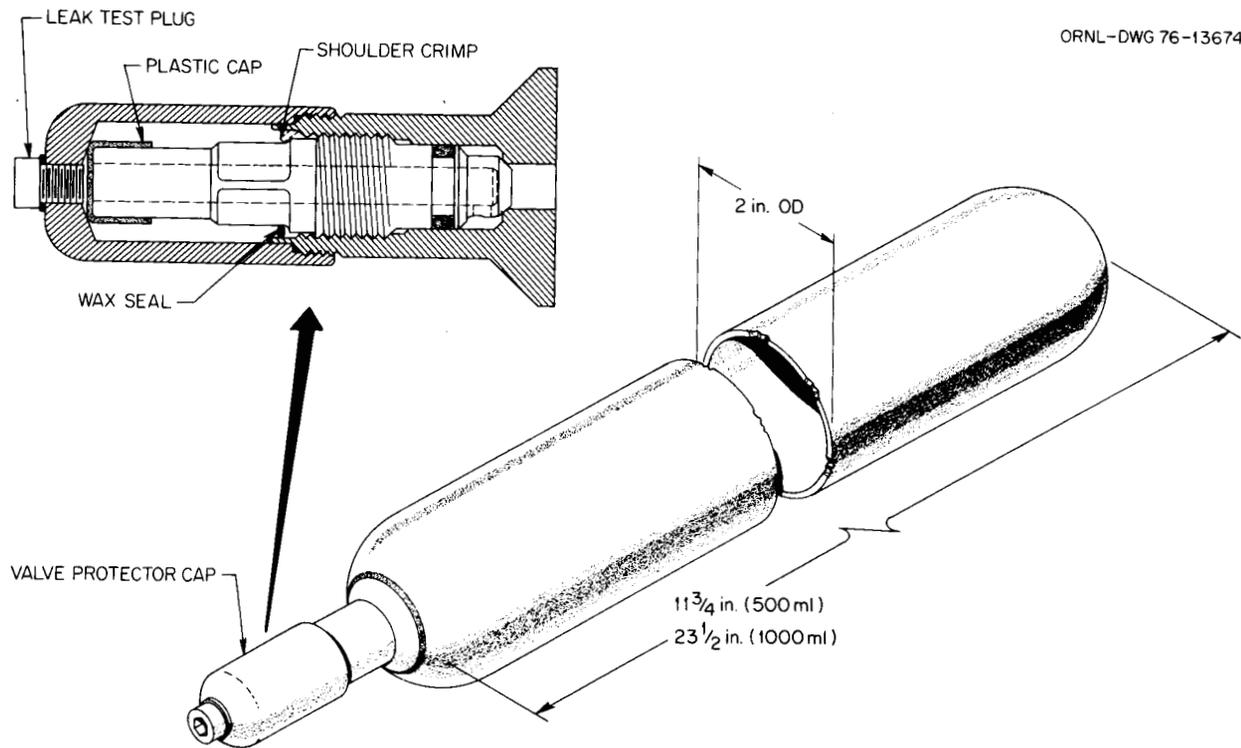
Cylinder and Plastic Box - 13 lbs.

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. 74-8422R3).

Weight: 2000 cc cylinder - 168 lbs.

5000 cc cylinder - 276 lbs.

Impact shield - 320 lbs.

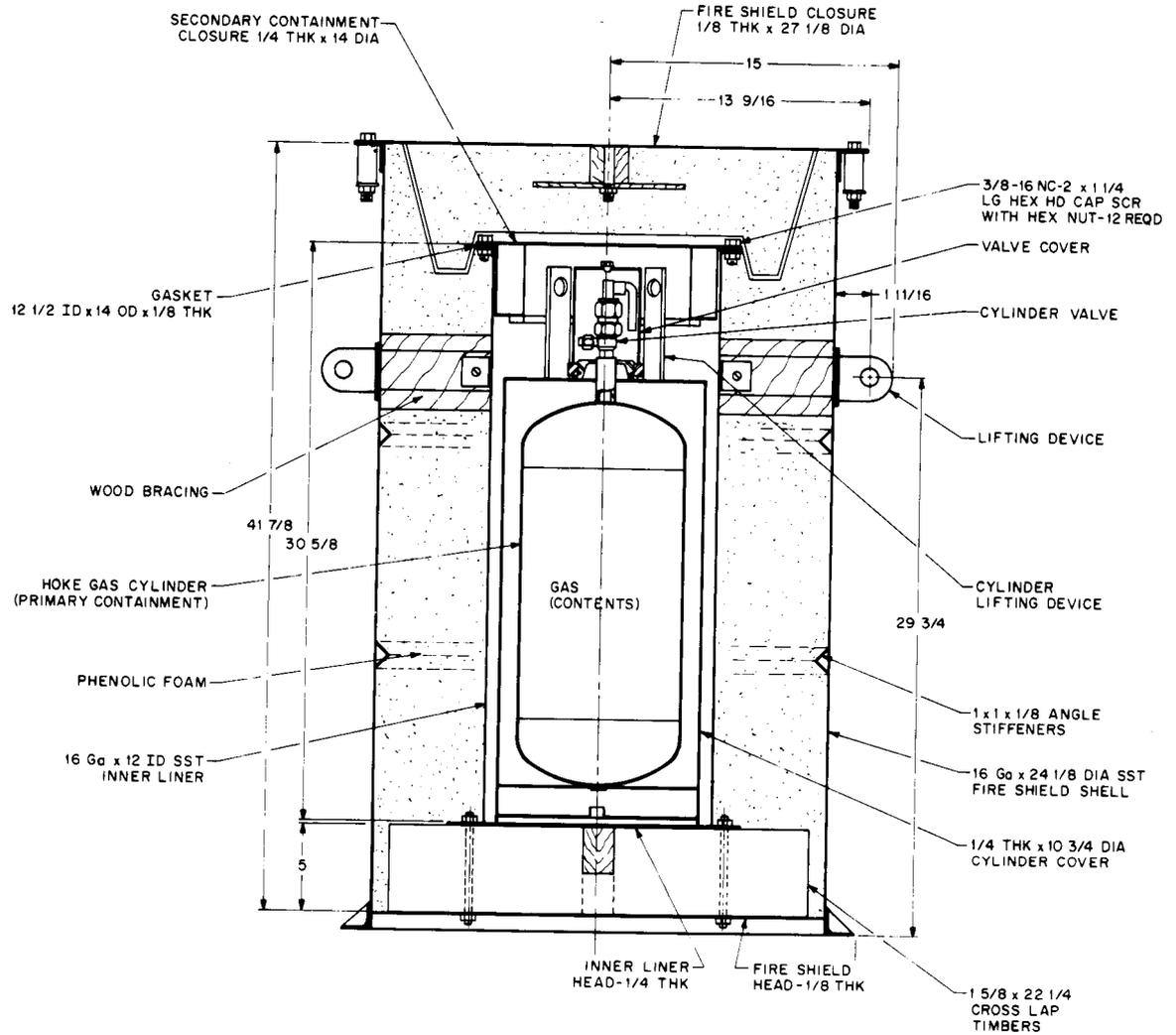
Radioactive Materials: All Type A quantities of gases requiring lead shielding to meet DOT regulations on radiation readings.

I.C.20

ORNL Photo 0418-83



ORNL Gas Package - Type B



TYPE B
ORNL GAS CYLINDER FIRE SHIELD
WEIGHT-320 lbs

ALL DIMENSIONS GIVEN IN INCHES

II.1

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 in a Type B(U) and Type B(M) package are those prescribed in 49CFR 173.416 or in the applicable approved certificates under 49CFR 173.471 and 173.472.

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 DOE or NRC for each package and states the limits for radioactive materials that can be shipped in each package.

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

II.A.1

A. RADIOACTIVE GASES

GAS CYLINDER FIRE AND IMPACT SHIELD

(2000, 5000, 16000 cc)

II.A.2

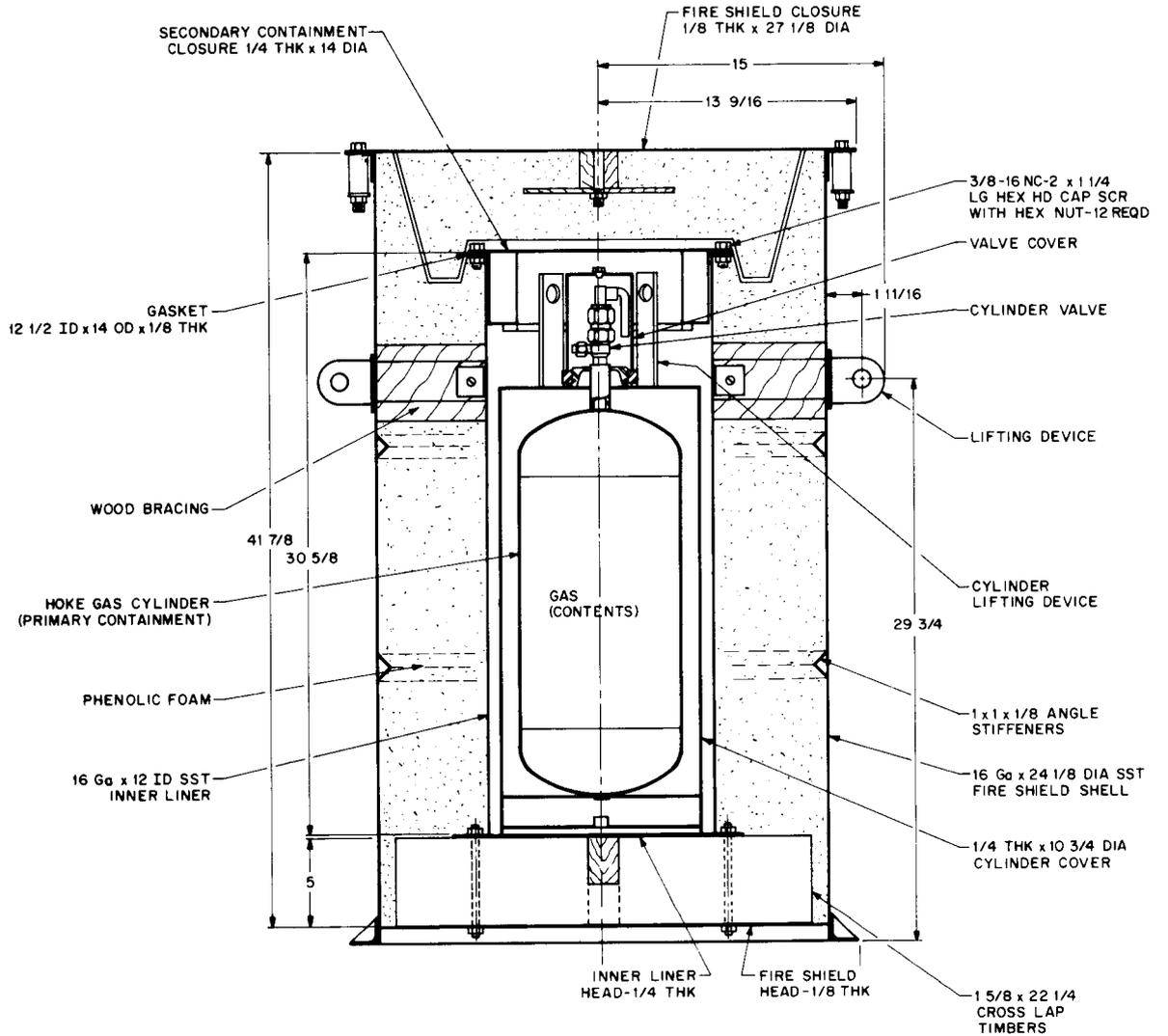
ORNL Photo 0418-83



ORNL Gas Package - Type B

II.A.3

ORNL-DWG 74-8422R3



ALL DIMENSIONS GIVEN IN INCHES

TYPE B
ORNL GAS CYLINDER FIRE SHIELD
WEIGHT-320 lbs

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. 4	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):

(2) Title and Identification of report or application:

(3) Date:

Oak Ridge National Laboratory
P.O. Box X
Oak Ridge, Tennessee 37830Safety Analysis Report for
Packaging for the ORNL Gas
Cylinder Fire and Impact Shield.

April 1983

Report No.: ORNL/ENG/TM-5, Rev. 1

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 - tritium.
The inner containment vessels consist of the following cylinders:

<u>Volume - l.</u>	<u>Tare Wt. - kg (lb)</u>
2	22.7 (50)
5	34.5 (76)
16	48.1 (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 30.5 cm (12 in.) dia. x 77.8 cm (30-5/8 in.) high, 16-gauge steel vessel. The 0.6 cm (1/4 in.) thick gasketed lid is held in with 12 1 cm (3/8 in.) dia. bolts. The outer shell

6a. Date of Issuance: May 13, 1983

6b. Expiration Date: May 31, 1985

FOR THE U.S. DEPARTMENT OF ENERGY

7a. Address (of DOE Issuing Office)

U.S. Department of Energy
P.O. 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

II.A.5

Page 2, C of C 5552, Rev. 4

consists of 16-gauge 304L Stainless Steel drum 61.3 cm (24-1/8 in.) dia. x 106.4 cm (41-7/8 in.) high with a 0.3 cm (1/8 in.) thick removable head held in place by 8 1.6 cm (5/8 in.) dia. bolts and nuts and equipped with lock washers. Sealed vent holes are provided in the outer drum. 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 340 kg. (750 lb.).

(3) Drawings:

The packagings are as described and fabricated in accordance with Oak Ridge National Laboratory Drawings:

M-11574-EM-001-E-6
X3E-11572-007-E
X3E-11572-012-0
X3E-11572-013-0
X3E-11572-014-0
X3E-11572-015-0

b. Contents:

(1) Type and Form of Material:

Uncompressed tritium gas.

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

Not more than 30,000 Ci of tritium.

(3) Maximum pressures of gases not to exceed:

Four-fifths atm (11.8 psia) for tritium.

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

c. Prior to each shipment, the package must be inspected and leak tested in accordance with the procedures specified in Appendix C to Report ORNL/ENG/TM-5, Rev. 1, April 1983.



U.S. Department
of Transportation

Research and
Special Programs
Administration

400 Seventh Street, S.W.
Washington, D.C. 20590

COMPETENT AUTHORITY CERTIFICATION
FOR A TYPE B(U)
RADIOACTIVE MATERIALS PACKAGE DESIGN
CERTIFICATE USA/5552/B(U), REVISION 0

AUG 3 1983

This certifies that the radioactive materials package design described below has been certified by the competent authority of the United States as meeting the regulatory requirements for a Type B (U) packaging for fissile radioactive materials as prescribed in the IAEA^{1/} and USA ^{2/} regulations.

1. Package Identification - Gas Cylinder Fire Impact Shield.
2. Packaging Description and Authorized Radioactive Contents - as described in U.S. Nuclear Regulatory Commission Certificate of Compliance No. 5552, Revision 0 (attached).
3. GENERAL CONDITIONS -
 - a. Each user of this certificate must have in his possession a copy of this certificate and all documents necessary to properly prepare the package for transportation in accordance with the endorsed certificate.
 - b. Each user of this certificate, other than the original petitioner, 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.
4. The package shall bear the marking USA/5552/B(U) in addition to other required markings and labeling.
5. This certificate, unless renewed, expires on July 31, 1988.

Certified by:

Richard R. Rawl
 Richard R. Rawl
 Chief, Radioactive Materials Branch
 Office of Hazardous Materials Regulation
 Materials Transportation Bureau

August 3, 1983
 (DATE)

^{1/} "Safety Series No. 6, Regulations for the Safe Transport of Radioactive Materials, [1973 Revised Edition]" published by the International Atomic Energy Agency (IAEA), Vienna, Austria.

^{2/} Title 49, Code of Federal Regulations, Parts 100-199, USA.

II.A.7

A. RADIOACTIVE GASES

SRO-LP 50 FIRE AND IMPACT SHIELD

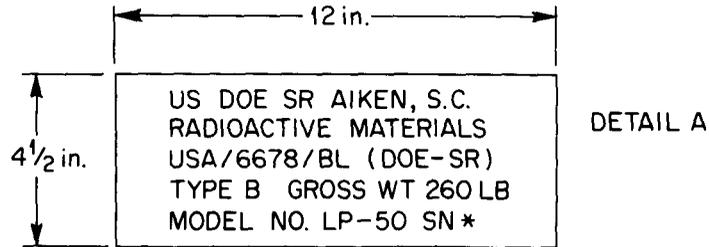
(50,000 cc)

II.A.8

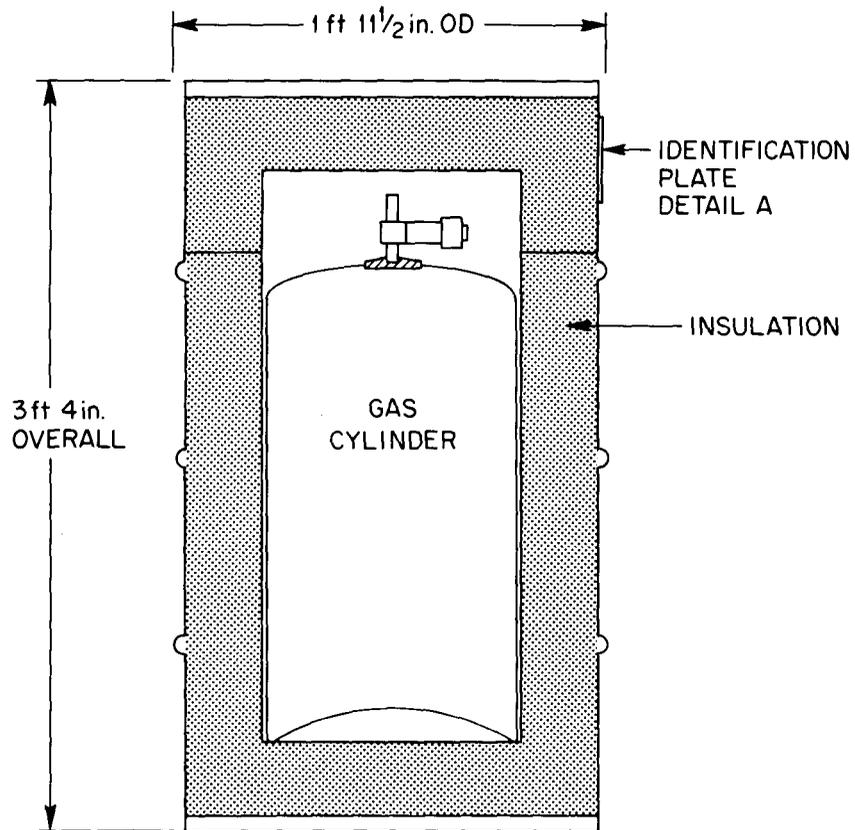
ORNL Photo 2416-78



SRO Tritium Shipping Container - Type B

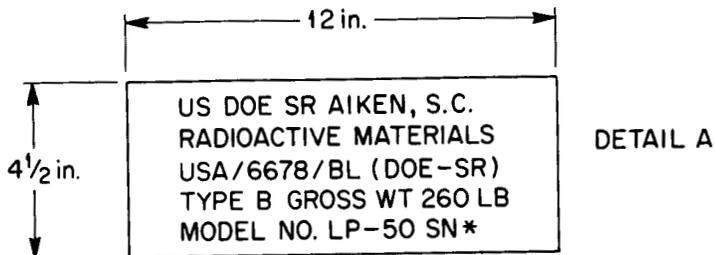


NOTE: * SERIAL NUMBER AS SPECIFIED
ON PURCHASE ORDER

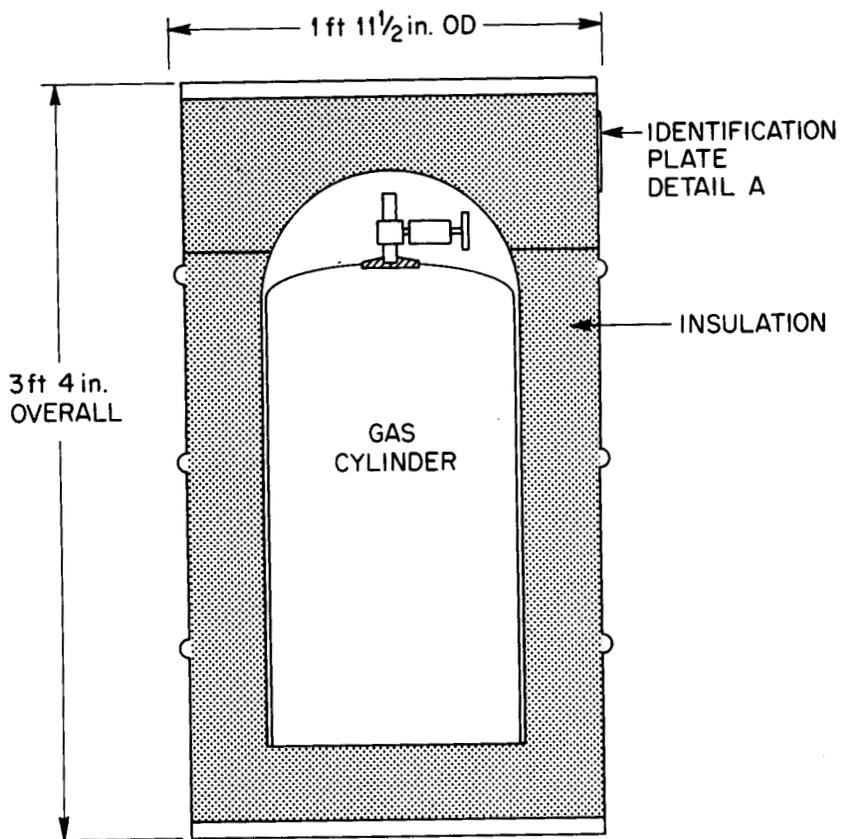


FLAT-TYPE ARRANGEMENT

FIRE AND IMPACT SHIELD FOR
LP-50 GAS CYLINDER



NOTE: * SERIAL NUMBER AS SPECIFIED ON PURCHASE ORDER



DOME-TYPE ARRANGEMENT

FIRE AND IMPACT SHIELD FOR
LP-50 GAS CYLINDER

II.A.11

Form NRC 818
 (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. 3	1.(c) Package Identification No. USA/6678/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 173.303a, 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):

E. I. du Pont de Nemours & Company
 Savannah River Plant
 Aiken, SC 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, Rev. 1,
 4/78.

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

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.

(3) Drawings

The packaging is fabricated in accordance with DuPont Drawing Nos.: S5-2-5733, Rev. 16; S5-2-5734, Rev. 9; S5-2-5735, Rev. 1; S4-2-595, Rev. 0; S5-2-186, Rev. 58; S5-2-187, Rev. 22; S4-2-633, Rev. 1; and Figure 4 of DuPont Report No. DPSPU-74-124-5, April 1975, Rev. 1, 4/78.

1125-3

Page 2 - Certificate No. 6578 - Revision No. 3 - Docket No. 71-5678

5. (b) Contents

(1) Type and form of material

Tritium in mixture with other gases.

(2) Maximum quantity of material per package

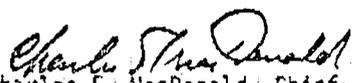
Not more than 75,300 cm³ of tritium at STP (1 atm, 25°C), and a maximum activity of 193,500 Curies.

6. The maximum internal fill pressure in the primary containment vessel shall not exceed 23.2 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, Rev. 1, 4/78.
8. The package authorized by this certificate is hereby approved for use under the general license provisions of 10 CFR §71.12(b).
9. Expiration date: September 30, 1987.

REFERENCE

E. I. DuPont de Nemours and Company Report No. DPSPU-74-124-5, April 1975, Rev. 1, 4/78.

FOR THE U.S. NUCLEAR REGULATORY COMMISSION

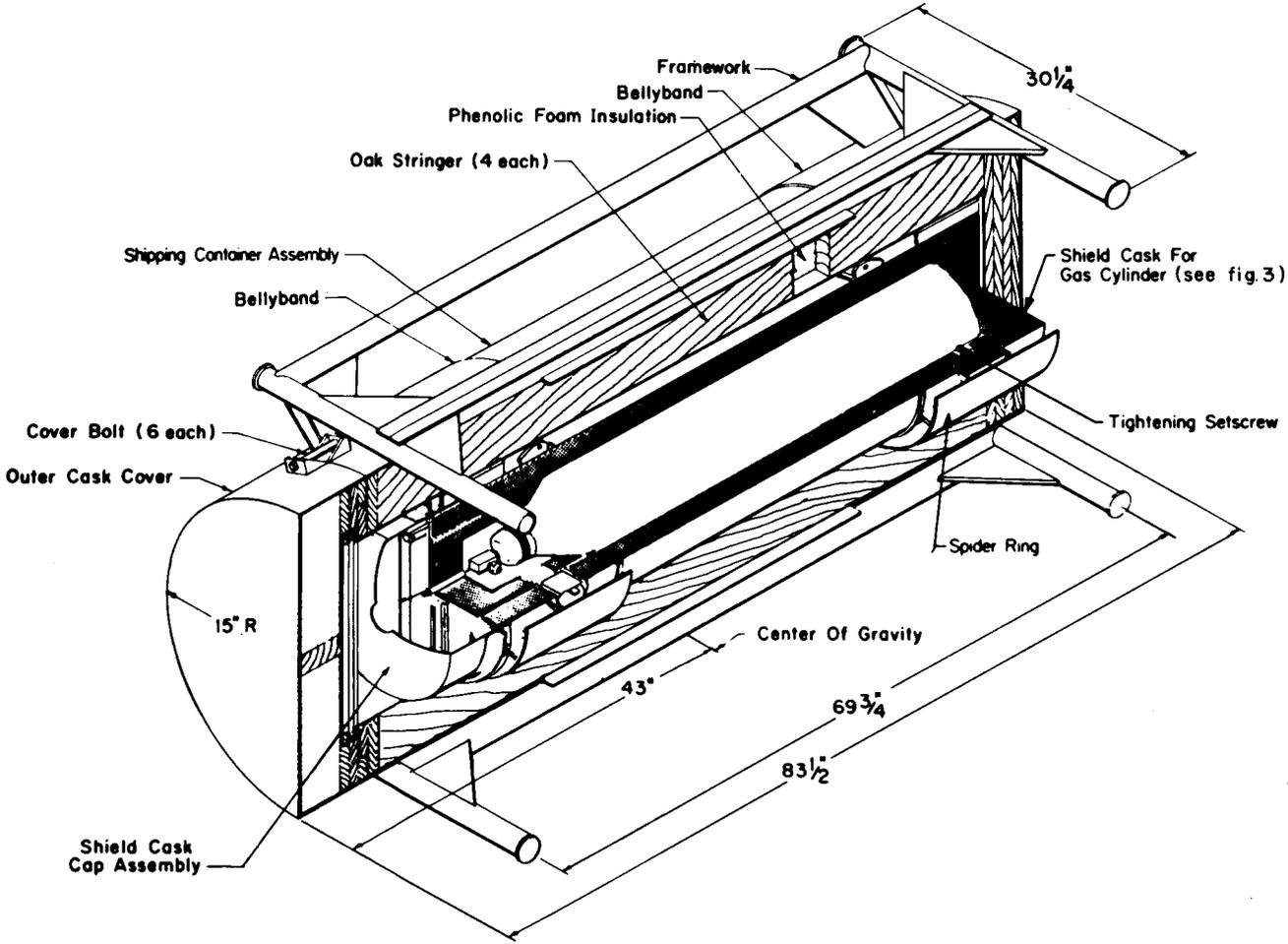

Charles E. MacDonald, Chief
Transportation Certification Branch
Division of Fuel Cycle and
Material Safety

Date: SEP 17 1992

II.A.13

A. RADIOACTIVE GASES

KRYPTON-85 SHIPPING CONTAINER



Krypton Shipping Container

II.A.14

Form AEC-618
(12-73)
10 CFR 71
AECM5701

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. Pgs. 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 146-19-10c 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, <u>Safety Analysis</u> <u>Report for Packaging - Krypton Shipping</u> <u>Container - USA/5958/BL(ERDA-ID)</u> , by C. W. Nielsen	(3) Date: June 1975
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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:

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.

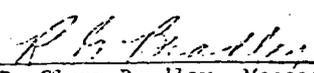
(2) Inner Packaging

(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: <u>AUG 4 1975</u>	6b. Expiration Date: <u>None</u>
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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, 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.

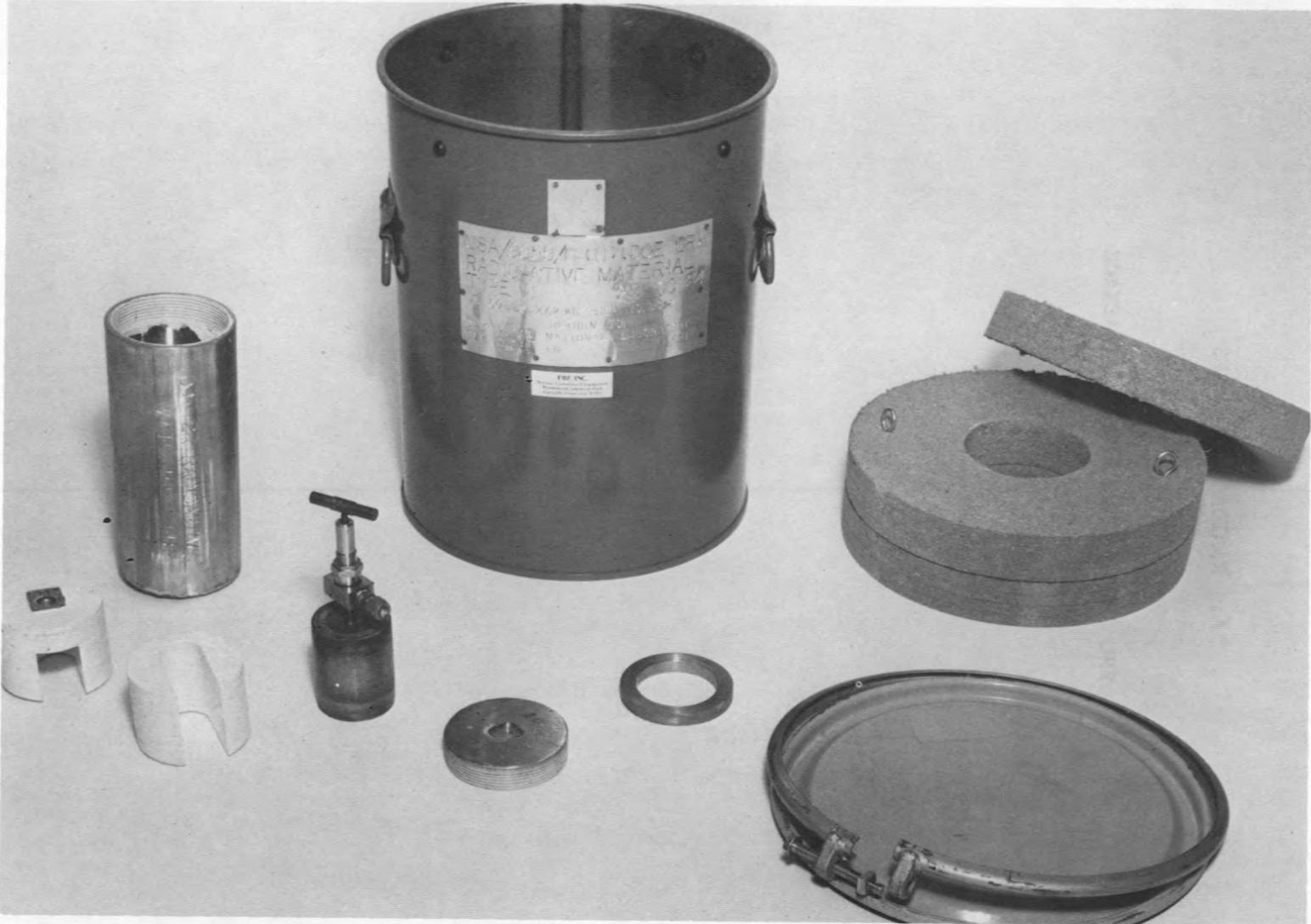
5.c. References

- (1) A. J. Mallett and S. G. Wheatley, Fissile Material Container and Packaging Development and Testing Program, K-1661 Union Carbide 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.A.17

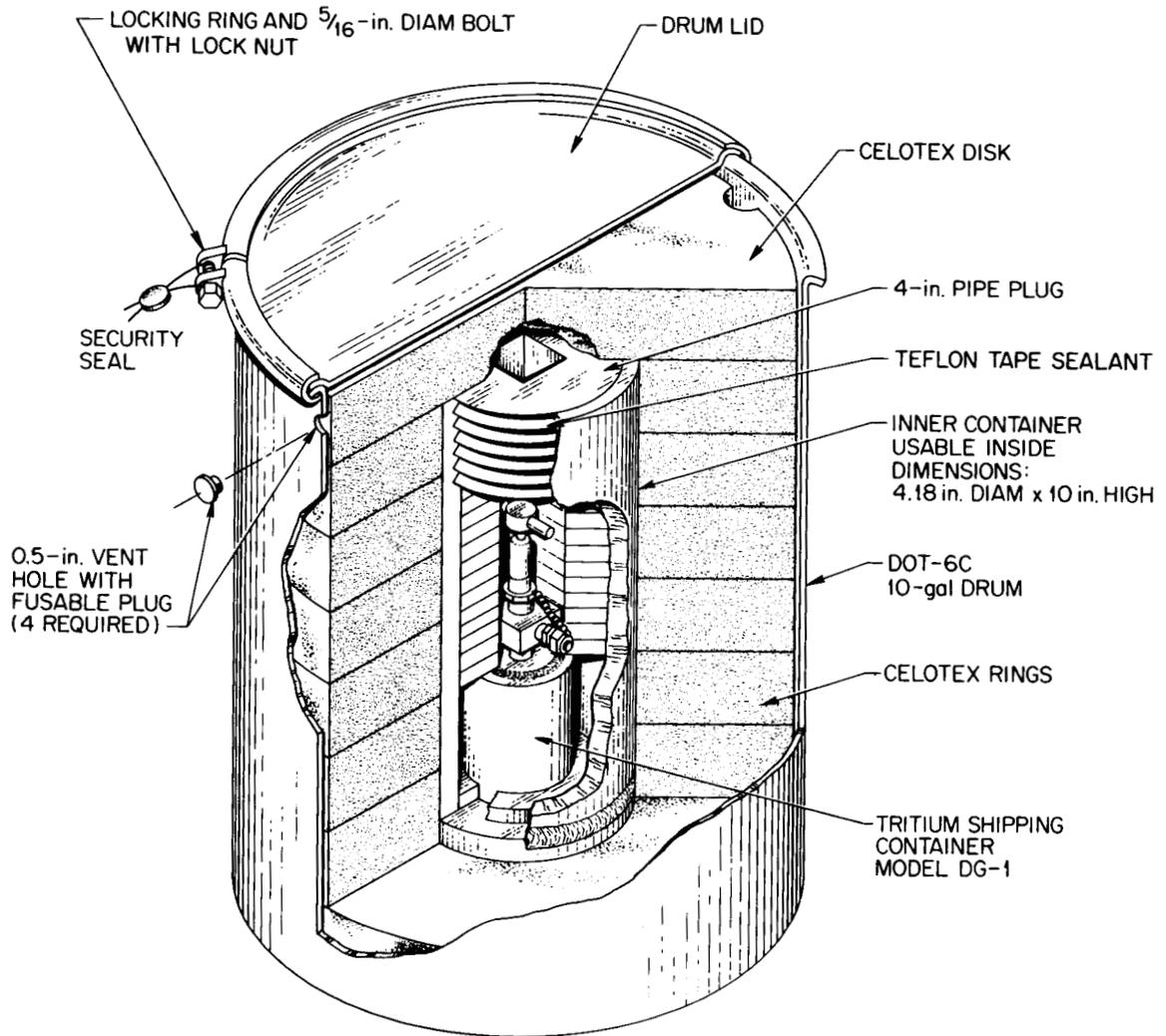
A. RADIOACTIVE GASES

ORNL SPEC 6M-TRITIUM TRAP PACKAGE



II.A.18

ORNL SPEC 6M-Tritium trap package



TYPICAL ASSEMBLY DETAIL, 10 gal SIZE DOT-6M SPECIAL FOR PACKAGE, TYPE B

II.A.20

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

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

1a. Certificate Number 9859	1b. Revision No. 0	1c. Package Identification No. USA/9859/B(U) (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 P.O. Box X Oak Ridge, TN 37831	(2) Title and Identification of report or application: Safety Analysis Report for Packaging-The ORNL 00T Specification 6M--Tritium Trap Package ORNL/TM - 8633	(3) Date: January 1984
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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.

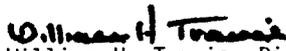
5. Description of Packaging and Authorized Contents, Model Number, Fissile Class, Other Conditions, and References:

a. Packaging

- (1) Model No.: DOT-6M Type B - Tritium Trap
- (2) Metal Packaging as described in accordance with DOT Specification 6M (49 CFR §178.104), 10-Gallon (38-liter) size as an overpack and an innermost Model DG-1 Tritium Trap. The DOT Specification 6M overpack consists of a nominal 10-gal (38-liter) size DOT Specification 6C metal drum 15 inches OD x 18 inches high (38.1 cm OD x 45.7 high) with an inner steel DOT Specification 2R container, 4.18 inches ID x 10 inches high (10.6 cm ID x 25.4 cm high). The inner specification 2R container is closed with a 4-inch (10.2 cm) diameter pipe plug. The space between the outer drum and the inner specification 2R is filled with solid industrial cane fiberboard (Celotex) having a density $> 15 \text{ lb/ft.}^3$ ($> 0.24 \text{ g/cc}$). The outer drum has a 16-gauge locking ring with a 5/16 inch (.8 cm) diameter bolt.

6a. Date of Issuance: January 19, 1983	6b. Expiration Date: January 31, 1988
--	---------------------------------------

FOR THE U.S. DEPARTMENT OF ENERGY

7a. Address (of DOE Issuing Office) U.S. Department of Energy P.O. Box E Oak Ridge, TN 37831	7b. Signature, Name, and Title (of DOE Approving Official)  William H. Travis, Director Safety & Environmental Control Division
---	--

Certificate of Compliance
No. 9859.

- 2 -

The outer drum has four 0.5 inch (.12 cm) diameter vent holes near the top and equally spaced around the outer surface of the drum. The holes are covered with waterproof seals. The Tritium Trap consists of a cylinder fabricated from Type 316 stainless steel pipe 2.32 inches ID x 2 5/16 inches high (5.9 cm ID x 5.6 cm high). A bellows valve is mounted on top of the cylinder. A Type 347 stainless steel sintered metal filter is positioned between the valve and the 250 gm of depleted uranium metal turnings used to absorb the tritium. The tritium trap sits on a steel ring inside the inside specification 2R vessel. A plywood insert provides protection for the valve. The gross weight of the package is 60 lb (27.2 kg).

(3) Drawings

The innermost tritium trap and valve protector are described and constructed in accordance with Oak Ridge National Laboratory Drawing Nos. DSK2117-B and DSK 2118.

b. Contents

(1) Type and form of material:

Tritium as solid uranium tritide.

(2) Maximum quantity of material per package:

500,000 Ci of Tritium

c. Maximum Radiocative decay heat:

10 watts

d. The Tritium Trap must be leak tested to assure a leak rate $\leq 1 \times 10^{-7}$ std CM^3/sec prior to shipment.

II.B.1

B. RADIOACTIVE SOLIDS

ORNL DOT-6M - SPECIAL FORM

II.B.2

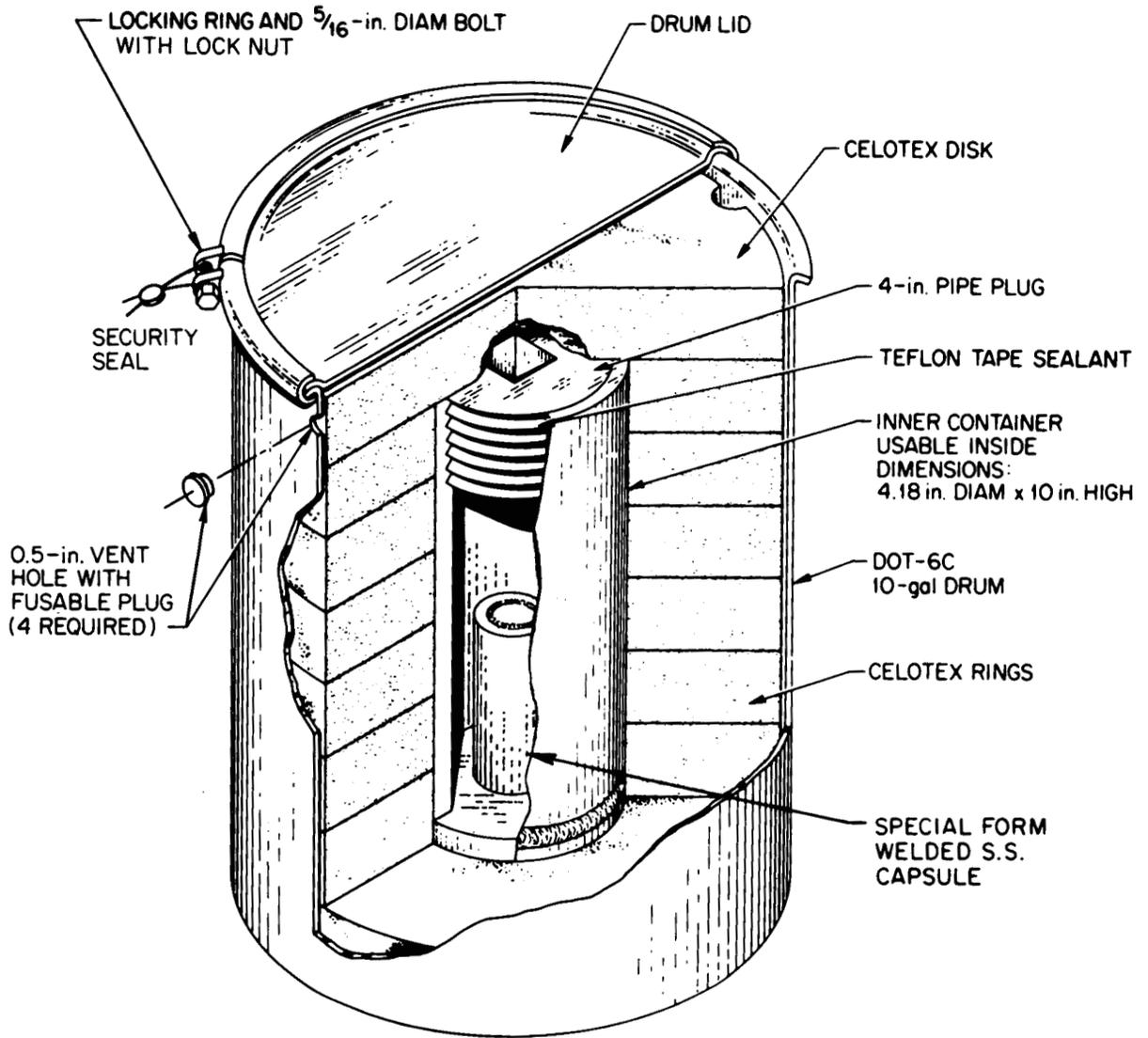
ORNL Photo 2539-68



DOT SPEC 6M - Type B Container

II.B.3

ORNL-DWG 76-13675R2



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

DOE Form EV-613
(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.
9855	1	USA/9855/B(U) (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—

- (1) Prepared by (Name and address):
Oak Ridge National Laboratory
P.O. Box X
Oak Ridge, TN 37830
- (2) Title and identification of report or application:
Safety Analysis Report for Packaging:
The ORNL DOT-6M Type B
Special Form Packaging
Report ORNL/TM-8340
- (3) Date: July 1982

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

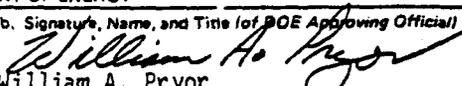
- (1) Model No.: DOT-6M Type B-Special Form
- (2) Description

Metal packaging as described and constructed in accordance with DOT Specification 6M (49 CFR 178.104), 10-gallon size.

b. Contents:

- (1) Type and Form of Material:
- (a) Fissile and nonfissile, solid radioactive materials which will not decompose at temperatures up to 250°F.
- (b) Radioactive material is encapsulated in a metal capsule meeting the special form definitions of:

1 U.S. Department of Transportation Regulations, 49 CFR 173.403(z) and

6a. Date of Issuance:	6b. Expiration Date:
April 12, 1957	April 30, 1989
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 P.O. Box E Oak Ridge, Tennessee 37830	 William A. Pryor Safety & Environmental Control Division

2 International Atomic Energy Agency Safety Series No. 6, Regulations for the Safe Transport of Radioactive Materials, 1973 Revised Edition (As Amended), Part 135.

Capsules are individually leak tested during fabrication per ANSI N542, procedure A2.2.1 (ethylene glycol-vacuum technique) or equivalent.

(2) Maximum quantity of material per package:

The maximum quantity of radioactive material is a Type B quantity for special form which is limited to:

- (a) Up to 10 watts of thermal decay energy,
- (b) Fissile materials are further limited to 15 g, and
- (c) The authorized external radiation levels specified within the regulations of the U.S. Department of Transportation 49 CFR 173.441.

(3) Restrictions

Due to the lack of radiation shielding, the following radionuclides are excluded:

^{60}Co , ^{192}Ir , ^{137}Cs , ^{90}Sr , and other radionuclides emitting similar levels of penetrating radiation.



US Department
of Transportation

**Research and
Special Programs
Administration**

400 Seventh Street, S.W.
Washington, D.C. 20590

IAEA CERTIFICATE OF COMPETENT AUTHORITY

Radioactive Material Package Design

Certificate Number USA/9855/B(U)T
Revision 0

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 radioactive materials as prescribed in IAEA 1/ Regulations and in accordance with §§ 49 CFR 173.393b and 173.7(d) of the USA 2/ Regulations for the transport of radioactive materials.

I. Package Identification - DOT Specification 6M.

II. Packaging Description - The packaging authorized by this certificate consists of a sealed DOT Specification 2R (Appendix A) metal inner containment vessel, centered and supported within a 10 gallon metal outer drum by means of machined discs and rings of specified solid materials which provide thermal and impact protection. Packaging must comply with the provisions of 49 CFR §178.104, attached as Appendix B. Typical assembly detail is illustrated in Appendix C.

III. Authorized Radioactive Contents - The authorized contents consist of special form encapsulations of nonfissile solid radioactive materials which will not decompose at temperatures up to 250°F. The decay heat load shall not exceed 10 watts and contents shall not exceed 5,000 curies. Cobalt-60, iridium-192, cesium-137 and strontium-90 are excluded.

Contents must be of a design which has been tested and demonstrated to be leaktight to a sensitivity of 10^{-5} atm-cm³/sec or less.

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 Department of Energy 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/9855/B(U) as well as the other marking and labels prescribed by the USA Regulations.

VI. Expiration Date - This certificate, unless renewed, expires on August 31, 1985.

This certificate is issued in accordance with the requirements of the IAEA and USA Regulations and in response to the June 14, 1982 petition by the Department of Energy, Washington, D.C. and in consideration of the associated information provided in DOE Certificate of Compliance USA/9855/B (DOE-OR) (Appendix D).

Certified by:



Richard R. RAWL
Chief, Radioactive Materials Branch
Office of Hazardous Materials Regulation
Materials Transportation Bureau



(DATE)

1/ "Safety Series No. 6, Regulations for the Safe Transport of Radioactive Materials, 1973 Revised Edition" published by the International Atomic Energy Agency (IAEA), Vienna, Austria.

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

II.B.9

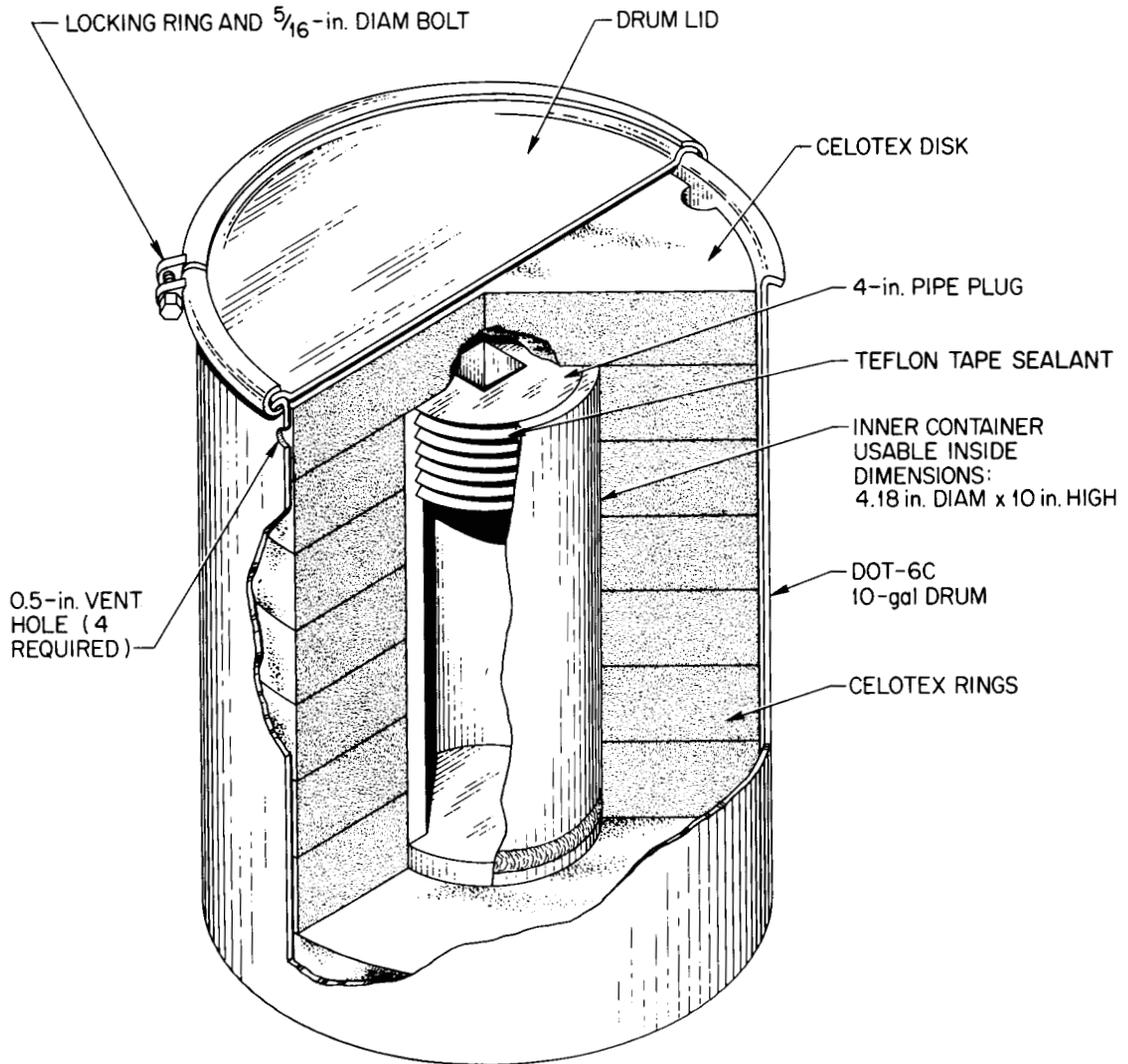
B. RADIOACTIVE SOLIDS

DOT - 6M



I.B.10

DOT-6M Drum, 10 gal Size, TYPE B



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

II.B.13

B. RADIOACTIVE SOLIDS

DOT-20WC-1

II.B.14

ORNL Photo 2866-78



DOT 20WC-1 - Type B Container

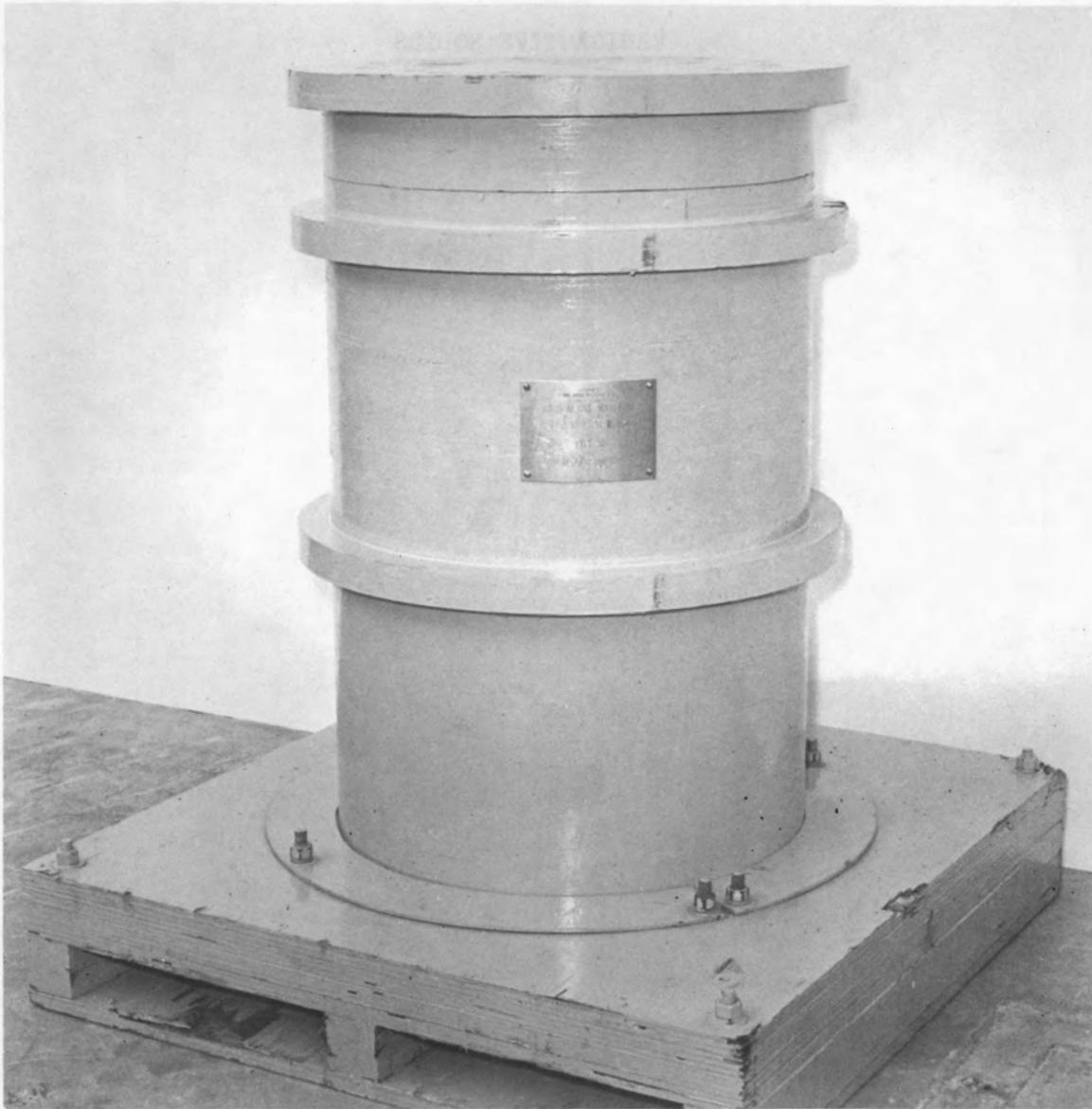
II.B.15

B. RADIOACTIVE SOLIDS

DOT-20WC-3

II.B.16

ORNL Photo 2426-78



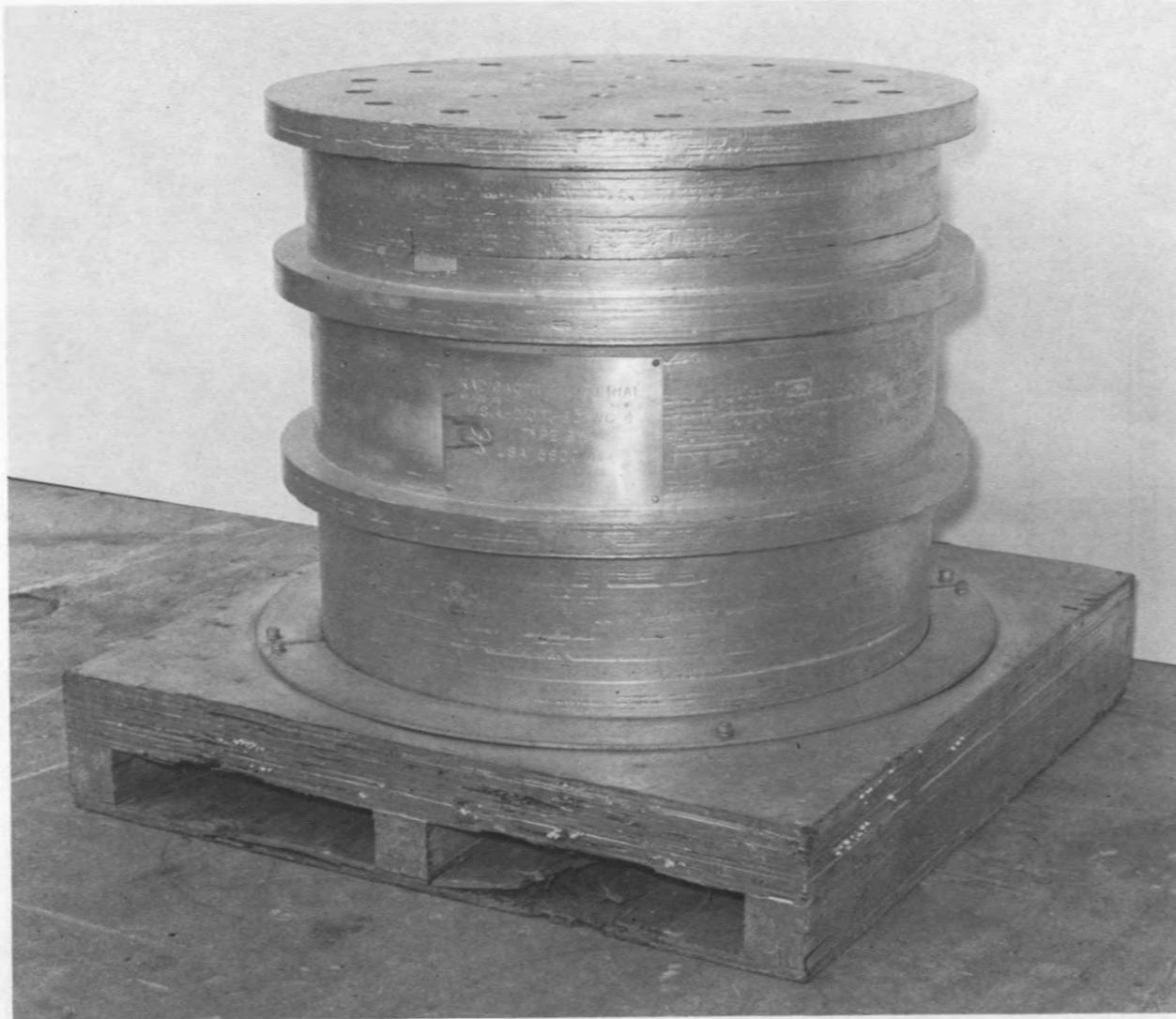
DOT 20WC-3 - Type B Container

II.B.17

B. RADIOACTIVE SOLIDS

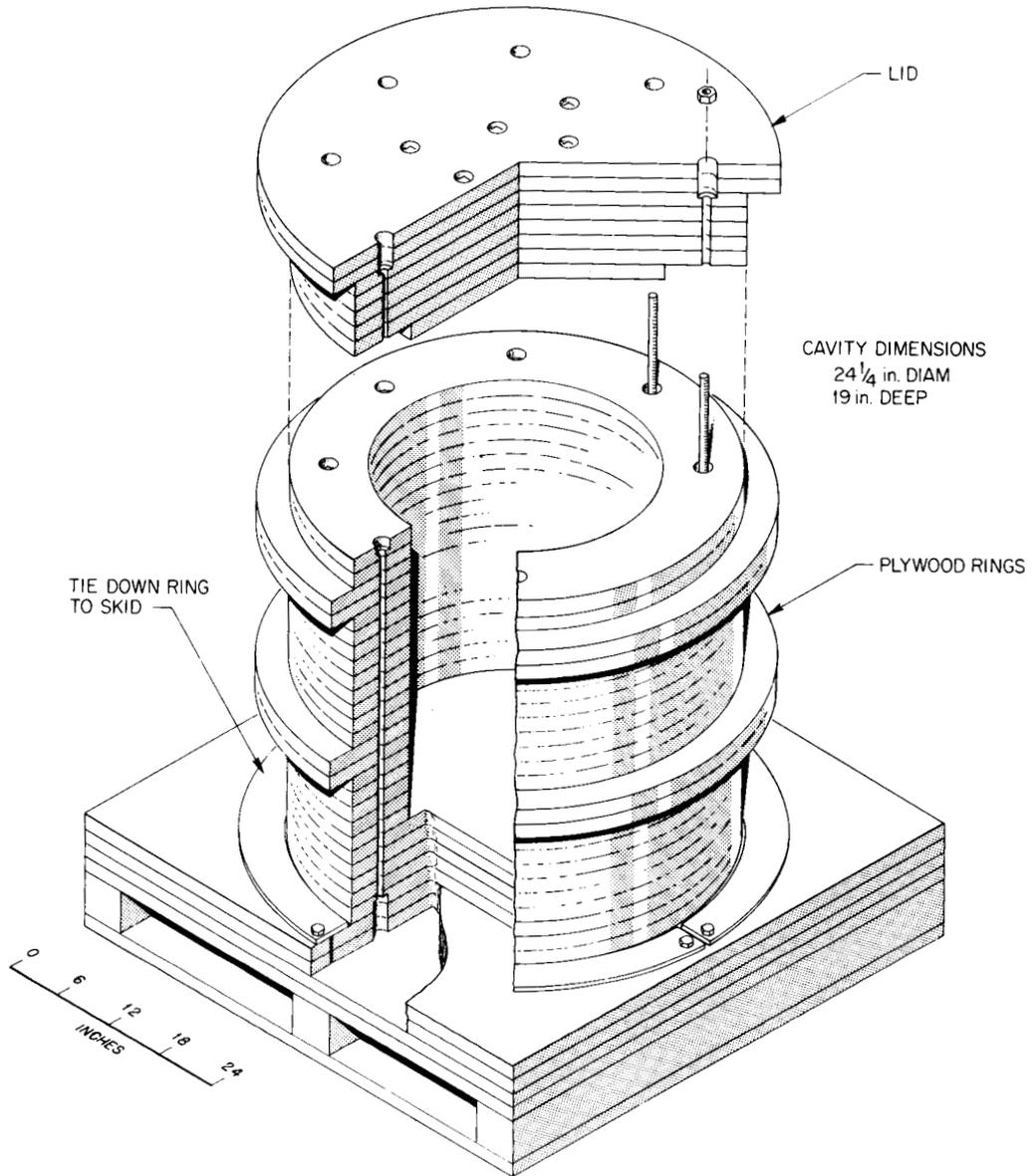
DOT-20WC-4

ORNL Photo 2420-78



DOT 20WC-4 - Type B Container

II.B.18



FIRE SHIELD US DOT-20 WC-4

II.B.21

B. RADIOACTIVE SOLIDS

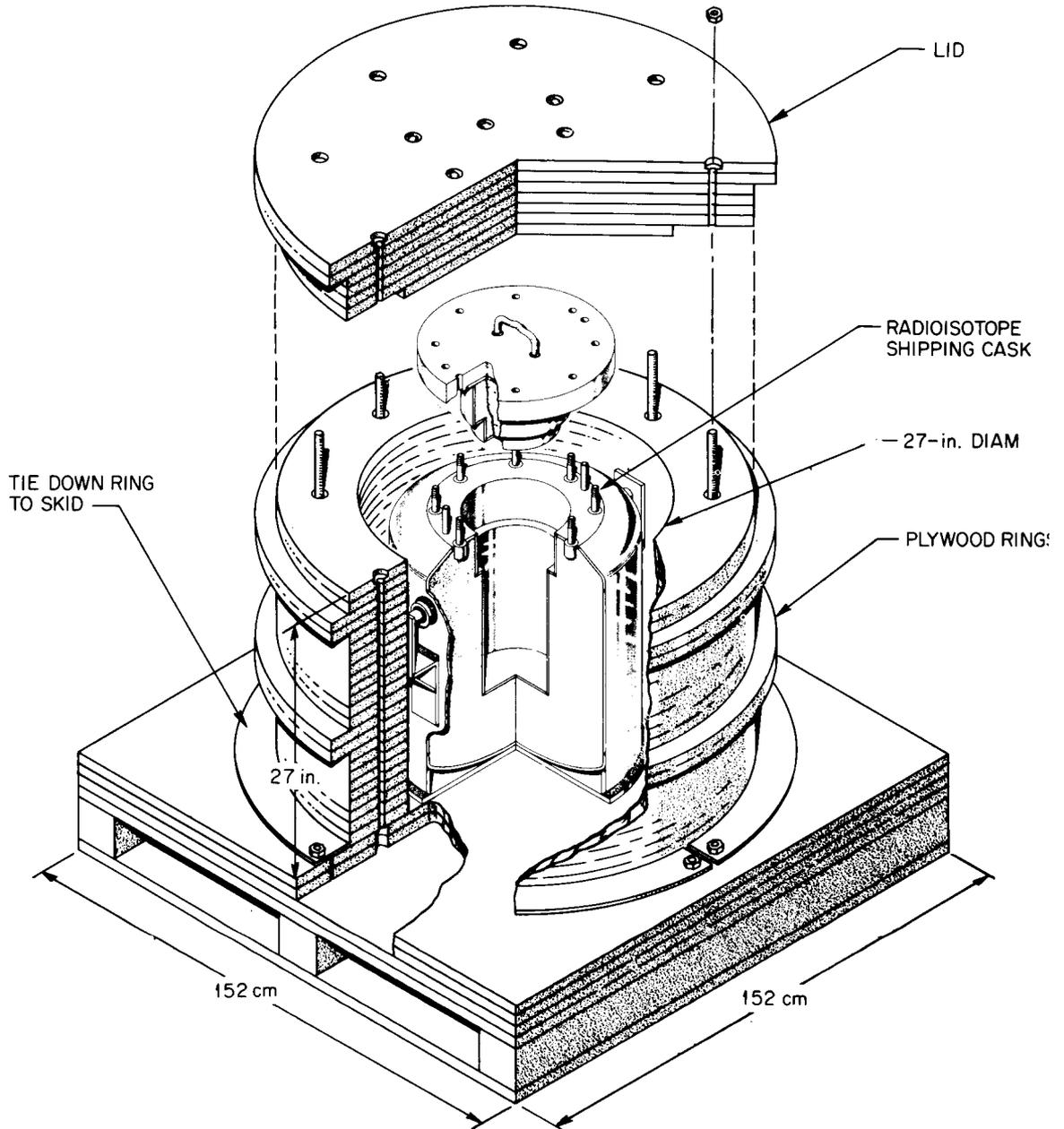
ORNL DOT-20WC-5 - SPECIAL FORM

ORNL Photo 5066-80



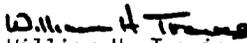
DOT 20WC-5 - Type B Container

II. B. 22



ORNL DOT-20 WC-5 — SPECIAL FORM PACKAGE
WEIGHT — 4000 lb (1815 Kg)

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

1a. Certificate Number 9856	1b. Revision No. 2	1c. Package Identification No. USA/9856/B(U) (DOE-OR)	1d. Page No. 1	1e. Total No. Pages. 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—				
(1) Prepared by (Name and address):		(2) Title and Identification of report or application:		(3) Date:
Oak Ridge National Laboratory P.O. Box X Oak Ridge, TN 37830		Safety Analysis Report for Packaging: The ORNL DOT Specification 20WC-5 Special Form Packaging Report ORNL/TM-8347/R1		October 1982 (Revised March 1983)
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. <u>Packaging</u>				
(1) <u>Model No.:</u> DOT 20WC-5 - Special Form				
(2) <u>Description:</u> Wooden protective jacket as described and constructed in accordance with DOT 20WC-5 (49 CFR 178.194) with a single inner packaging consisting of a lead shield encased in series 300 stainless steel and conforming to DOT 7A (49 CFR 178.352).				
The wooden protective jacket is a hollow cylindrical shell constructed of one-piece discs and rings fabricated from 1-inch (2.5-cm) thick exterior grade, Douglas fir plywood. The discs and rings are both glued and nailed together and reinforced with 16 1/2-inch (1.3-cm) diameter steel rods. Closure is provided by the bolted reinforcing rods. Usable cavity dimensions are 27-inches ID X 27-inches high (69.6-cm ID X 69.6-cm high). Minimum plywood thicknesses around the cavity are 6-inches (15.2-cm) in the wall and 8-inches (20.3-cm) at the ends. The protective jacket has six chimes with an O.D. of 43-inches (109-cm). The protective jacket is mounted on a skid 60-inches X 60-inches (152-cm X 152-cm).				
6a. Date of Issuance: February 28, 1984		6b. Expiration Date: February 28, 1989		
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 P.O. Box E Oak Ridge, TN 37831		 William H. Travis, Director Safety & Environmental Control Division		

The DOE Specification 7A is a 300 series stainless steel encased, lead shielded cask. The outer shell is fabricated from 1/4-inch (0.64-cm) thick steel plate and the cavity is lined with 11 gauge steel plate. Closure is accomplished with a steel-clad, recessed plug-type lid with eight 1/2-inch (1.3-cm) bolts. Containment for the contents is provided by special form encapsulation.

The gross weight of the packaging is 4,000 lbs. (1815 kg).

- (3) Drawings: The packaging is constructed in accordance with the drawings and specifications shown on pages 68, 69, 70, 71, and 72 and DOT Specification 20WC-5. A typical special form capsule is constructed in accordance with the drawings and specifications shown on page 5 (Figure 2) and 67.

b. Contents

(1) Type and Form of Material:

- (a) Nonfissile, solid radioactive materials.
- (b) Radioactive material encapsulated in a metal capsule meeting the special form definitions of:
- 1) U.S. Nuclear Regulatory Commission Regulations, 10 CFR 71.13 and 71.75.
 - 2) U.S. Department of Transportation Regulations, 49 CFR 173.469, and
 - 3) International Atomic Energy Agency Safety Series No. 6, Regulations for the Safe Transport of Radioactive Materials, 1973 Revised Edition (As Amended), Part 135, and specifically limited to the radioisotopes and in Type B Special Form quantities specified in the following IAEA Certificates of Competent Authority:

USA/0156/S	USA/0204/S
USA/0198/S	USA/0205/S
USA/0202/S	USA/0206/S
USA/0203/S	
- (c) Maximum quantity per package. The maximum internal heat is limited to 100 watts.

c. Other Restrictions and Limitations

Only one type of radioactive material will be shipped per capsule.

II.B-27

B. RADIOACTIVE SOLIDS

DOT-20WC-6



DOT 20WC-6 - Type B Container

II.B.29

B. RADIOACTIVE SOLIDS

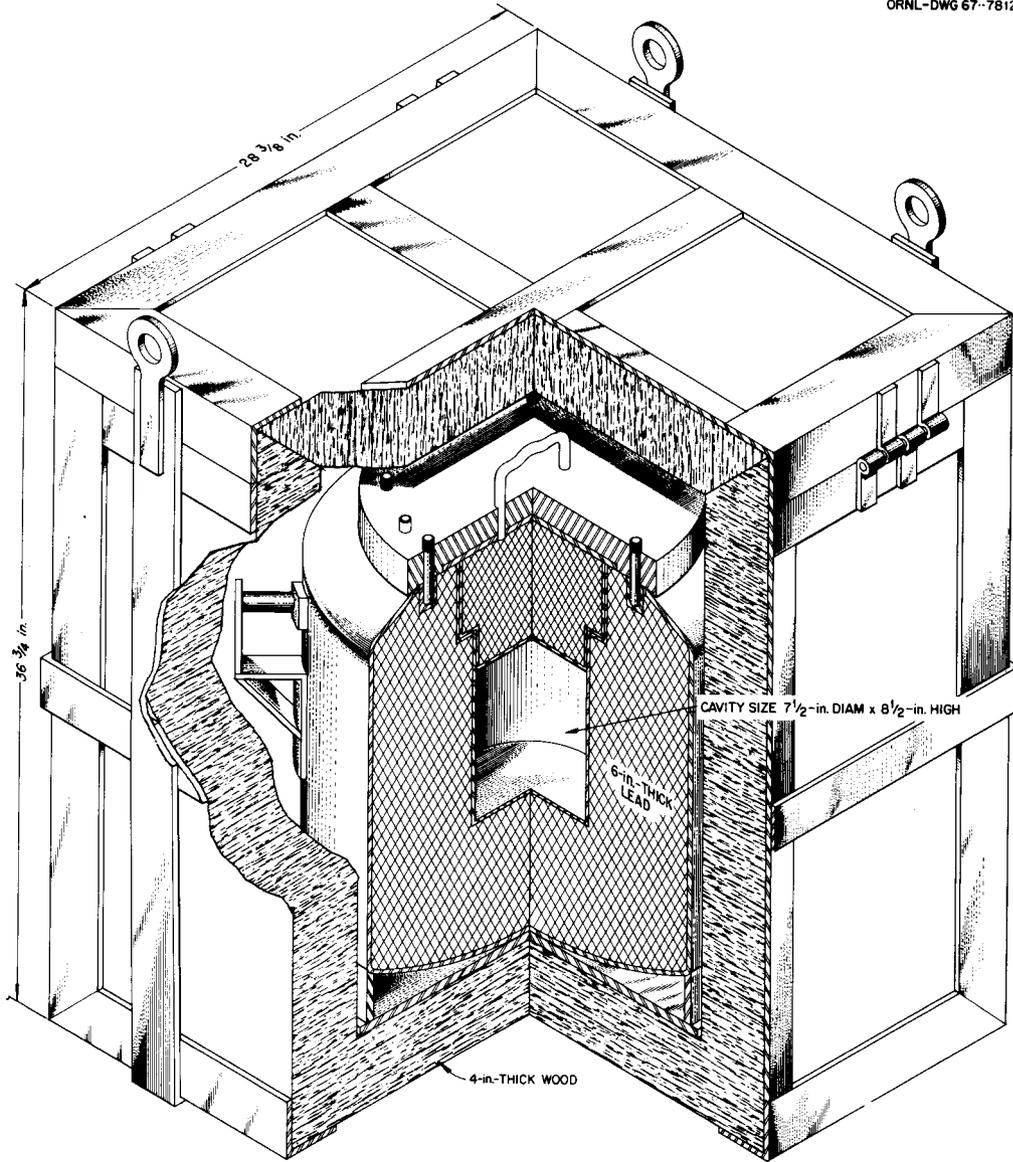
DOT-21WC

II.B.30

ORNL Photo 88461



DOT 21WC - Type B Container



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).

II.B.33

(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.

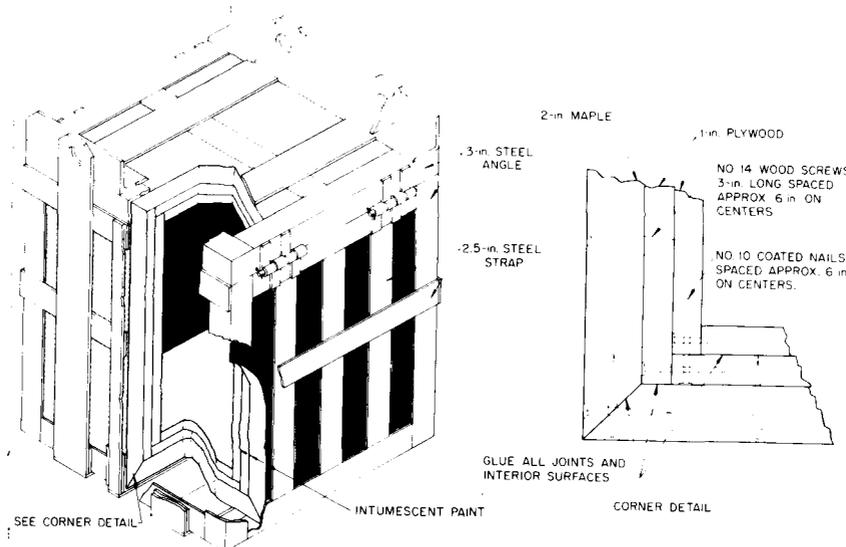
§ 178.195-5 Required marking. (a) Marking must be as prescribed in § 178.24 of this subchapter.

(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.

ORNL DWG 68-7482A



RADIOISOTOPE SHIPPING CASK FIRE AND IMPACT SHIELD

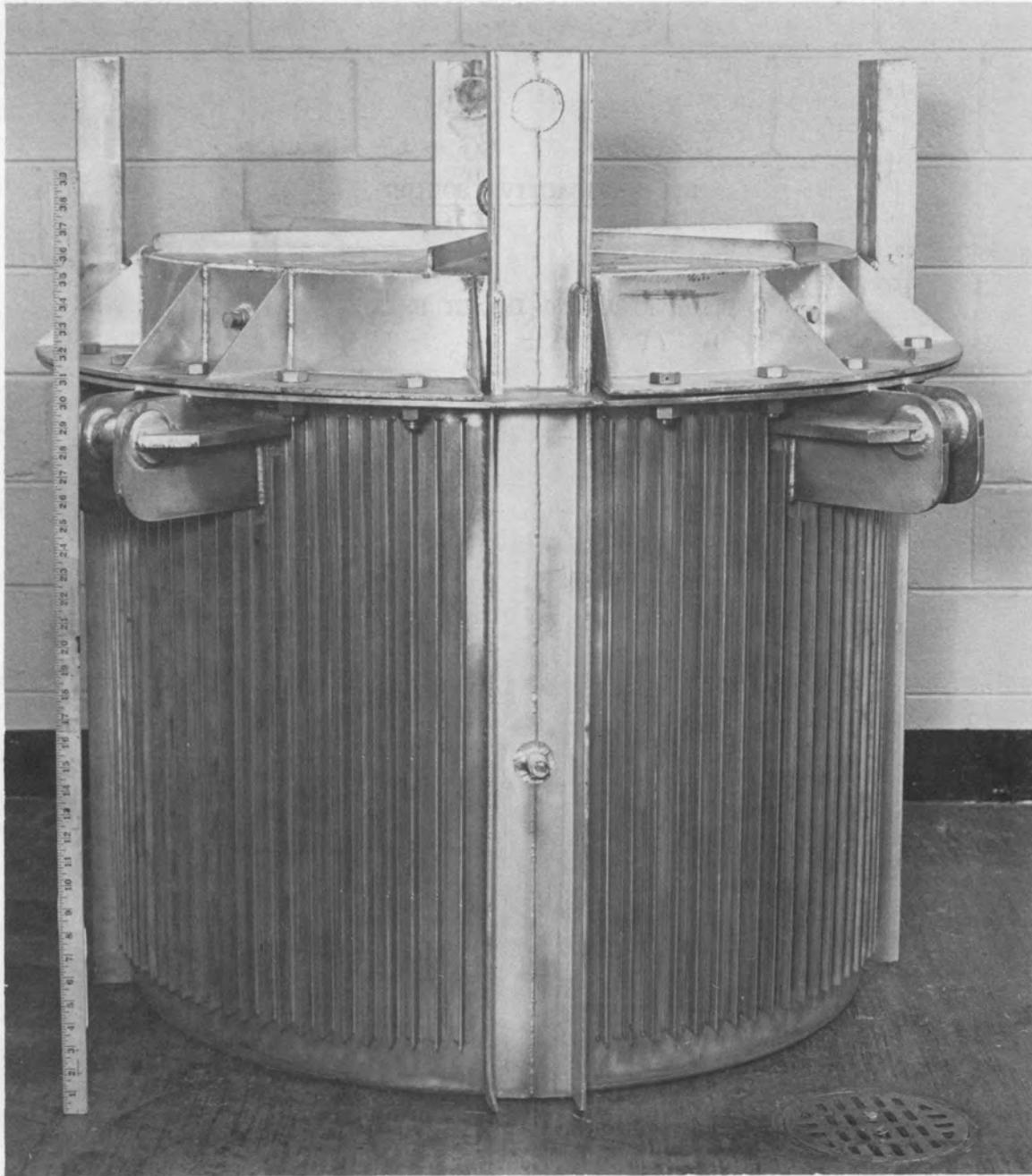
II.B.35

B. RADIOACTIVE SOLIDS

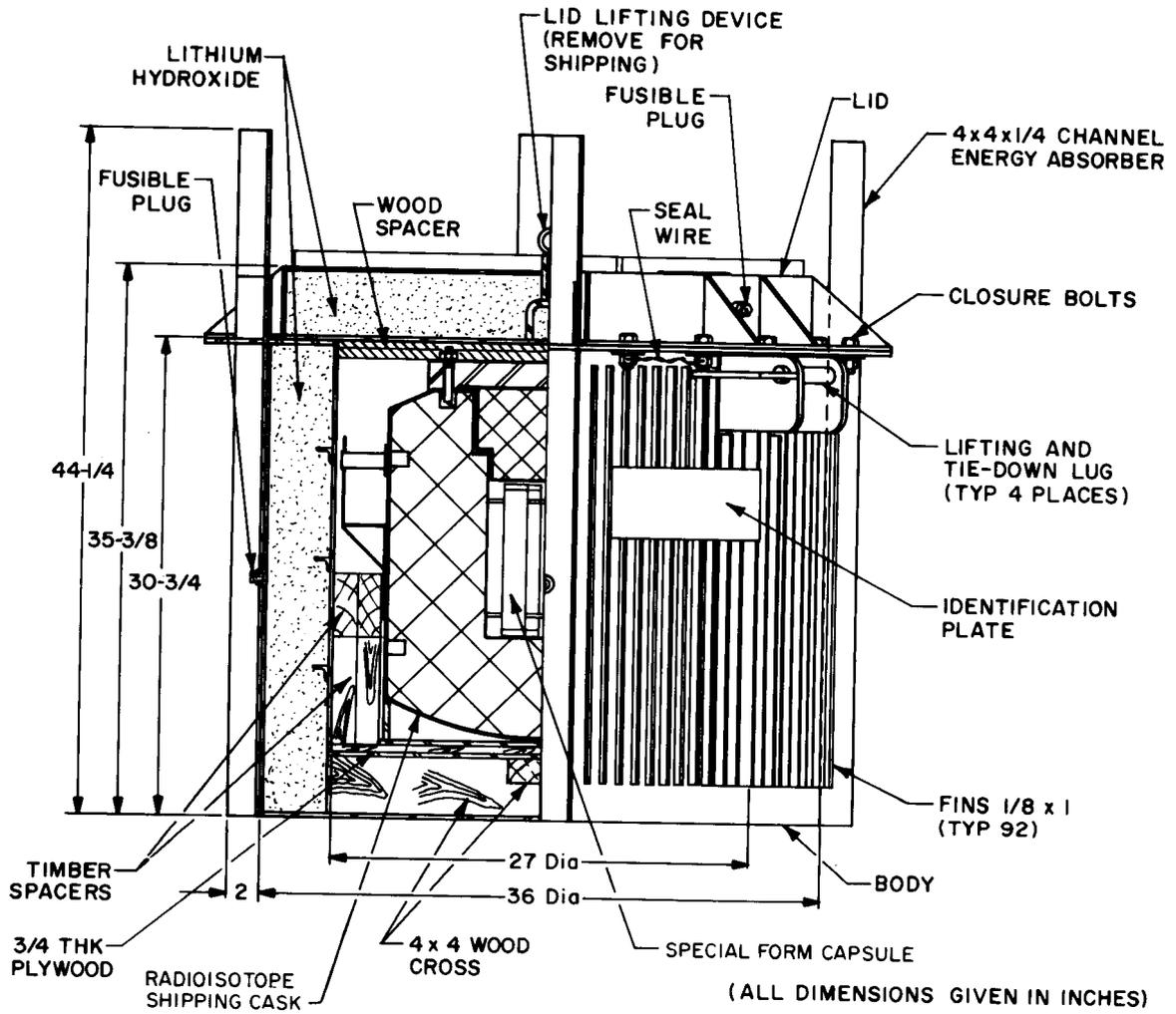
L10H FIRE AND IMPACT SHIELD

II.B.36

ORNL Photo 2868-78



ORNL LiOH Fire and Impact Shield
Type B Container



LiOH FIRE AND IMPACT SHIELD PACKAGING

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

1a. Certificate Number 9851	1b. Revision No. 2	1c. Package Identification No. USA/9851/B(U) (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):

(2) Title and Identification of report or application:

(3) Date:

November 1983

Oak Ridge National Laboratory
Post Office Box X
Oak Ridge, TN 37830Safety Analysis Report for
Packaging for the ORNL Lithium
Hydroxide Fire and Impact Shield

Report No.: ORNL/ENG/TM-8/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: Lithium Hydroxide Fire and Impact Shield

(2) Description:

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

The inner cavity of the shield is a cylinder 27 inches diameter x 26 inches high (68.6 cm. dia. x 66 cm. high). The outer shell is 36 inches diameter x 30-3/4 inches high (91.4 cm. dia. x 78.1 cm. high).

The lid is 4-5/8 inches (11.7 cm.) thick. The shield is fabricated from 1/8 inches (0.3 cm.) thick 304-L stainless steel with the 4-1/4 inches (10.8 cm.) nominal space between inner and outer cladding being filled with $\text{LiOH}\cdot\text{H}_2\text{O}$ crystals. The outer surface of the shield has 92 vertical cooling fins.² The flanged closure is held in position by twenty 1-inch (2.5 cm.) alloy steel bolts.

6a. Date of Issuance: November 30, 1983

6b. Expiration Date:

November 30, 1988

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
P.O. Box E
Oak Ridge, Tennessee 37830

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

The inner Type A package is a top loading, cylindrical lead shield clad with 3/8 inch (1 cm.) thick Series 300 stainless steel. Outside dimensions are 20 inches OD x 21-11/16 inches high (51 cm. OD x 55 cm. high). Cavity dimensions are 7-1/4 inches ID x 10-1/2 inches high (18.4 cm. ID x 26.7 cm high). The cavity plug is closed with eight 1/2-inch (1.3 cm.) diameter bolts and nuts.

The gross weight of the package is 4,000 lbs. (1814 kg.).

(3) Drawings:

The overpack and the inner Type A Cask are described and fabricated in accordance with Union Carbide Corp., Nuclear Division, Oak Ridge National Laboratory drawings:

D-RD-2760-D through D-RD-2764-D, X3D-1091-109, and X3D-10191-109.

(b) Contents:

(1) Type and form of material:

Any solid, large quantity of radioactive materials, fissile and nonfissile, meeting special form 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) 100 g of:

^{235}U or ^{233}U .

(iii) Irradiated metal such as tensile, impact, and weld specimens (including but not limited to stainless steel, mild steel, INOR-89, nickel, high-nickel alloys such as Inconel, Monel, and tungsten).

(c) Fissile Class:

I

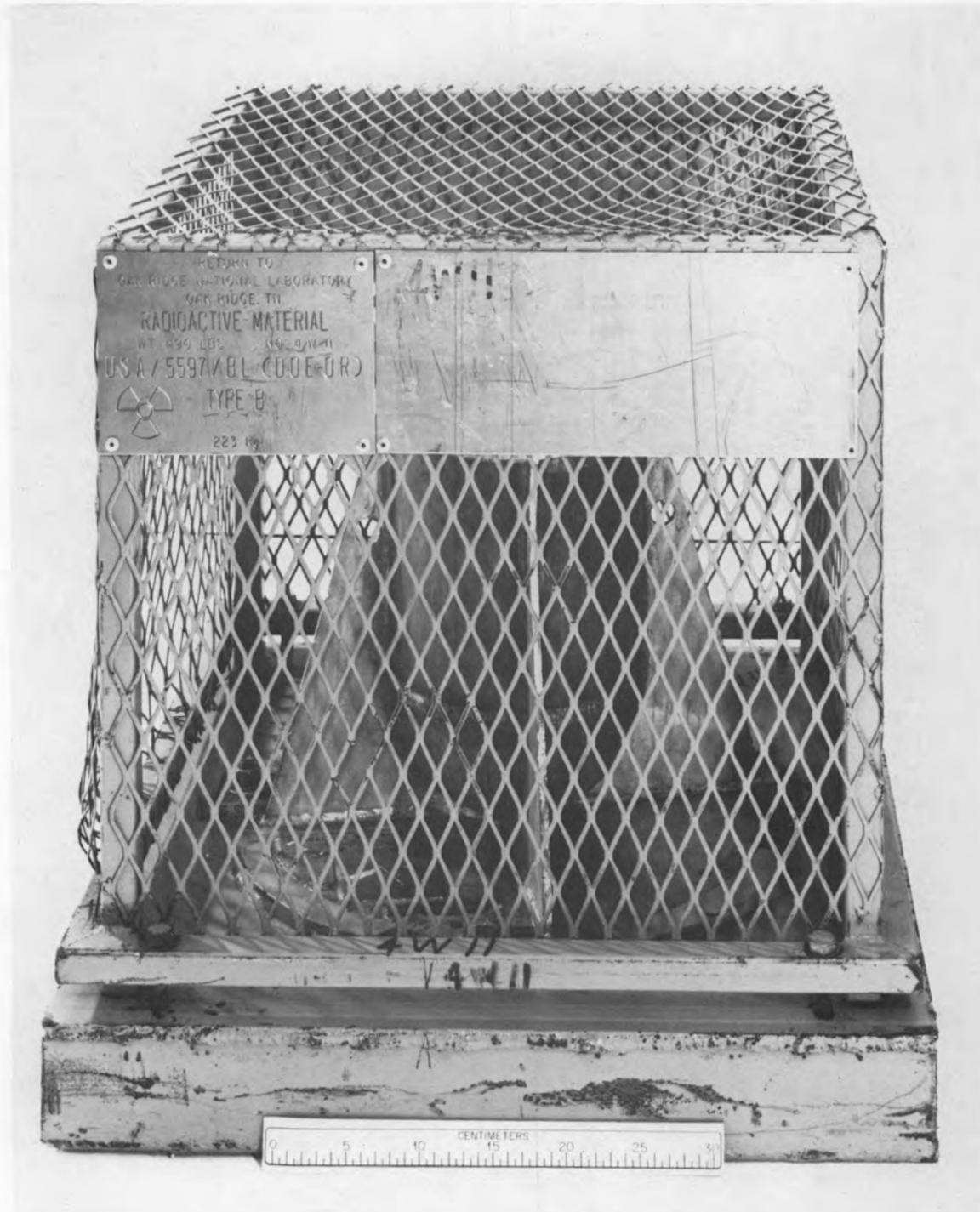
II.B.41

B. RADIOACTIVE SOLIDS

TUNGSTEN SHIELDED CASKS

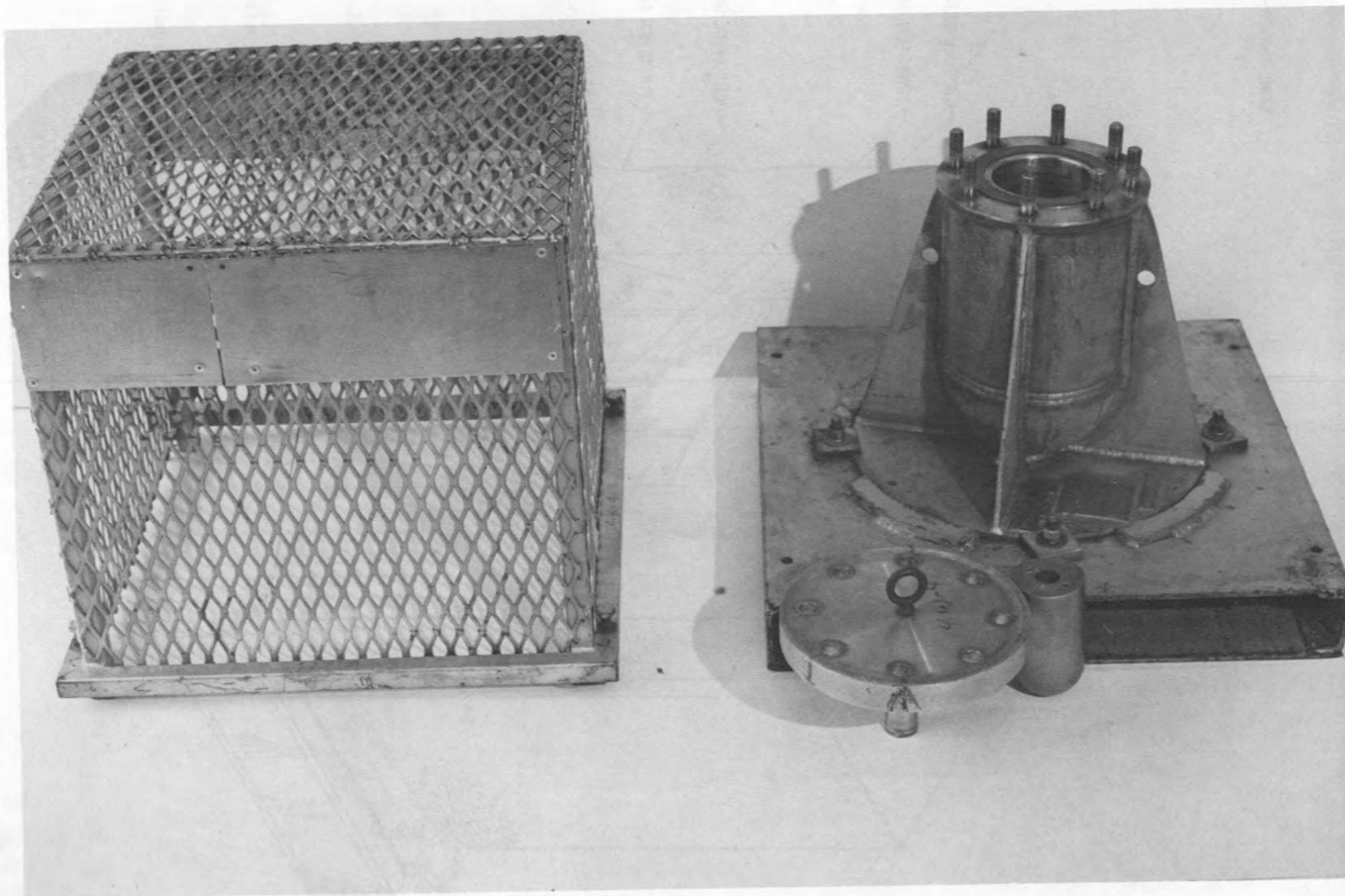
II.B.42

ORNL Photo 2996-79



ORNL Tungsten Shielded Type B Container

ORNL Photo 5069-80



II.B.43

ORNL TUNGSTEN SHIELDED TYPE B CONTAINER

DOE Form EV-613
(11-77)
10 CFR 71U.S. DEPARTMENT OF ENERGY
CERTIFICATE OF COMPLIANCE
For Radioactive Materials Packages

1a. Certificate Number 5597	1b. Revision No. 3	1c. Package Identification No. USA/5597/BL(DOE-CR)	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
P.O. 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
- b) Safety Analysis Report for the ORNL Tungsten-Shielded Cask, Addendum 1, Report No. ORNL/ENG/TM-3, Addendum 1

(3) Date:

a) Oct. 1977

b) March 1979

c) Ltr from Sommerfeld to Lenhard

c) Apr. 7, 1982

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-in. 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: April 20, 1982	6b. Expiration Date:
FOR THE U.S. DEPARTMENT OF ENERGY	
7a. Address (of DOE Issuing Office) U.S. Department of Energy P.O. 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 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:

- (a) Nonfissile, solid radioactive materials which will not decompose at temperatures up to 250°F.
- (b) Radioactive material is encapsulated in a metal capsule meeting the special form definitions of:
 - 1 U.S. Department of Transportation Regulations, 49 CFR 173.389(g) and
 - 2 International Atomic Energy Agency Safety Series No. 6, Regulations for the Safe Transport of Radioactive Materials, 1973 Revised Edition (As Amended), Part 135.

Capsules are individually leak tested during fabrication per ANSI N542, procedure A2.2.1 (ethylene glycol-vacuum technique) or equivalent.

(2) Maximum quantity of material per package:

The maximum quantity of radioactive material is a large quantity which is limited to:

- (a) For the package without the insert, heat shield, and skid-- ≤ 25 watts of thermal decay energy or
- (b) For the package with the insert, heat shield, and skid-- ≤ 50 watts of thermal decay energy and
- (c) The authorized external radiation levels specified within the regulations of the U.S. Department of Transportation 49 CFR 173.393(j).

(3) Prior to each loading:

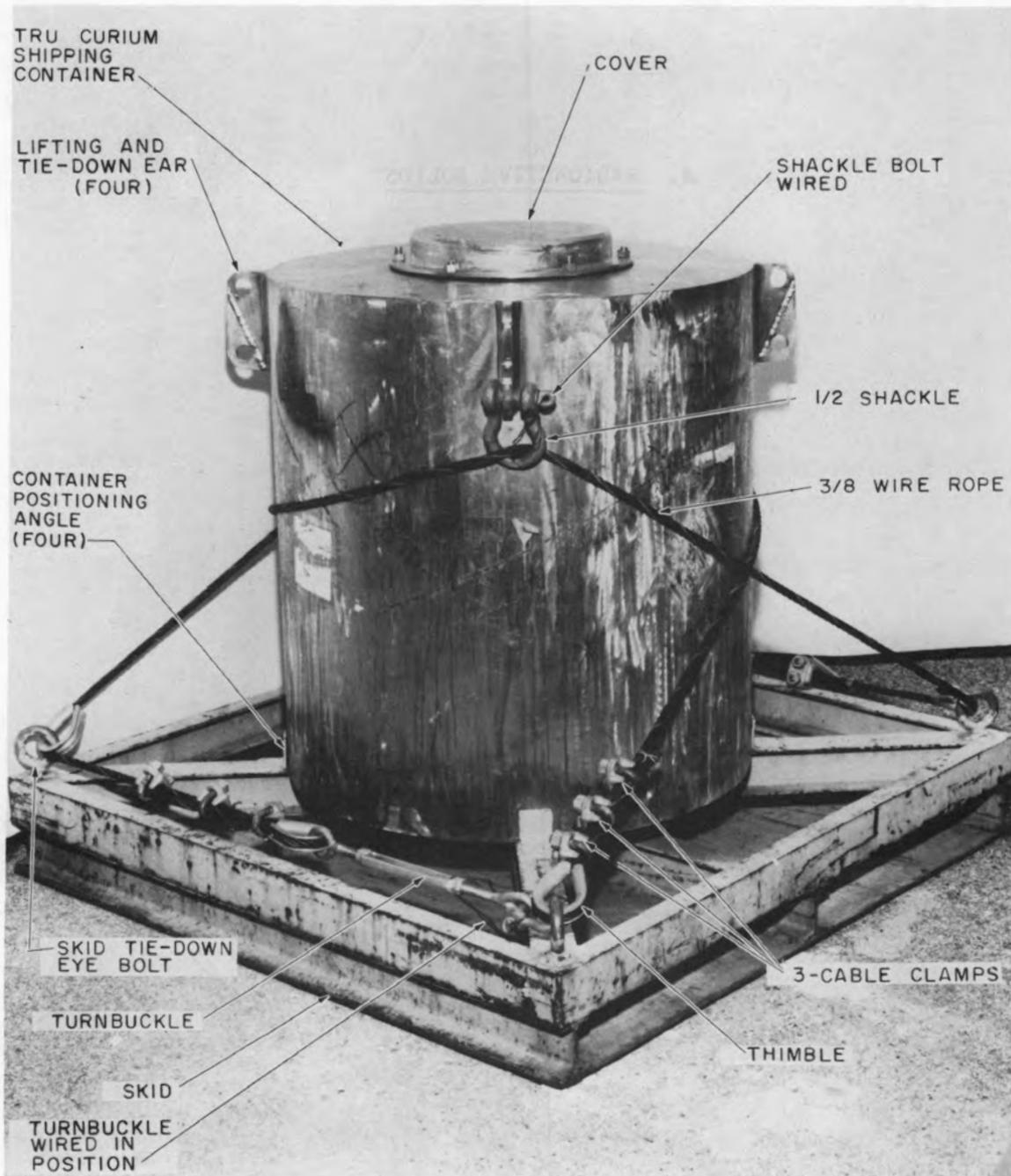
- (a) The package and gaskets will be inspected. The gaskets shall be replaced with new gaskets if any defects are noted or every six months, whichever occurs first.
- (b) The package shall be leak tested to 10^{-3} at. cm³/sec using the soap bubble test or equivalent.

(4) Within six (6) months prior to shipment, package welds will receive a dye penetrant inspection. Repairs will be made as appropriate.

II.B.47

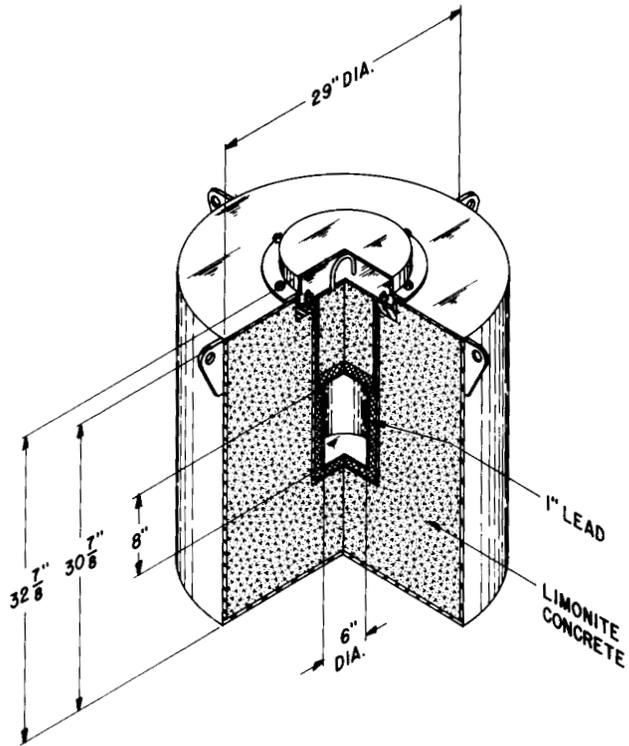
B. RADIOACTIVE SOLIDS

TRU CURIUM SHIPPING CONTAINER



ORNL TRU Shipping Container - Type B

ORNL DWG 67-9810



ORNL TRU Shipping Container - Type B

NRC FORM 618 (6-83) 10 CFR 71		U.S. NUCLEAR REGULATORY COMMISSION		
CERTIFICATE OF COMPLIANCE FOR RADIOACTIVE MATERIALS PACKAGES				
1. a. CERTIFICATE NUMBER	b. REVISION NUMBER	c. PACKAGE IDENTIFICATION NUMBER	d. PAGE NUMBER	e. TOTAL NUMBER PAGES
5461	1	USA/5461/B()	1	3
2. PREAMBLE				
a. This certificate is issued to certify that the packaging and contents described in item 5 below, meets the applicable safety standards set forth in Title 10, Code of Federal Regulations, Part 71, "Packaging of Radioactive Materials for Transport and Transportation of Radioactive Material Under Certain Conditions."				
b. This certificate does not relieve the consignor from compliance with any requirement of the regulations of the U.S. Department of Transportation or other applicable regulatory agencies, including the government of any country through or into which the package will be transported.				
3. THIS CERTIFICATE IS ISSUED ON THE BASIS OF A SAFETY ANALYSIS REPORT OF THE PACKAGE DESIGN OR APPLICATION				
a. PREPARED BY (Name and Address):		b. TITLE AND IDENTIFICATION OF REPORT OR APPLICATION:		
Oak Ridge National Laboratory P.O. Box X Oak Ridge, TN 37830		Safety Analysis Report for Packaging (SARP) of the Oak Ridge National Laboratory TRU Curium Shipping Container, Report No. ORNL-5147/R1, August 7, 1981 Revision.		
		c. DOCKET NUMBER 71-5461		
4. CONDITIONS This certificate is conditional upon fulfilling the requirements of 10 CFR Part 71, as applicable, and the conditions specified below.				
5.				
(a) Packaging				
(1) Model No: ORNL TRU Curium Shipping Container				
(2) Description:				
Packaging for solid radioactive materials. The container is a right circular cylinder 29 inches in diameter and 30-7/8 inches high with a 304L stainless steel outer shell which is 3/8-inch thick for the bottom and sides and 1/4-inch thick for the top. The shell for inner cavity is 8-1/4 inches in diameter x 19-1/4 inches deep, is fabricated from 1/4-inch thick 304L stainless steel plate, and is recessed 1-3/8 inches from the top. The inner cavity for the radioactive materials is 6 inches in diameter x 8 inches high and fabricated from 1/4-inch thick 304L stainless steel. Seven-eighths-inch 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-inch thick 304L stainless steel plate. A 1/16-inch thick Neoprene gasket serves as a seal between the top flange of the plug and the cask body. Eight, 1/2 "-13 UNC-2 nuts on studs hold the plug flange to the cask body. A 3/8-inch diameter 304L stainless steel bail is used to lift the plug. A 1/4-inch thick 304L stainless steel plate, which covers the top 13UNC-2 nuts on studs. The cask is equipped with four, 1/2-inch thick lifting and tie-down ears with two, 1-inch diameter holes per ear. The cask is mounted on a skid. The gross weight of the cask and skid is 2,800 pounds.				

Page 2 - Certificate No. 5461 - Revision No. 1 - Docket No. 71-5461

5. (a) (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 (Report No. ORNL-5147/RI, August 7, 1981 Revision).

(b) Contents

(1) Type and form of material

- (i) Transuranics, including any isotopes of curium, berkelium, californium and fermium in the form of metal, oxide, chloride, or other salt contained in capsules that meet the requirements of special form radioactive material.
- (ii) Transuranics, including any isotopes of plutonium in the form of metal, oxide, chloride, or other salt doubly encapsulated in capsules that each meet the requirements of special form radioactive material.

(2) Maximum quantity of material per package

The maximum internal heat not to exceed 150 watts;

- (i) For the material described in 5(b)(1)(i) a total of 10 g or any combination of Am-242, Cm-243, Cm-245, Cm-247, or Cf-249.
- (ii) For the material described in 5(b)(1)(i) a total of 3 g of Cf-251.
- (iii) For the material described in 5(b)(2)(ii) the total of any combination of Pu-239 and Pu-241 shall be limited to 10 g.

- 6. Special form radioactive material capsules may be held within DOT Specification 2R containers.
- 7. The package authorized by this certificate is hereby approved for use under general provisions of 10 CFR §71.12.
- 8. Expiration date: June 30, 1986.

CONDITIONS (continued)

Page 3 - Certificate No. 5461 - Revision No. 1 - Docket No. 71-5461

REFERENCE

Safety Analysis Report for Packaging (SARP) of the Oak Ridge National Laboratory TRU Curium Shipping Container, August 7, 1981 Revision to Report No. ORNL-5147/RI.

FOR THE U.S. NUCLEAR REGULATORY COMMISSION

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

Date: SEP 06 1983



U.S. Department
of Transportation
**Research and
Special Programs
Administration**

400 Seventh Street, S.W.
Washington, D.C. 20590

IAEA CERTIFICATE OF COMPETENT AUTHORITY

Type B Radioactive Material Package Design

Certificate Number USA/5461/B()
(Revision 3)

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 radioactive materials as prescribed in IAEA 1/ Regulations and 49 CFR §§ 173.393b and 173.395(c)(2) of the USA 2/ Regulations for the transport of radioactive materials.

I. Package Identification - Model No. ORNL TRU Curium Shipping Container.

II. Packaging Description - The packaging authorized by this certificate consists of a stainless steel weldment 29" in diameter and 31" long with shielding provided by 1 inch of lead and 9-3/4 inches of limonite concrete. Inner cavity closure is by means of a neoprene gasketed stainless steel plug which is filled with lead and concrete and which is bolted to the cask body. A stainless steel plate covers the closure. Gross weight of the cask and skid is 2,800 pounds.

III. Authorized Radioactive Contents - The authorized contents consist of any isotope of americium, curium, berkelium, californium, fermium or plutonium as metal, oxide, chloride or other salt contained in capsules meeting the requirements for special form (49 CFR 173.389(g)). Contents are limited to a total 10g of Am-242, Cm-243, Cm-245, Cm-247, Cf-249, Pu-239 and Pu-241. Californium-251 is limited to 3g. The balance of other transuranic and non-fissile isotopes present is limited to a total decay heat load not to exceed 150 watts. Encapsulations may be further contained in a DOT Specification 2R container.

IV. General Conditions

a. Each user of this certificate must have in his possession a copy of this certificate.

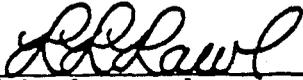
b. Each user of this certificate, other than the Department of Energy, Washington, D.C. shall register his identity in writing to the Office of Hazardous Materials Regulation, U.S. Department of Transportation, Washington, D.C. 20590.

V. Marking and Labeling - The package must bear the marking USA/5461/B() as well as the other marking and labels prescribed by the USA Regulations.

VI. Expiration Date - This certificate, unless renewed, expires on June 30, 1986.

This certificate is issued in accordance with the requirements of the IAEA and USA Regulations and in response to the February 25, 1982, petition by the Department of Energy, Washington D.C., and in consideration of the associated information provided in Department of Energy Certificate No. 5461 and Nuclear Regulatory Commission Certificate No. 5461, both of which constitute Appendix A.

Certified by:



Richard R. Rawl
Chief, Radioactive Materials Branch
Office of Hazardous Materials Regulation
Materials Transportation Bureau

October 15, 1982
(DATE)

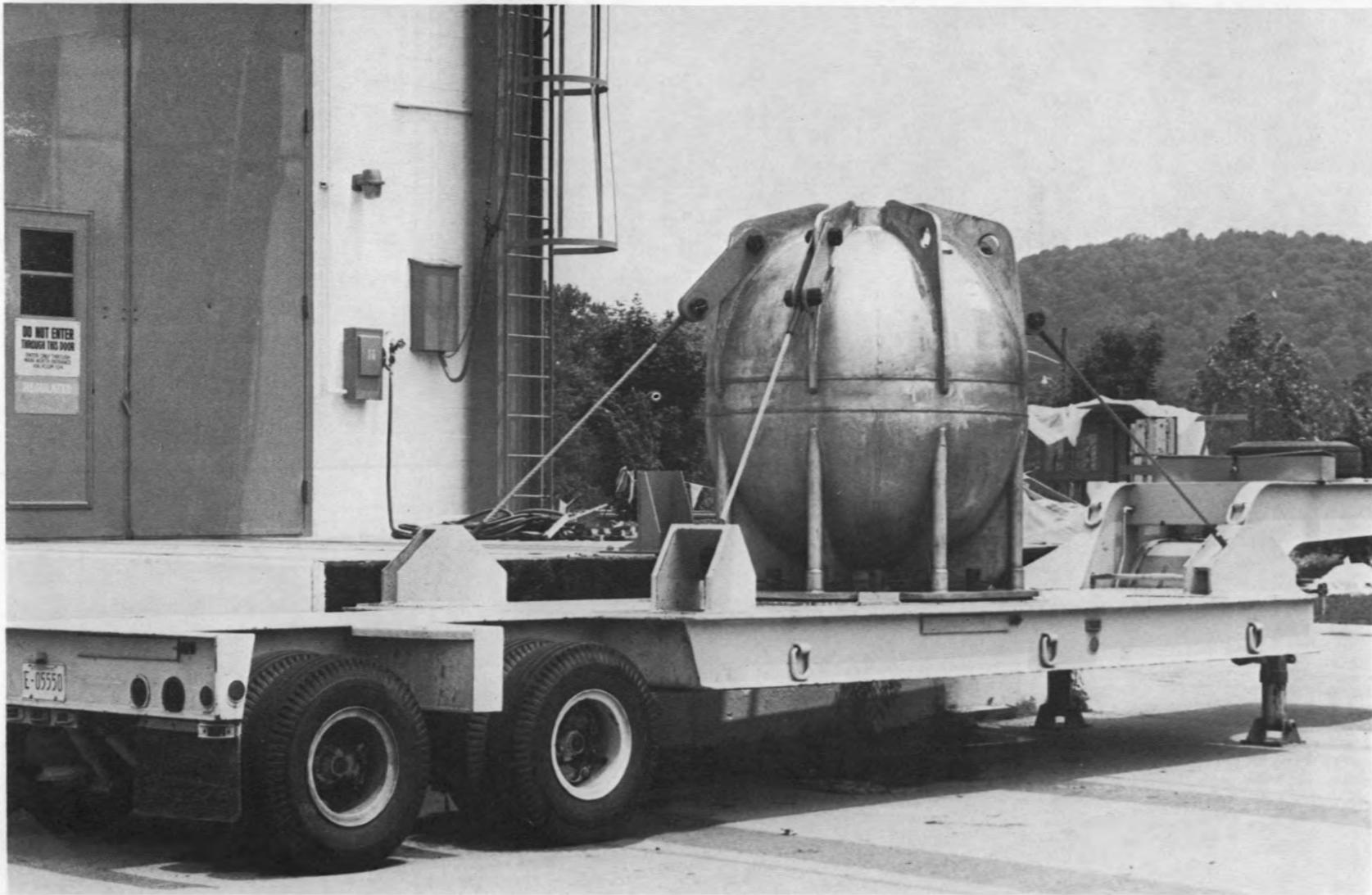
1/ "Safety Series No.6, Regulations for the Safe Transport of Radioactive Materials, 1967 Edition" published by the International Atomic Energy Agency (IAEA), Vienna, Austria.

Revision 3 issued to incorporate USDOE Certificate No. 5461, Revision 1 and USNRC Certificate No.5461, Revision 0 and to extend expiration date.

II.B.55

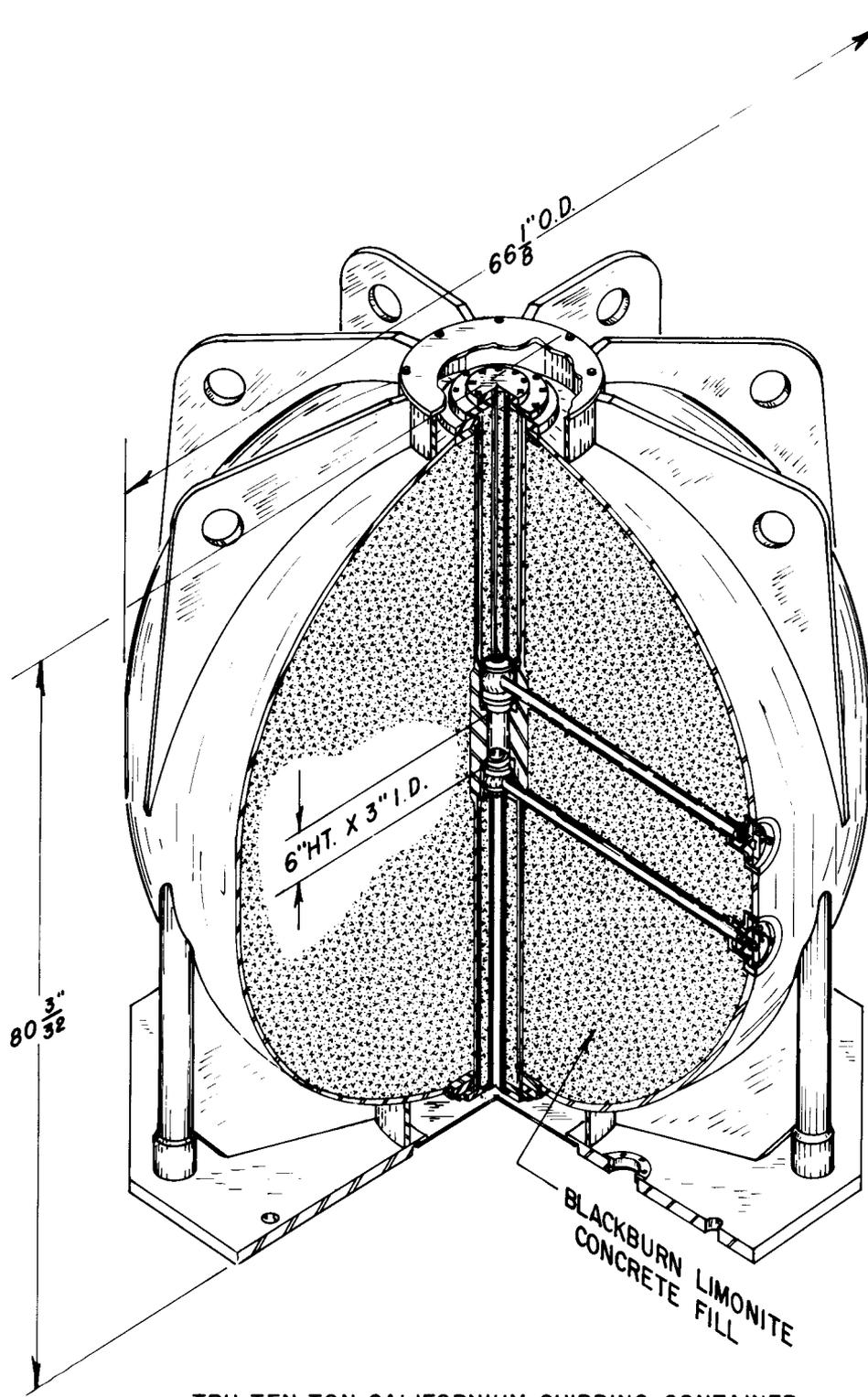
B. RADIOACTIVE SOLIDS

TRU TEN-TON CALIFORNIUM SHIPPING CONTAINER



II. B. 56

ORNL TRU Californium Shipping Container - Type B



TRU TEN TON CALIFORNIUM SHIPPING CONTAINER

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

SEP 09 1993

1a. Certificate Number 5740	1b. Revision No. 3	1c. Package Identification No. USA/5740/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 173.333a, 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. Safety Analysis Report for Packaging (SAR) of the Oak Ridge National Laboratory TRU Californium Shipping Container.
Report ORNL-5409/R1 and Revisions of 8/7/81.
b. Ltr. dtd. 5/30/83, Sommerfeld to Lenhard.
- (3) Date: Jan. 1980

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

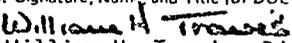
(1) Model: ORNL TRU Californium Shipping Container.

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

The outer shell consists of two 1/2-in.-thick, 66-in.-dia. hemispherical heads joined by a 6-in. cylindrical section. The cylindrical cavity has a 1-in.-thick stainless steel wall and is 3-in. dia. 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 are located in the cover plates and the shell.

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

The cask is mounted onto a 1-in.-thick steel base plate by eight steel 2-1/2-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: September 8, 1983	6b. Expiration Date: September 7, 1988
FOR THE U.S. DEPARTMENT OF ENERGY	
7a. Address for Corresponding Office: U.S. Department of Energy P.O. Box 1 Oak Ridge, Tennessee 37830	7b. Signature, Name, and Title (of DOE Approving Official)  William H. Travis, Director Safety & Environmental Control Division

(3) Drawings:

The package and special trailer are constructed in accordance with Oak Ridge National Laboratory (ORNL) Drawings M-11230-EN-001-D through 003-D, 012-E, 014-E, 017-D, 018-E, and M-12166-CD-019-D (Rev. 1 for 004 and Rev. 17 for 017).

(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

3 g. (large quantity).

(3) Other Limitations

a. Maximum heat load - 5W.

b. External radiation dose rates - limited to DOT Regulations, 49 CFR 173.393.

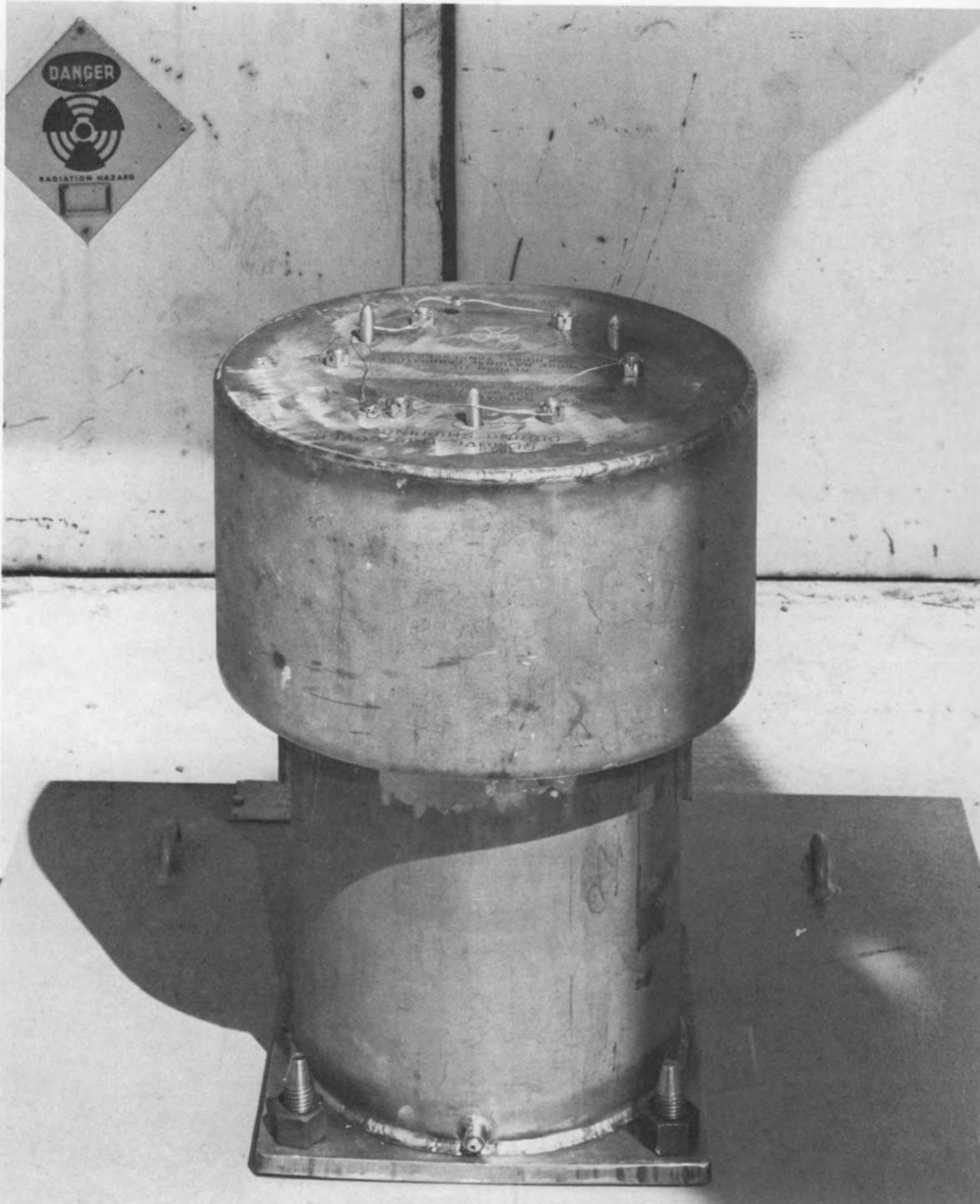
c. Conditions

A minimum of two lifting ribs shall be used to lift the package.

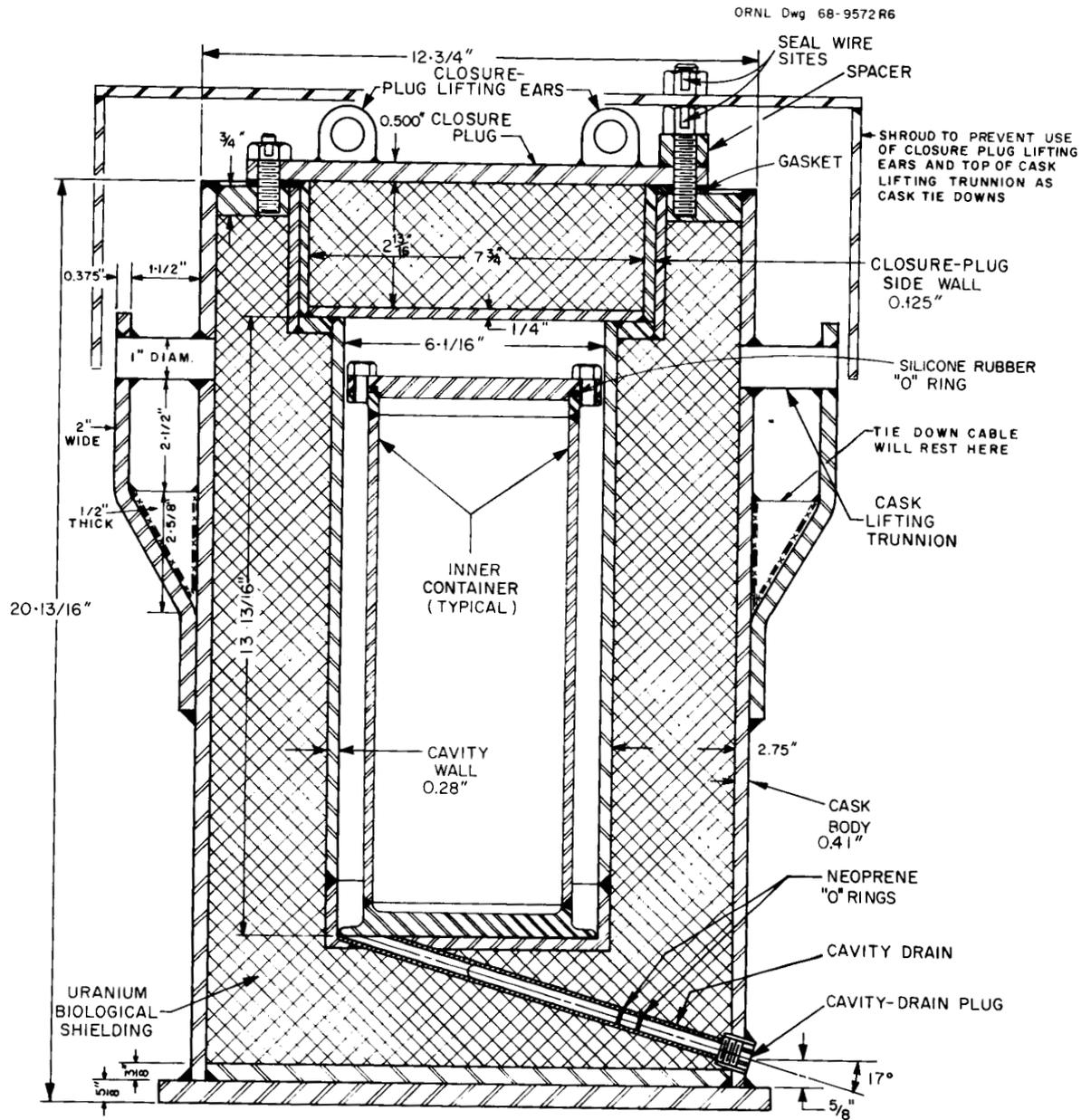
II.B.61

B. RADIOACTIVE SOLIDS

D-38 URANIUM SHIELDED SHIPPING CASK



ORNL D-38 Uranium Shielded Container
Type B



ORNL D-38 Uranium Shielded Container
Type B

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

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:
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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)  for William H. Travis, Director Safety & Environmental Control Division
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Page 2 of Certificate No. 5787

(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:

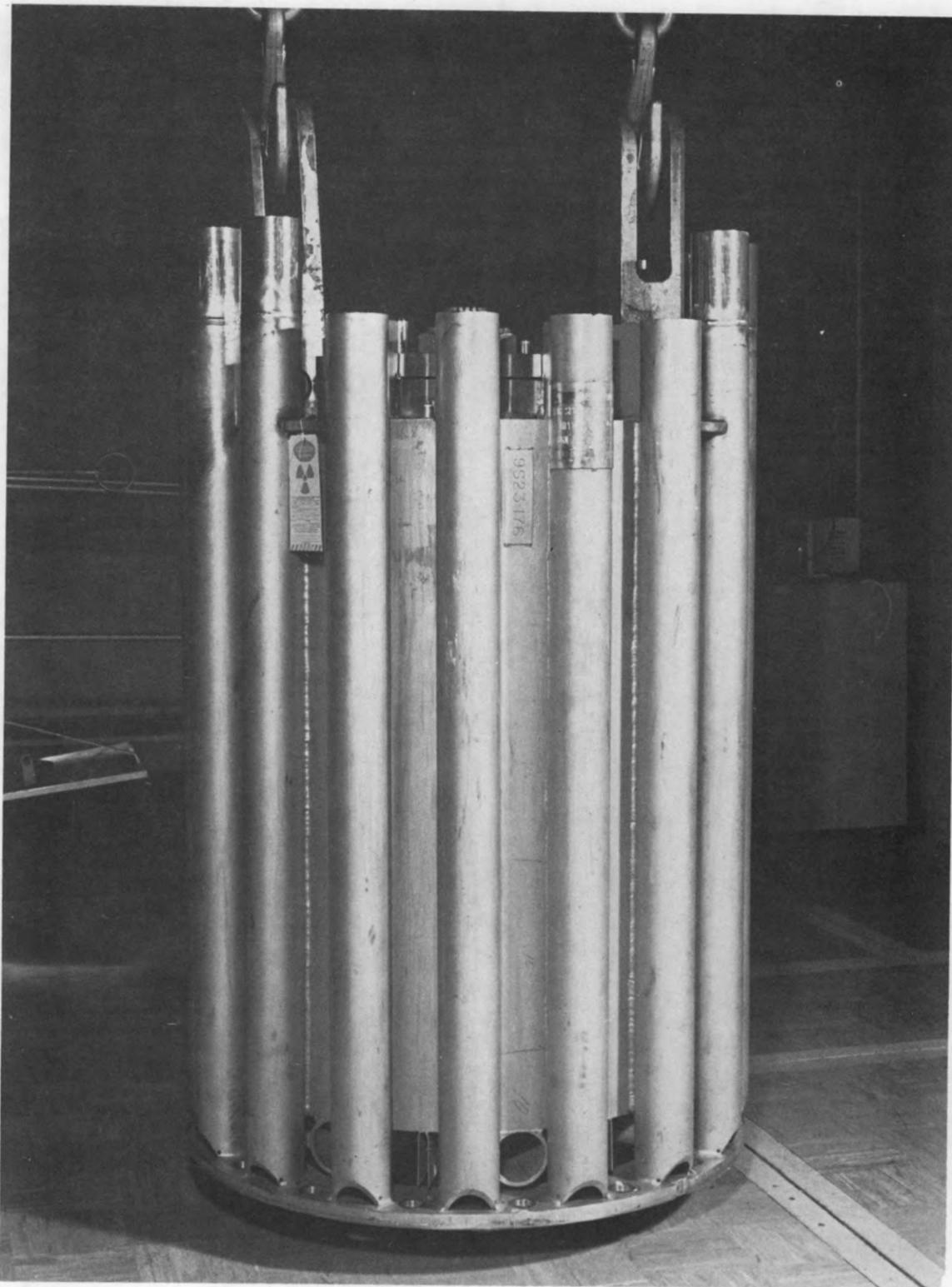
- (1) Solid, large quantity of radioactive materials, fissile and nonfissile, packaged in DOT Specification 2R inner Container(s) or meeting Special Form. Plutonium will be doubly contained inside the cask. Dry heat load does not exceed 80 watts. Heat loads in excess of 20 watts are shipped "exclusive-use" 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

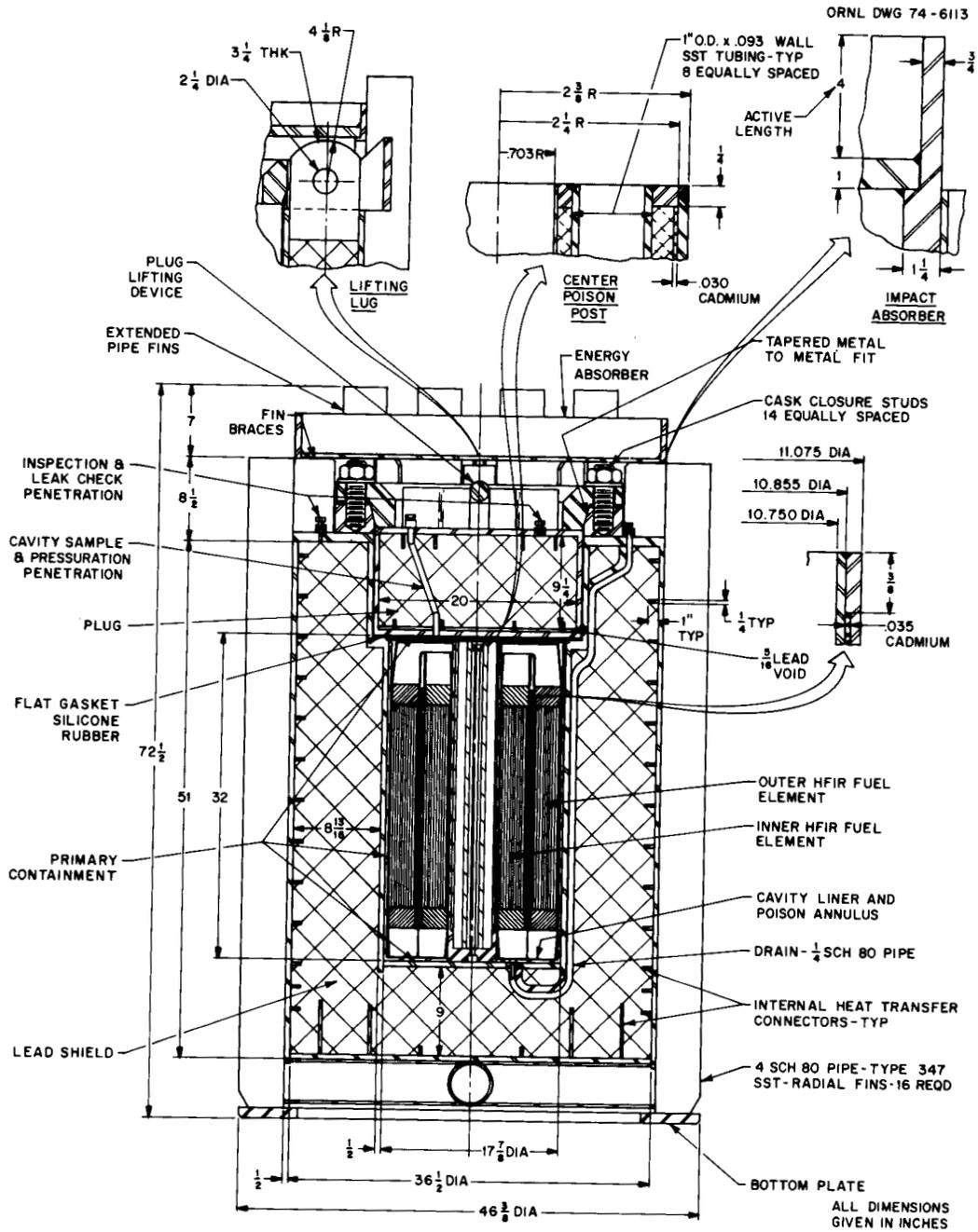
II.B.67

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-418
(11-77)
10 CFR 71

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

1a. Certificate Number 5507	1b. Revision No. 10	1c. Package Identification No. USA/5507/B() (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:

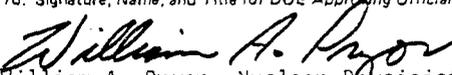
- (1) Model: HFIR (High Flux Isotope Reactor) Spent Fuel Element Shipping Cask
- (2) Description:

Packaging for irradiated fuel elements and irradiated UCC primary ⁹⁹Mo target capsules. The inner cavity is 45.4 cm (17-7/8 in.) diameter x 81.3 cm (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 the Oak Ridge Research Reactor (ORR) type fuel elements which also include Bulk Shielding Reactor (BSR) fuel elements, for Puerto Rico Research Reactor (PRR) fuel elements, and for Chicago Pile No. 5 (CP-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.

6a. Date of Issuance: April 24, 1984	6b. Expiration Date: April 30, 1989
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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 A. Pryor, Nuclear Physicist Safety & Environmental Control Division
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3.(2) (Continued)

- b. Memorandum, R. M. Moser to William H. Travis, December 30, 1975.
- c. Memorandum, R. M. Moser to William H. Travis, October 27, 1976.
- d. Letter, M. E. Ramsey to J. A. Lenhard, July 26, 1979.
- e. Letter, K. W. Sommerfeld to J. A. Lenhard, July 29, 1982.
- f. Memorandum, R. M. Moser to W. H. Travis, July 11, 1983.
- g. Memorandum, R. M. Moser to W. H. Travis, March 14, 1984.

5. (Continued)

- (iii) For TRIGA/FLIP and standard TRIGA 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 22.2 cm (8-3/4-in.) thickness of lead between 1.3 cm (1/2-in.) thick stainless steel inner and outer liners. Overall dimensions are 117.8 cm (46-3/8-in.) diameter x 184.2 cm. (72-1/2-in.) high. Access to the cavity is through a top plug having 3.8 cm (1 1/2-in.) alloy steel studs. The gross weight is 10,430 Kg (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 TRIGA/FLIP and standard TRIGA 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^g in metal cladding as irradiated fuel elements OR as irradiated primary^{Mo} target capsules.

(2) Maximum quantity of fissile material per package

- (i) One HFIR irradiated^g 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 (These fuel elements are also referred to as MTR-type fuel elements. Other MTR-type fuel elements with up to 400 g ²³⁵U loading and construction similar to the ORR fuel elements are also authorized.) each containing up to 400 g of ²³⁵U as uranium-aluminum alloy at a ²³⁵U enrichment up to 93% for a maximum ²³⁵U content of 6,800 g.

- (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 g of ^{235}U as uranium-aluminum alloy at a ^{235}U enrichment up to 93% for a maximum ^{235}U content of 2,890 g.
- (v) Forty-eight TRIGA/FLIP and/or standard TRIGA irradiated fuel assemblies, cooled for at least 30 days, each containing up to 125 g ^{235}U as a uranium-zirconium hydride mixture, with ^{235}U enrichments of 70% and about 19.5%, respectively, for a maximum ^{235}U content of 6,000 g.
- (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 g of ^{235}U at 93% ^{235}U enrichment, for a maximum ^{235}U content of 80 g.
- (vii) Seventeen irradiated ANL-JANUS reactor fuel assemblies, each containing up to 141 grams of ^{235}U as uranium-aluminum alloy at a ^{235}U enrichment up to 93% for a maximum of ^{235}U content of 2,397 grams.

(3) The heat load is ≤ 3.57 kw.

(c) Fissile Class

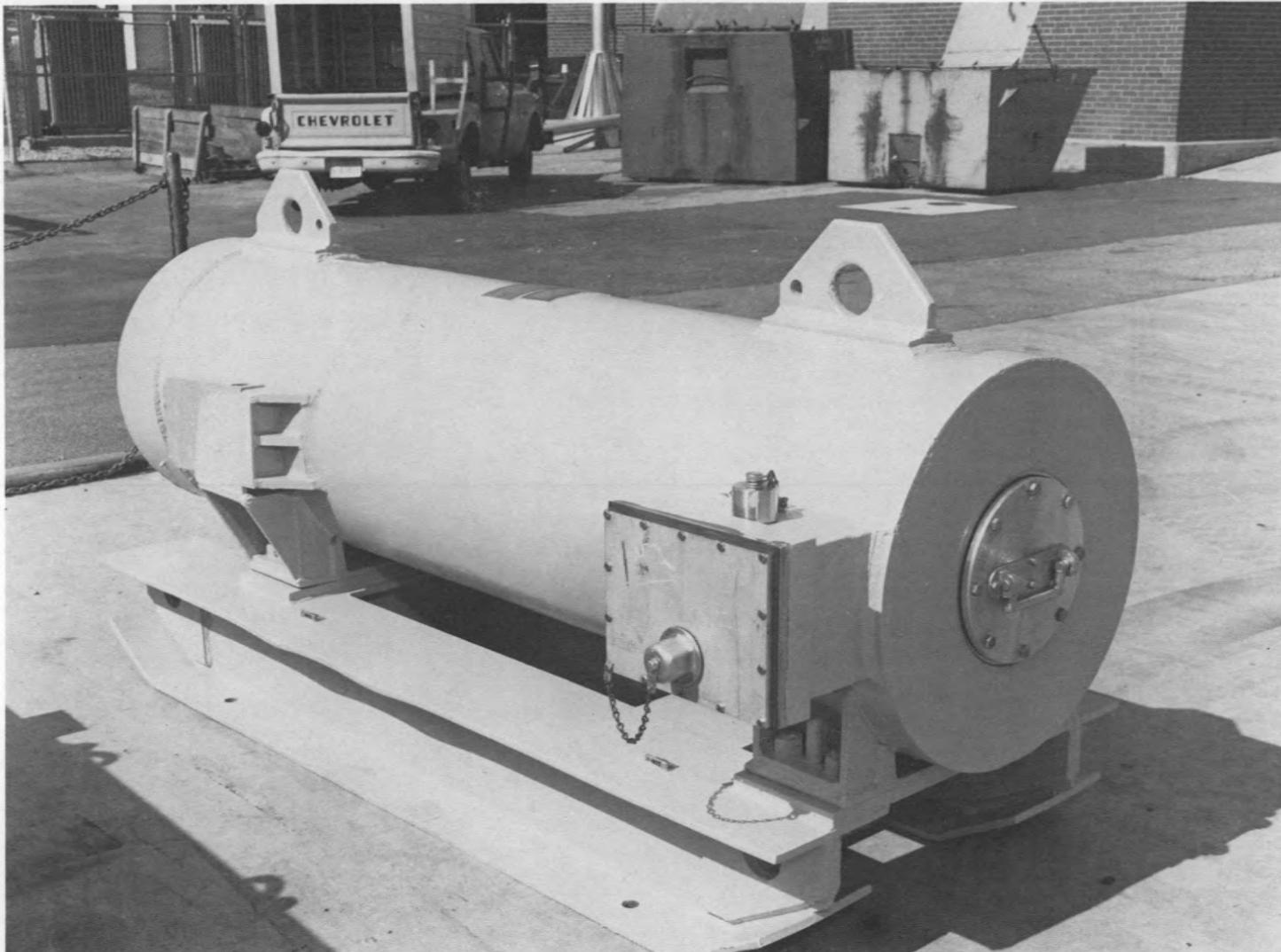
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II.B.73

B. RADIOACTIVE SOLIDS

ORNL LOOP TRANSPORT CASK

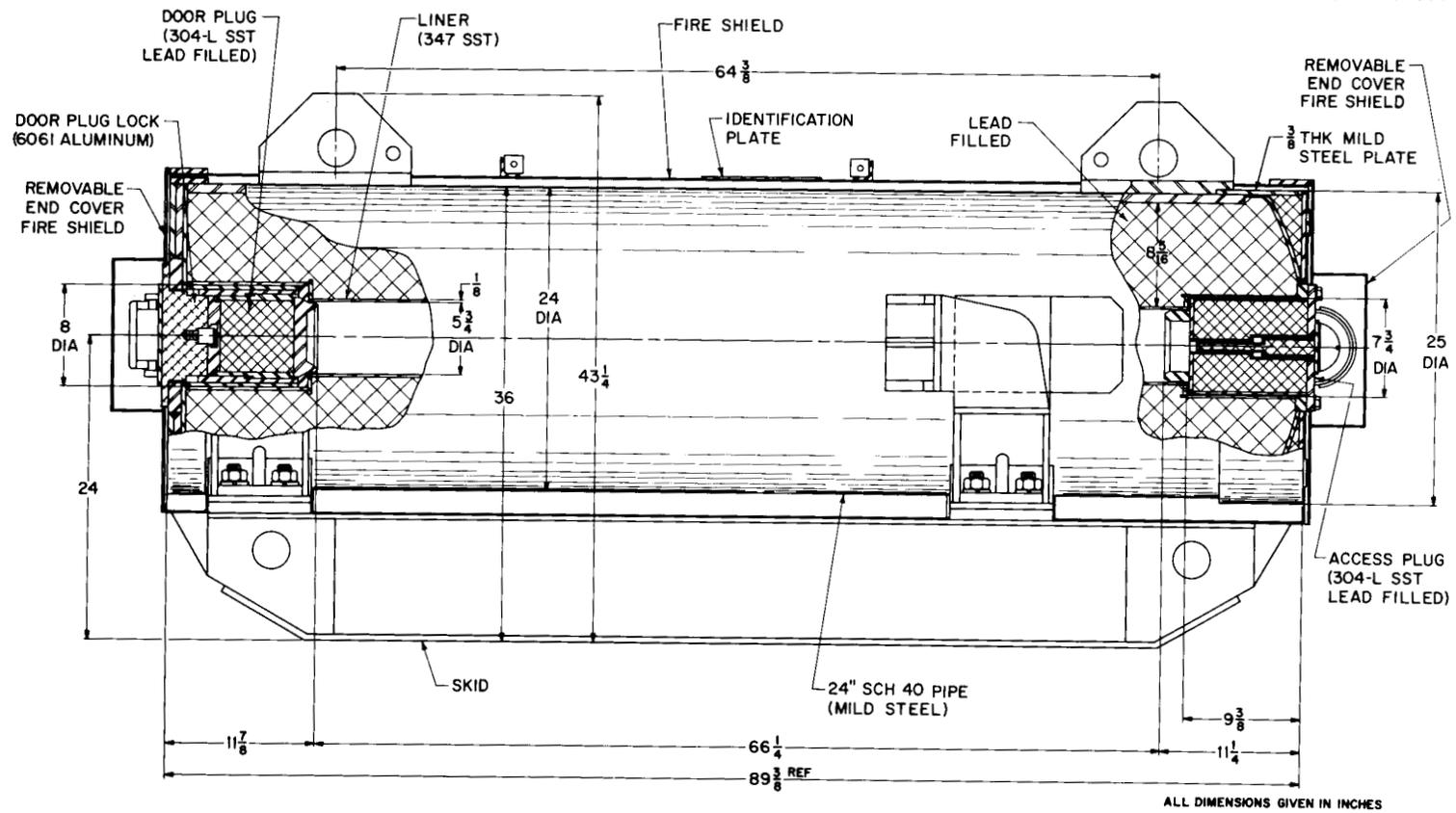
ORNL Photo 0876-72



ORNL Loop Transport Cask - Type B

II.B.74

ORNL DWG 75-500



II.B.75

ORNL Loop Transport 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 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 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):	(2) Title and Identification of report or application:	(3) Date:
Oak Ridge National Laboratory Post Office Box X Oak Ridge, Tennessee 37830	Safety Analysis Report for Packaging ORNL Loop Transport Cask Report No.: ORNL/ENG/TM-11	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 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:
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

II.B.77

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

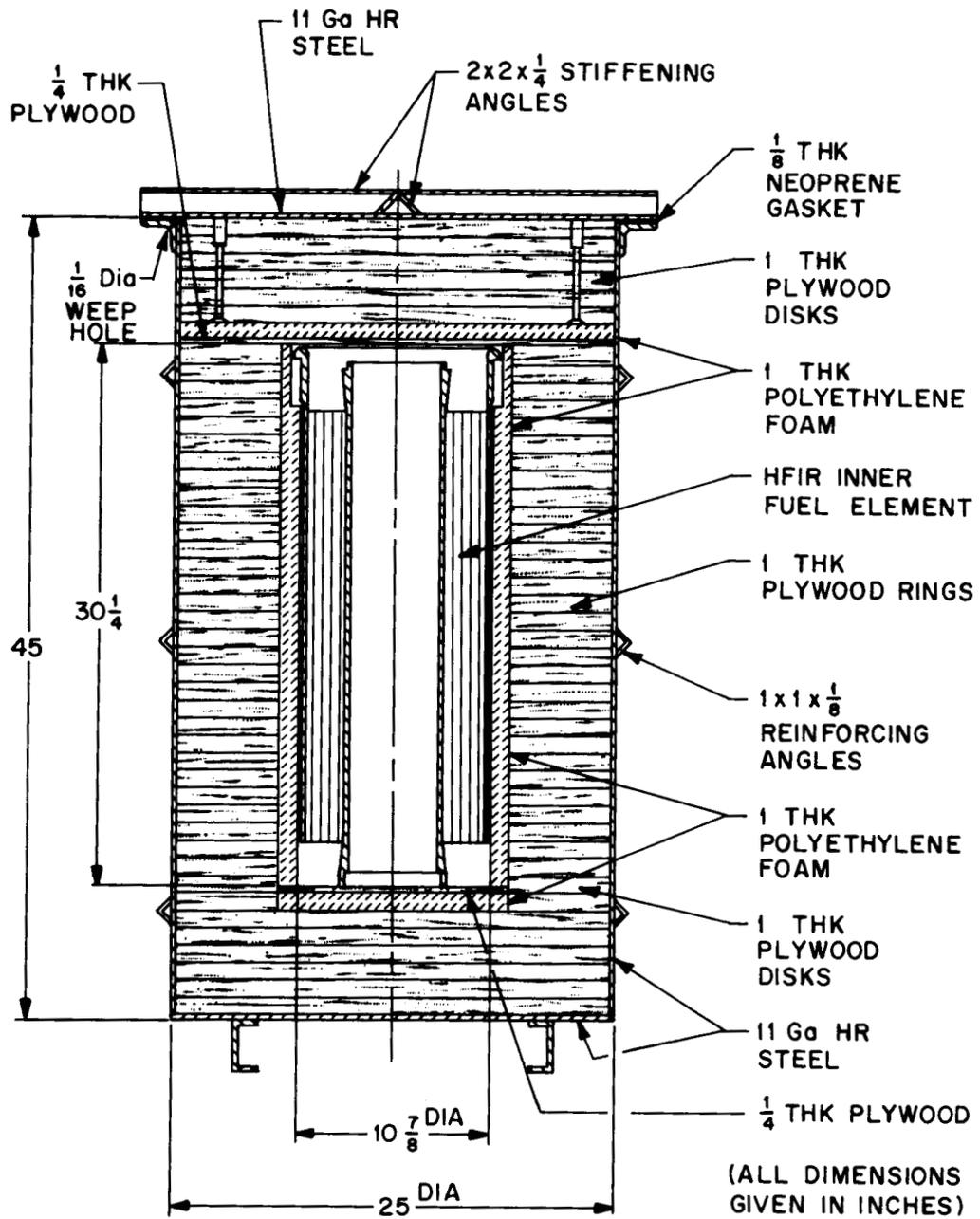
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B. RADIOACTIVE SOLIDS

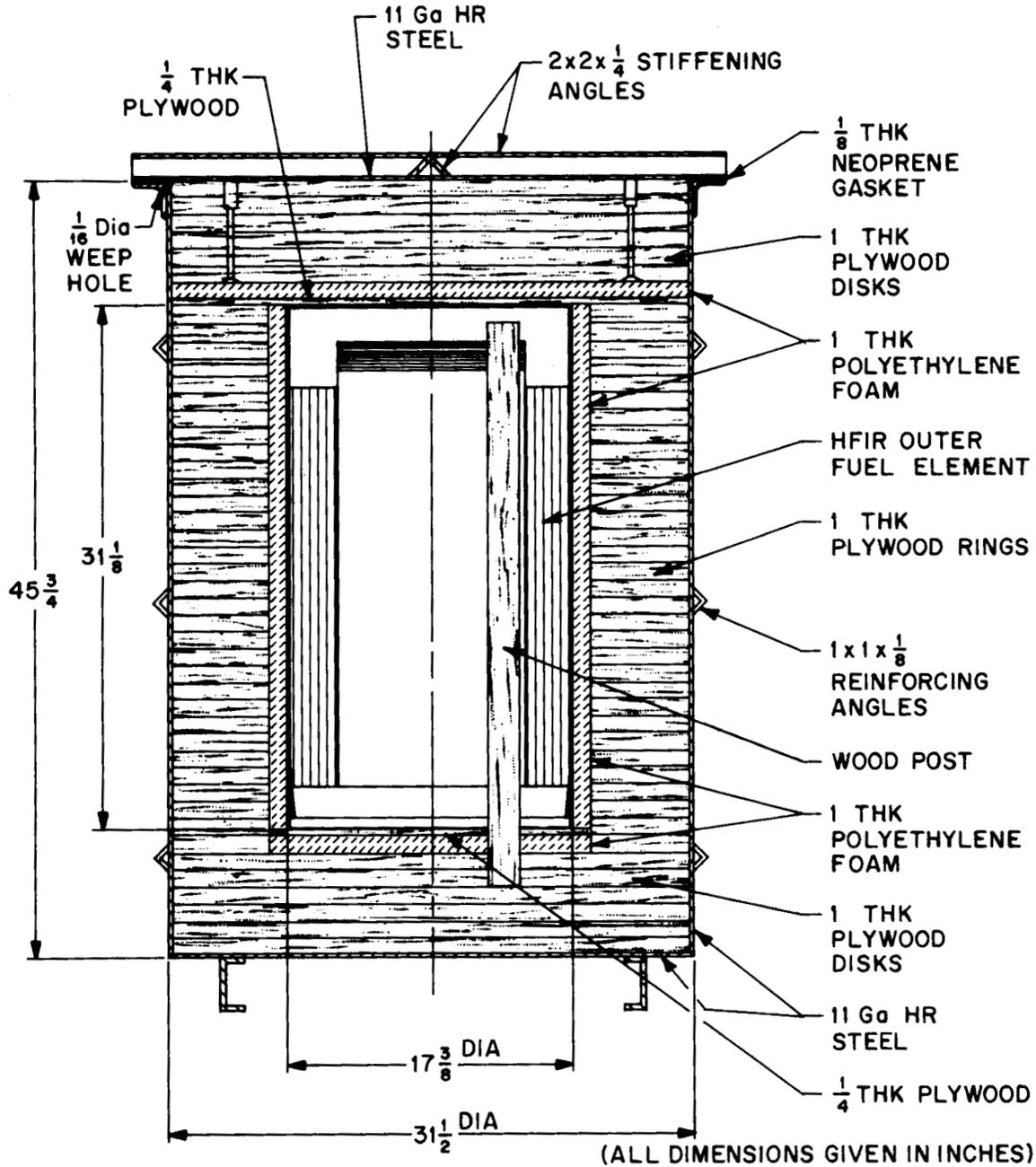
HFIR UNIRRADIATED FUEL ELEMENT CASK



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



ORNL HFIR Unirradiated Fuel Element Cask (Inner)



ORNL HFIR Unirradiated Fuel Element Shipping Container (Outer)
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 5797	1b. Revision No. 2	1c. Package Identification No. USA/5797/AF(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 P.O. 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, ORNL/ENG/TM-9 Ltr., Postma to Lenhard	(3) Date: November 1977 Oct. 19, 1983
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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 Nos.: (a) Inner High Flux Isotope Reactor (HFIR) Unirradiated Fuel Element Shipping Container;
(b) Outer HFIR Unirradiated Fuel Element Shipping Container.

(2) Description

Packaging for unirradiated fissile radioactive material as fuel elements for the HFIR. The containers are right circular cylinders with an 11-gauge carbon steel shell. Closure is provided by 16, 3/8-inch (1 cm) 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 (15.2 cm). A central cavity is formed in the plywood, and lined with a 1-inch (2.5 cm) thickness of polyethylene foam.

- (a) Packaging for the inner HFIR fuel element has overall dimensions of 25-inches OD x 45 inches high (63.5 cm OD x 114.3 cm high), with cavity dimensions of 17-3/8 inches ID x 31-1/8 inches deep (44.1 cm ID x 79.1 cm deep). The gross weight is 660 lb (229 kg).

6a. Date of Issuance: October 27, 1983	6b. Expiration Date: October 31, 1988
FOR THE U.S. DEPARTMENT OF ENERGY	
7a. Address (of DOE Issuing Office) U.S. Dept. of Energy P.O. 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) Packaging for the outer HFIR fuel element has overall dimensions of 31.5 inches OD x 45.75 inches high (80 cm OD x 116.2 cm high), with cavity dimensions of 17-3/8 inches ID x 31-1/8 inches deep (44.1 cm ID x 79.1 cm deep). The gross weight is 1050 lb (476 kg).

(3) Drawings

(a) The packaging for the inner HFIR fuel element is described and constructed in accordance with Oak Ridge National Laboratory Drawing No. M-20978-EL-003, Rev. 4.

(b) The packaging for the outer HFIR fuel element is described and constructed in accordance with Oak Ridge National Laboratory Drawing No. M-20978-EL-002, Rev. 4.

b. Contents

(1) Type and form of material

Uranium as U_2O_8 -Al cermet, enriched up to 93% in the U-235 isotope, and clad in aluminum, 10-mils thick, and

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

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

(2) Maximum quantity of material per package

(a) For the contents described in 5b(1)(a), not more than 1.7 kg of U-235;

(b) For the contents described in 5b(1)(b), not more than 6.9 kg of U-235.

c. Fissile Class

I

d. Prior to delivery to a carrier for transport, the shipper shall ensure that, at no point along the proposed shipping route, the ambient temperature will be less than 32°F (0°C), or the shipment shall be made in a heated vehicle such that the package temperature shall not be less than 32°F (0°C) along the shipping route.

NRC FORM 618
(6-83)
10 CFR 71

**CERTIFICATE OF COMPLIANCE
FOR RADIOACTIVE MATERIALS PACKAGES**

U.S. NUCLEAR REGULATORY COMMISSION

1. CERTIFICATE NUMBER	2. REVISION NUMBER	3. PACKAGE IDENTIFICATION NUMBER	4. PAGE NUMBER	5. TOTAL NUMBER PAGES
5797	1	USA/5797/AF	1	3

2. PREAMBLE

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

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

a. PREPARED BY (Name and Address):

U.S. Department of Energy
P.O. Box E
Oak Ridge, TN 37830

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.

c. DOCKET NUMBER

71-5797

4. CONDITIONS

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

a.

(a) Packaging

- (1) Model 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 OD 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 OD x 45.75-inch high, a 17-3/8-inch diameter by 31-1/8-inch deep cavity, and a 1050 pound gross weight.

Page 2 - Certificate No. 5797 - Revision No. 1 - 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. 4.
- (ii) The packaging for the outer HFIR fuel is constructed in accordance with Oak Ridge National Laboratory Drawing No. M-20978-EL-002, Rev. 4.

(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

I

- 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.
- 8. Expiration date: September 30, 1984.

Page 3 - Certificate No. 5797 - Revision No. 1 - Docket No. 71-5797

REFERENCES

Oak Ridge National Laboratory Report No. ORNL/ENG/TM-9, Nov. 1977.

Supplements dated: July 31, 1978; and September 17, 1979.

FOR THE U.S. NUCLEAR REGULATORY COMMISSION

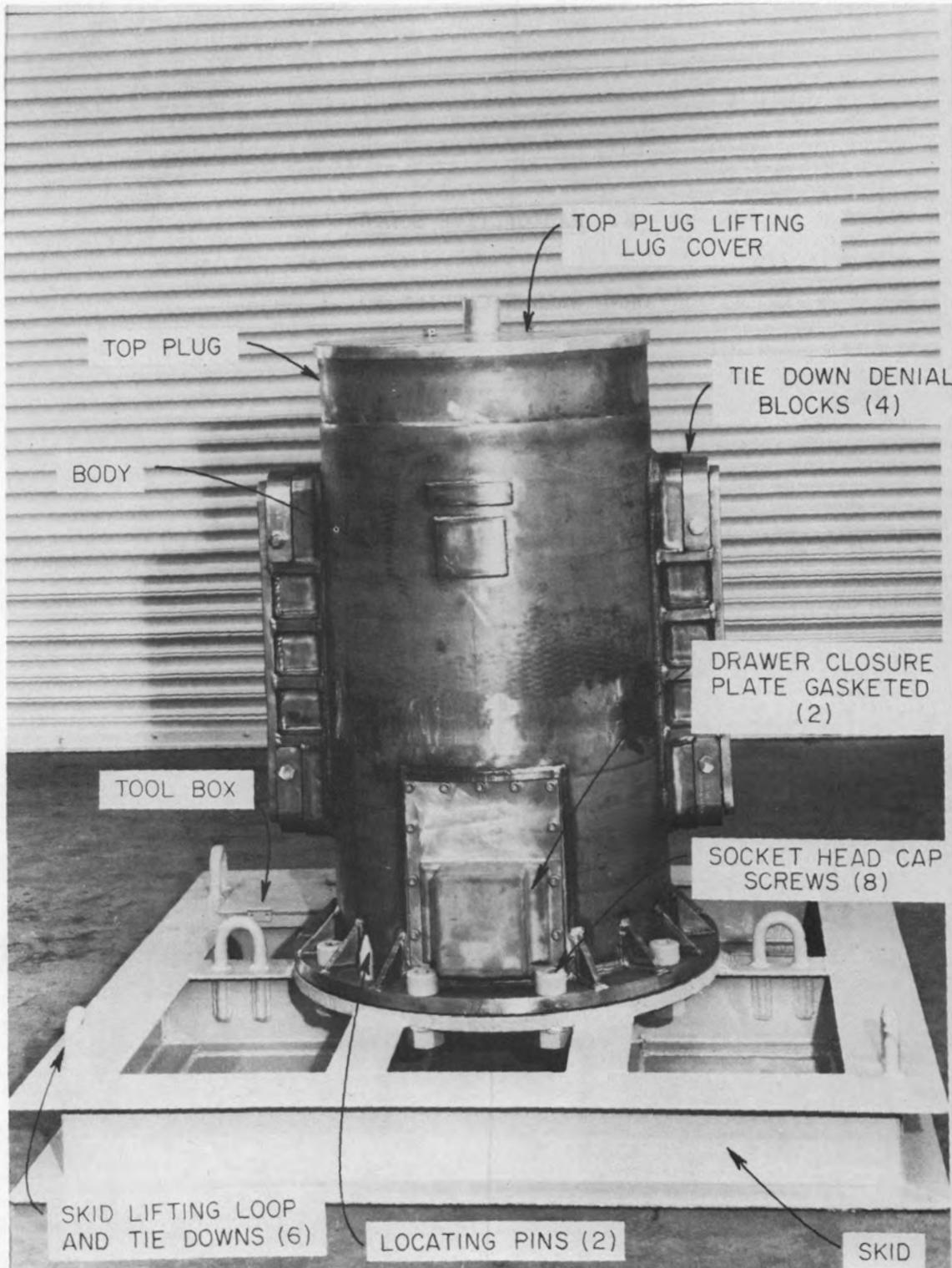

Charles E. MacDonald, Chief
Transportation Certification Branch
Division of Fuel Cycle and
Material Safety, NMSS

Date: SEP 09 1983

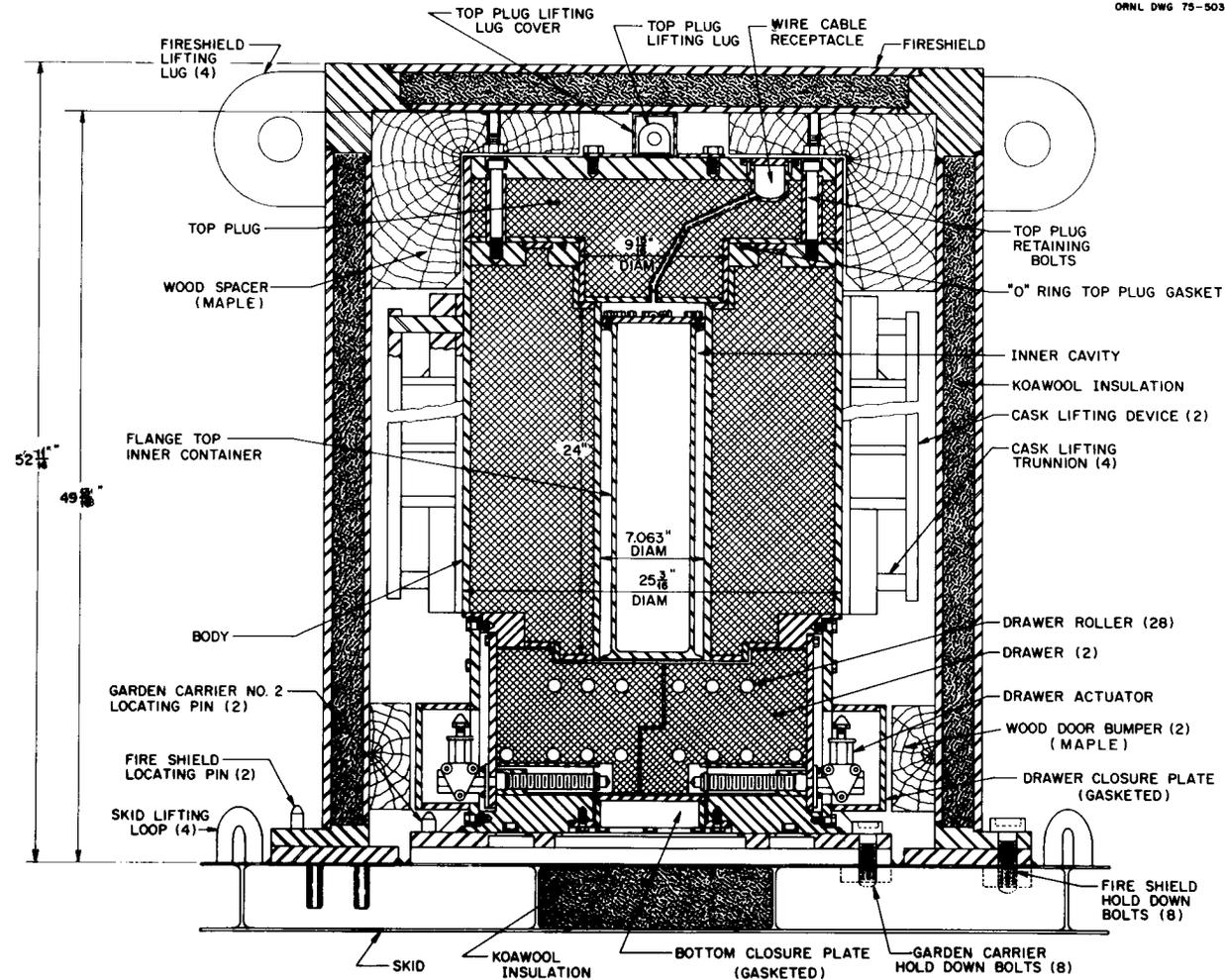
II.B.89

B. RADIOACTIVE SOLIDS

ORNL GARDEN CARRIER NO. 2



ORNL Garden Carrier No. 2
Type B



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

ORNL Garden Carrier No. 2 - Type B

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

U.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):

(2) Title and Identification of report or application:

(3) Date:
August 1979

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

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

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

(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.

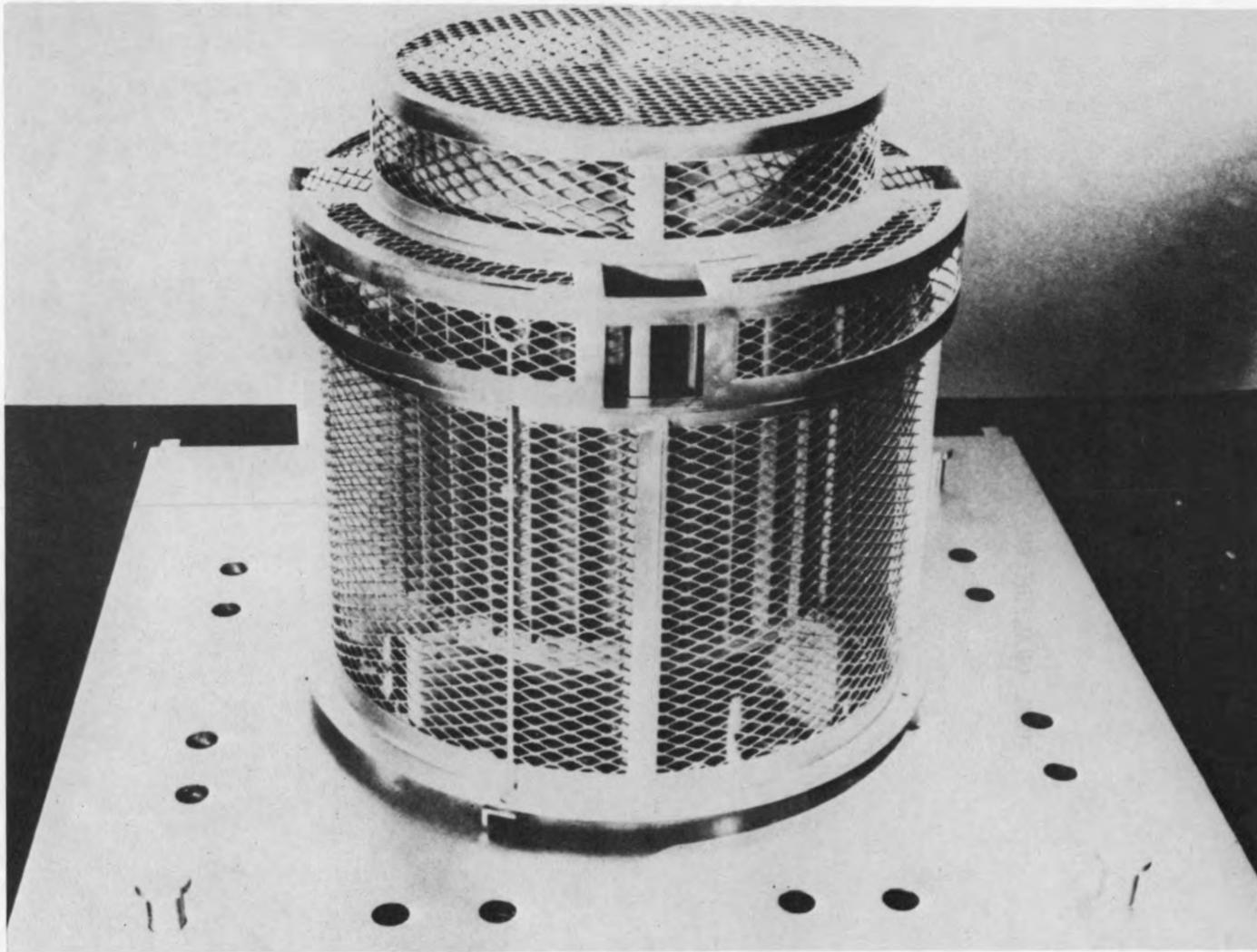
(c) Fissile Class: I

II.B.95

B. RADIOACTIVE SOLIDS

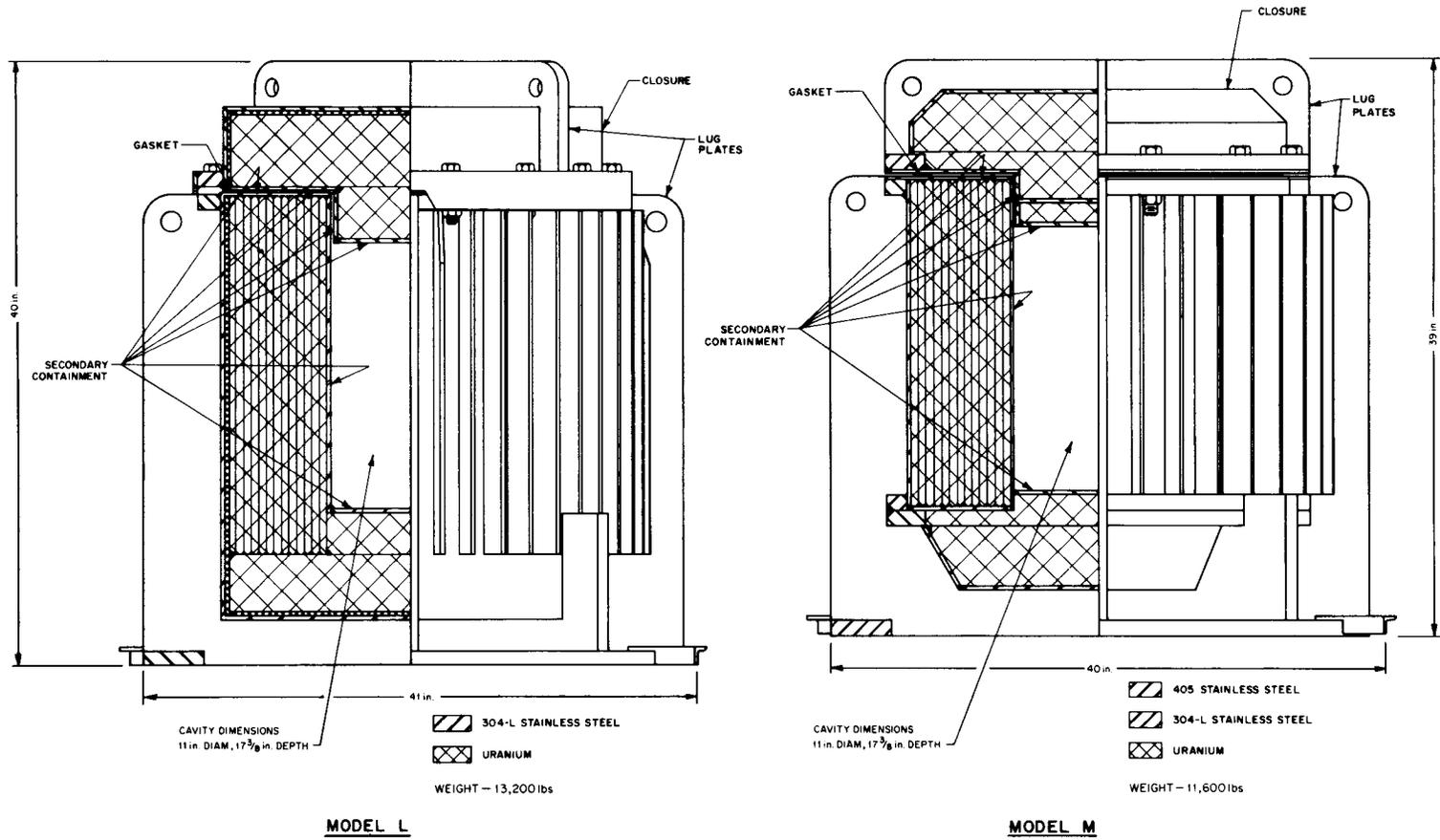
ORNL URANIUM SHIELDED SHIPPING CASKS

ORNL Photo 2289-78



ORNL Uranium Shielded Shipping Cask - Type B

II.B.96



ORNL Uranium Shielded Shipping Cask - Type B

II.B.97

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

1a. Certificate Number 5595	1b. Revision No. 5	1c. Package Identification No. USA/5595/B(U)(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): | (2) Title and Identification of report or application: | (3) Date: |
| Oak Ridge National Laboratory
P.O. Box X
Oak Ridge, Tennessee 37830 | Safety Analysis Report for Packaging
for the ORNL Uranium-Shielded
Shipping Casks.

Report No. ORNL/ENG/TM-4
Ltr., Sommerfeld to Lenhard, 4/14/82 | Nov. 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:

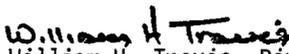
Type B Packaging for large quantities of nonfissile radioactive material consisting of a right circular cylinder of 1/4-inch-thick stainless steel-clad depleted uranium having a plug-type, bolted and gasketed top lid closure.

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		

6a. Date of Issuance: September 20, 1983	6b. Expiration Date: September 30, 1988
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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 P.O. Box E Oak Ridge, Tennessee 37830	 William H. Travis, Director Safety & Environmental Control Division

	<u>Model L</u>	<u>Model M</u>
<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 M - M-11572-EM-001-E through -003-E

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

b. Contents

(1) Type and Form of Material

Radioactive material as a solid is encapsulated in a metal capsule meeting the special form definitions of:

- (a) U.S. Department of Transportation Regulations, 49 CFR 173.469, and
- (b) International Atomic Energy Agency Safety Series No. 6, Regulations for the Safe Transport of Radioactive Materials, 1973 Revised Edition (as Amended), Part 135.

Capsules are individually leak tested during fabrication per ANSI N542, procedure A2.2.1 (ethylene glycol-vacuum technique) or equivalent.

(2) Maximum quantity of material per package:

The maximum quantity of radioactive material is a large quantity which is limited to:

- (a) A maximum thermal decay energy not to exceed 4000 watts; however, when the thermal decay energy exceeds 1125 watts, transport will be made by exclusive-use vehicle.
- (b) The authorized external radiation levels specified within the regulations of the U.S. Department of Transportation 49 CFR 173.441.

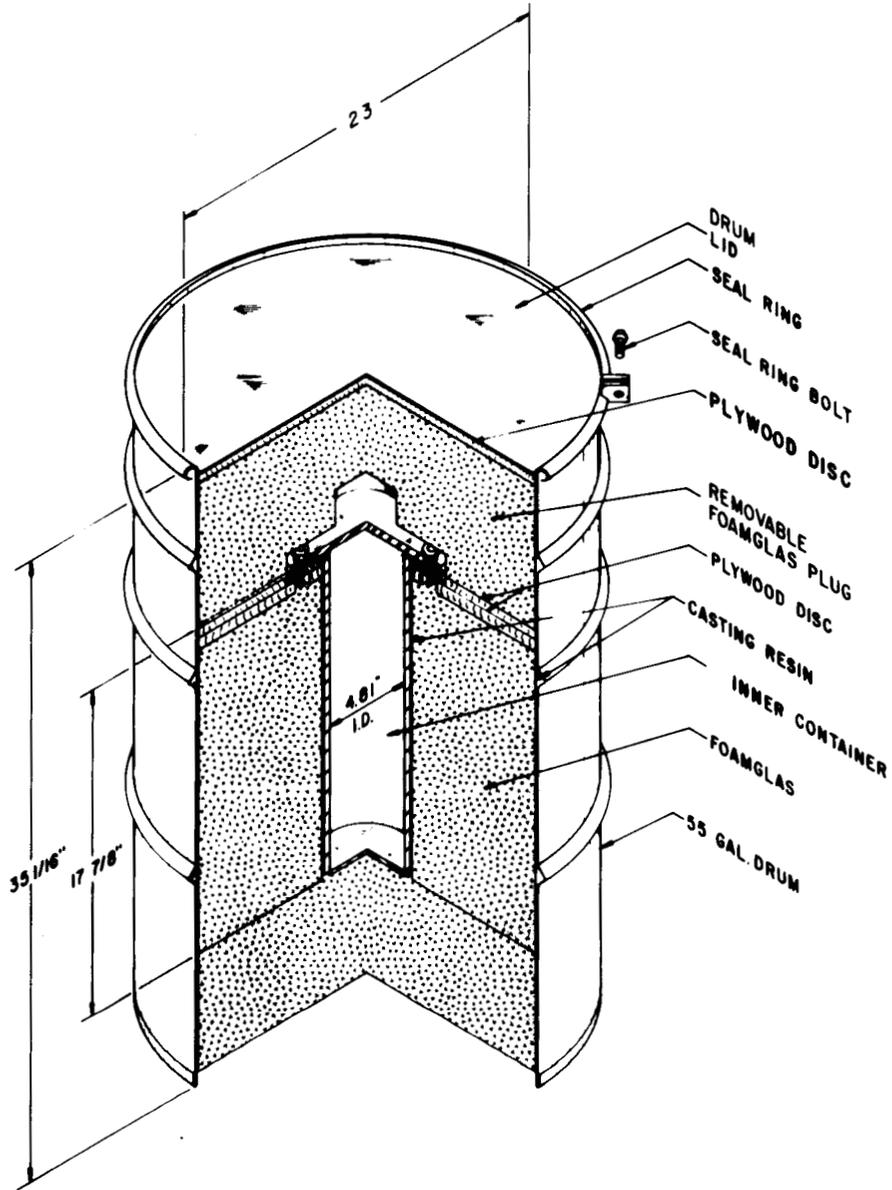
II.B.101

B. RADIOACTIVE SOLIDS

ORNL FOAMGLASS SHIPPING CONTAINER



ORNL Foamglass Shipping Container - Type B



FOAMGLAS SHIPPING 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 5795	1b. Revision No. 1	1c. Package Identification No. USA/5795/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 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 Report No.: ORNL-5407/RI	(3) Date: January 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 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) <i>William H. Travis</i> William H. Travis, Director Safety & Environmental Control Division

II.B.105

Page 2 - Certificate of Compliance, No.: 5795, Revision 1

(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			
	(ρ = 18.76 g U/cm ³)	(ρ = 8.09 g U/cm ³)	(ρ = 4.48 g U/cm ³)
0.1	17.2 kg	10.8 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			
	(ρ = 19.7 g Pu/cm ³)	(ρ = 8.73 g Pu/cm ³)	(ρ = 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			
	(ρ = 18.4 g U/cm ³)	(ρ = 8.03 g U/cm ³)	(ρ = 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

Page 3 - Certificate of Compliance, No.: 5795, Revision 1

- (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)

II.B.107

B. RADIOACTIVE SOLIDS

Y-12 DT-14A PACKAGING FOR ENRICHED URANIUM

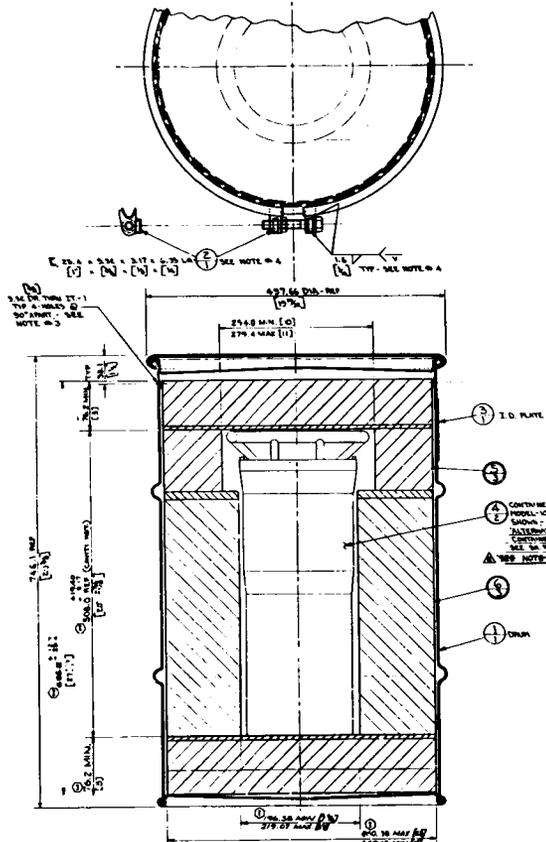
II.B.108

ORNL Photo 2865-78



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

SIMETRIC



177.8
7
FISSILE RADIOACTIVE MATL. CONTAINER
▲ USA/5852/BF (DOE-OR) TYPE B
UNION CARBIDE CORP. - NUCLEAR DIV.
K-25 PLANT, OAK RIDGE, TN.
MAX GROSS WT. 210 LBS.
MODEL DT-14
SERIAL NO. K-25-0001

12.7 (1/2) HIGH LETTERS
(THIS LINE ONLY)

③ I.D. PLATE (K-25)
REQ'D: 1
MAT'L: 304, 1.6 (1/16) THK.
SCALE: 1"=1"

177.8
7
FISSILE RADIOACTIVE MATL. CONTAINER
▲ USA/5852/BF (DOE-OR) TYPE B
UNION CARBIDE CORP. - NUCLEAR DIV.
Y-12 PLANT, OAK RIDGE, TN.
MAX GROSS WT. 210 LBS.
MODEL DT-14
SERIAL NO. DT-14-12-1001

12.7 (1/2) HIGH LETTERS
(THIS LINE ONLY)

③ I.D. PLATE (Y-12)
REQ'D: 1
MAT'L: 304, 1.6 (1/16) THK.
SCALE: 1"=1"

I.D. NOTES:
① ALL LETTERS TO BE 4.5 MM (EXCEPT IN NOTES & PHOTOGRAPHIC STICKERS) - 1/16 (1.6) THK.
② SERIAL NOS. OF CONTAINERS TO BE STAMPED IN SEQUENCE. (EXAMPLE: 0001, 0002, ETC.)

- GENERAL NOTES:**
1. SUGGESTED VENDOR: FLORIDA STEEL DRUM CO. HAWTHORNE, FL. (OR EQUIV.). MAKE LARGE HEAD DT 7A.
 2. PRIME & FRONT IT-1 AS PER USARF SPECIFICATION.
 3. 3/8" DRILL TAPED DRUM, A PLACED 50% ON PERIPHERY. DRUM COVER HOLES (ON INSIDE) WITH PLASTIC TAPE (1-POLY).
 4. LOCATE TAPES IN APPROPRIATE CENTER OF LID AS "DRUM" ON TOP SURFACE OF LID.
 5. CONTAINER (IT-1) TO BE WELDED & FINISHED AS PER USARF SPECIFICATION.
 6. WELDING SHALL BE IN ACCORDANCE WITH THE APP. STANDARD FOR THE DRUM AND WELDING IN BUILDING CONSTRUCTION.
 7. BRACKET, I.J. DESIGNATED WELDED.
 8. WHEN USING M-101 OR M-102 CONTAINMENT VESSELS, GASKET AND VALVE MUST BE REMOVED AND REPLACED BY APPROPRIATE TAPED PLATE.
 9. 1/8" MAX GAP PERMISSIBLE BETWEEN MATING SURFACES OF SUB-ASSEMBLIES & ALSO G DUE TO SURFACE IRREGULARITIES.
 10. GASKET FURNISHED WITH 17H DUBLIN (ITEM 1) OPTIONAL.
 11. DIMENSIONS SHOWN BY (1) ARE SHIP DIMENSIONS & ALLOWANCES MUST BE MADE FOR VARIATION IN SIZE AND DIMENSIONAL STABILITY OF PALLETS.
 12. SEE SAFETY ANALYSIS REPORT FOR PACKAGING (OAK RIDGE Y-12 PRODUCE PACKAGE FOR ENRICHED URANIUM)/DD-244 FOR PACKAGING, RELEASE AND MAINTENANCE INSTRUCTIONS.

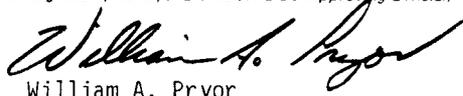
ASSEMBLY
REQ'D: 1
MAT'L: SEE PARTS LIST
SCALE: 1/2"=1"

SIMETRIC

NO.	DESCRIPTION	QTY	UNIT	REMARKS
1	DRUM	1	EA	
2	CONTAINER MODEL NO. 102	1	EA	
3	I.D. PLATE (K-25)	1	EA	
4	I.D. PLATE (Y-12)	1	EA	
5	GASKET	1	EA	
6	VALVE	1	EA	
7	BRACKET	1	EA	
8	TAPES	1	EA	
9	GASKET	1	EA	
10	VALVE	1	EA	
11	BRACKET	1	EA	
12	TAPES	1	EA	
13	GASKET	1	EA	
14	VALVE	1	EA	
15	BRACKET	1	EA	
16	TAPES	1	EA	
17	GASKET	1	EA	
18	VALVE	1	EA	
19	BRACKET	1	EA	
20	TAPES	1	EA	
21	GASKET	1	EA	
22	VALVE	1	EA	
23	BRACKET	1	EA	
24	TAPES	1	EA	
25	GASKET	1	EA	
26	VALVE	1	EA	
27	BRACKET	1	EA	
28	TAPES	1	EA	
29	GASKET	1	EA	
30	VALVE	1	EA	
31	BRACKET	1	EA	
32	TAPES	1	EA	
33	GASKET	1	EA	
34	VALVE	1	EA	
35	BRACKET	1	EA	
36	TAPES	1	EA	
37	GASKET	1	EA	
38	VALVE	1	EA	
39	BRACKET	1	EA	
40	TAPES	1	EA	
41	GASKET	1	EA	
42	VALVE	1	EA	
43	BRACKET	1	EA	
44	TAPES	1	EA	
45	GASKET	1	EA	
46	VALVE	1	EA	
47	BRACKET	1	EA	
48	TAPES	1	EA	
49	GASKET	1	EA	
50	VALVE	1	EA	

NO.	DESCRIPTION	QTY	UNIT	REMARKS
1	DRUM	1	EA	
2	CONTAINER MODEL NO. 102	1	EA	
3	I.D. PLATE (K-25)	1	EA	
4	I.D. PLATE (Y-12)	1	EA	
5	GASKET	1	EA	
6	VALVE	1	EA	
7	BRACKET	1	EA	
8	TAPES	1	EA	
9	GASKET	1	EA	
10	VALVE	1	EA	
11	BRACKET	1	EA	
12	TAPES	1	EA	
13	GASKET	1	EA	
14	VALVE	1	EA	
15	BRACKET	1	EA	
16	TAPES	1	EA	
17	GASKET	1	EA	
18	VALVE	1	EA	
19	BRACKET	1	EA	
20	TAPES	1	EA	
21	GASKET	1	EA	
22	VALVE	1	EA	
23	BRACKET	1	EA	
24	TAPES	1	EA	
25	GASKET	1	EA	
26	VALVE	1	EA	
27	BRACKET	1	EA	
28	TAPES	1	EA	
29	GASKET	1	EA	
30	VALVE	1	EA	
31	BRACKET	1	EA	
32	TAPES	1	EA	
33	GASKET	1	EA	
34	VALVE	1	EA	
35	BRACKET	1	EA	
36	TAPES	1	EA	
37	GASKET	1	EA	
38	VALVE	1	EA	
39	BRACKET	1	EA	
40	TAPES	1	EA	
41	GASKET	1	EA	
42	VALVE	1	EA	
43	BRACKET	1	EA	
44	TAPES	1	EA	
45	GASKET	1	EA	
46	VALVE	1	EA	
47	BRACKET	1	EA	
48	TAPES	1	EA	
49	GASKET	1	EA	
50	VALVE	1	EA	

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

1a. Certificate Number 9860	1b. Revision No. 0	1c. Package Identification No. USA/9860/B(U)F	1d. Page No. 1	1e. Total No. Pages. 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):		(2) Title and Identification of report or application:	(3) Date:	
(a) Union Carbide Corp. Nuclear Division Oak Ridge Y-12 Plant P.O. Box Y Oak Ridge, TN 37831		Safety Analysis Report for Packaging (Oak Ridge Y-12 Plant Model DT-14A Package for Enriched Uranium) Report Y/DD-326	January 31, 1984	
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. <u>Packaging</u>				
(1) <u>Model No.:</u> DT-14A				
(2) <u>Description</u>				
Packaging for uranium enriched in the ^{235}U isotope. The 6 1/2-inch ID (16.5-cm ID) steel containment vessel is lined laterally with a 0.006-inch (0.1524-mm) thick layer of cadmium. High density polyurethane rubber, 0.22-inch (5.59-mm) thick covers the bottom and lateral inside surface. The useful inside dimensions are 6.06-inches ID X 15 1/2-inches (15.4-cm ID X 39.4-cm).				
Positive closure is provided by a bolted flange, sealed by a neoprene O-ring. The containment vessel is centered and supported by cane fiberboard insulation within an 18-gauge DOT Specification 17H or equivalent 30-gallon (114-liter) drum. The minimum density of the cane fiberboard insulation is 14 lb/ft ³ (224 kg/m ³). Plywood discs, 1/4-inch (6.35-mm) thick are located at the ends of the inner steel vessel. A 1/2-inch (12.7-mm) thick plywood ring is positioned under the outside of the flange of the steel containment vessel.				
6a. Date of Issuance: March 14, 1984		6b. Expiration Date: March 31, 1989		
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 P.O. Box E Oak Ridge, TN 37831		 William A. Pryor Safety & Environmental Control Division		

The drum shall have at least four 0.375-inch (9.53-mm) diam. vent holes near the top. Each hole is covered with either a weatherproof tape or fusible plug, or an equivalent device.

The overall package dimensions are 18-inches diameter X 30-inches high (45.7-cm diameter X 76.2-cm high). The package gross weight is 210 lb (95.2 kg).

(3) Drawings

The packaging is constructed in accordance with the drawings shown in Figures 1, 2, and 3 of Oak Ridge Y-12 Plant Report Y/DD-326, January 13, 1984.

5. (b) Contents

(1) Type and form of material

Uranium as metals, alloys, compounds, mixtures, or solutions enriched to any degree in the ²³⁵U isotope. The ²³³U isotope not to exceed 1.0 w/o of the ²³⁵U.

(2) Maximum quantity of material per package

Not to exceed 10 watts internal decay heat. Maximum content weight within the containment vessel not to exceed 66.2 lb (30 kg), the U-235 density not to exceed 18.8-g/cm³, and contents are further restricted as follows:

Maximum U-235 Mass (kg)

	Metal or Alloys*		Mixtures, compounds, and solutions			
²³⁵ U density (g/cm ³)	<18.8	<8.33	<4.55	<2.05	<1.15	<18.8
H/ ²³⁵ U atom ratio	0.00	<0.43	<3.22	<10.7	<21.4	Unlimited
²³⁵ U mass/package (kg)	18.0	21.0	16.0	8.5	5.5	1.0
Minimum Transport Index	FC-I*	FC-I*	0.1	0.1	0.2	FC-I*

*Fissile Class I

(c) Other Requirements and Restrictions

- (1) Any amount of low-density ($<1.0 \text{ g/cm}^3$) packaging material, providing it is not intermingled within the loading, may be used to cushion the loading within the inner containment vessel.
- (2) Up to 120 g of packaging material may be interstitially used for metal pieces; however, greater packaging-material masses require that the limits on mixtures, compounds, and solutions be observed. Alloys with ^{235}U densities $<8.33 \text{ g/cm}^3$ may be packaged under the limits for mixtures, compounds, and solutions in (b)(2).
- (3) Uranium hydrides with densities greater than 4.55 g/cm^3 are not permitted.
- (4) Beryllium and deuterium are not permitted.
- (5) Metals or alloys in solid form must be held within the containment cavity in screw top polyethylene bottles with a 1-mm (40 mils) minimum wall thickness or metal cans with nominal wall thickness of 0.254-mm (10 mils).
- (6) Powders must be packaged in a water-tight screw-top polyethylene bottle with a 1-mm (40 mils) minimum wall thickness. Before loading, the lid on the polyethylene bottle must be visibly inspected to ensure the gasket is present and functional. Each loaded polyethylene bottle must be inverted and hand shaken; a smear must be taken and checked with an alpha detector to ensure non-leakage of the powder with all of these conditions are satisfied, the lid must be sealed and closed using pressure-sensitive tape.
- (7) Solutions must be packaged in a water tight, screw-top polyethylene bottle with a 1-mm (40 mils) minimum wall thickness. Before loading, the lid on the polyethylene bottle must be visibly inspected to ensure the gasket is present and functional. Each filled polyethylene bottle must be inverted and observed for five minutes. If no leakage is visible, a smear must be taken and checked with an alpha detector to ensure non-leakage of the solution. When all of these conditions are satisfied, the lid must be sealed using pressure-sensitive tape.
- (8) Upon receipt and prior to the first use of each new package, the containment vessel must be leak tested to $1 \times 10^{-7} \text{ atm-cm}^3/\text{sec}$ at standard test conditions of ANSI N14.5.
- (9) Containment vessels must be leak tested to $1 \times 10^{-7} \text{ atm-cm}^3/\text{sec}$ at standard test conditions of ANSI N14,5 after the third usage, and within one year from the last inspection date thereafter, prior to use.

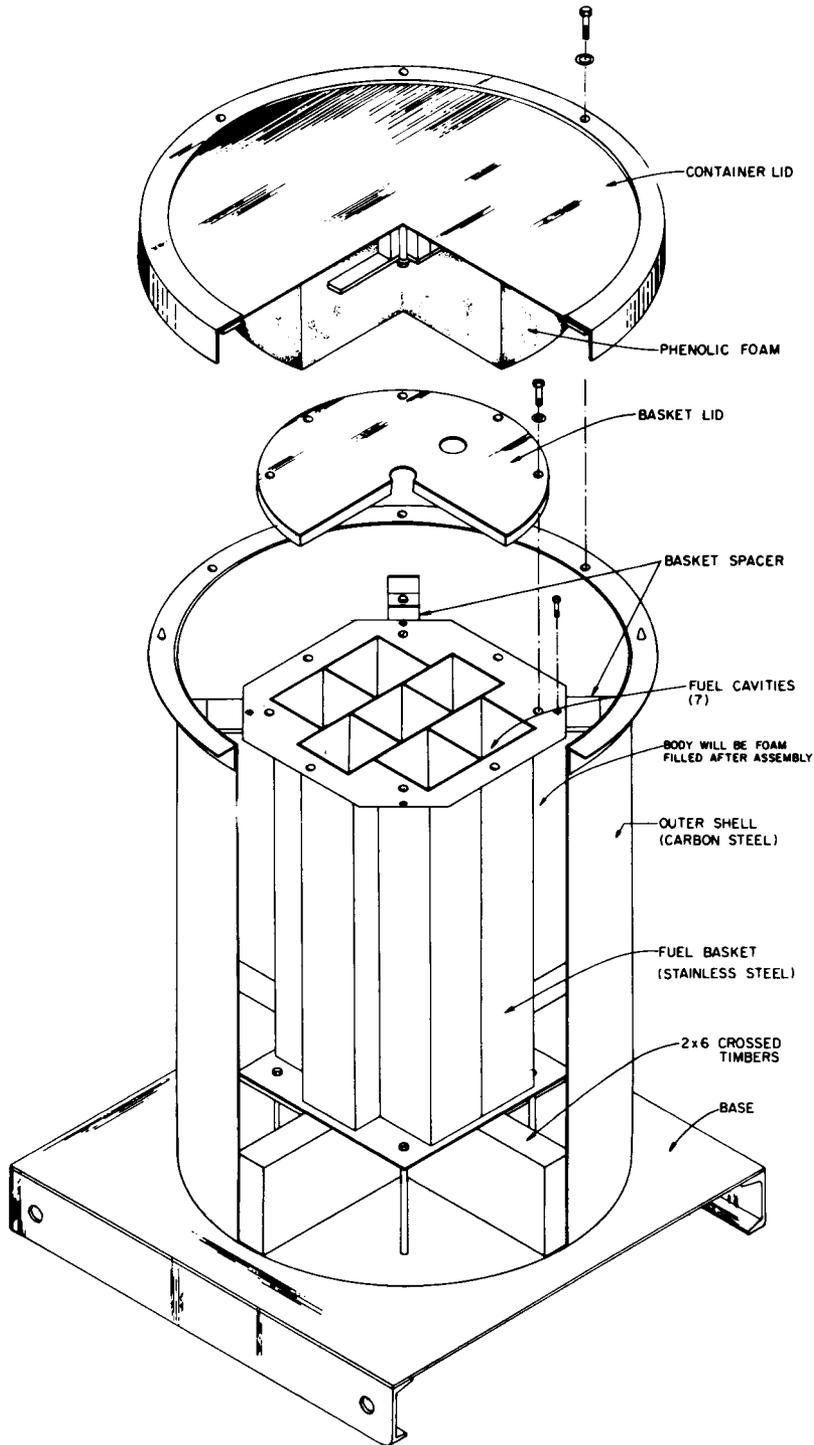
II.B.113

B. RADIOACTIVE SOLIDS

ORNL UNIRRADIATED FUEL SHIPPING CONTAINER

II.B.114

ORNL-DWG 79-10675



	OVERALL LENGTH (in.)	OUTSIDE DIA. (in.)
ORR	56 ³ / ₈	24 ¹ / ₂
BNL	75 ¹ / ₂	24 ¹ / ₂
NBS	87 ¹ / ₂	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 9853	1b. Revision No. 2	1c. Package Identification No. USA/9853/AF	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): | (2) Title and Identification of report or application: | (3) Date: |
| Oak Ridge National Laboratory
P.O. Box X
Oak Ridge, TN 37830 | (a) Safety Analysis Report for
Packaging: The Unirradiated Fuel
Shipping Container Report, ORNL/ENG/TM-15 | (a) 8/79 |
| | (b) Ltr. M.E. Ramsey to J.A. Lenhard | (b) 1/22/80 |
| | (c) Ltr. K.W. Sommerfeld to J.A. Lenhard | (c) 4/28/82 |

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 11 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 11 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 details the design of each container and the types of fuel elements shipped therein.

b. Contents:

- (1) Type and form of material:
The uranium is enriched to ~93% ²³⁵U, is in oxide form, and is contained in fuel plates as follows:

6a. Date of Issuance: May 13, 1982	6b. Expiration Date:
FOR THE U.S. DEPARTMENT OF ENERGY	
7a. Address (of DOE Issuing Office) U.S. Department of Energy P.O. Box E Oak Ridge, Tennessee 37830	7b. Signature, Name, and Title (of DOE Approving Official)  William H. Travis, Director Safety & Environmental Control Division

- (a) Assembled into reactor fuel elements.
- (b) Unassembled fuel plates.
- (2) Maximum quantity of material per package.
- (a) As fuel elements (see Table I) as follows:
- i. For each type of shipping container - seven fuel elements containing 370 g ^{235}U per fuel element.
- or
- ii. For mixed loading of the NBS shipping container, six fuel elements as follows: no more than two NBS fuel elements containing 210 g ^{235}U per fuel element, and no more than four ALRR fuel elements containing 841 g ^{235}U per fuel element.
- (b) As fuel plates:
Maximum of 19.5 g ^{235}U per fuel plate.
- Maximum of 50 fuel plates per bound stack with each stack wrapped in 4-6 mil polyethylene. Two tiers of stacks permitted. Total ^{235}U content < 13.7 kg.
- (3) Fissile Class: I

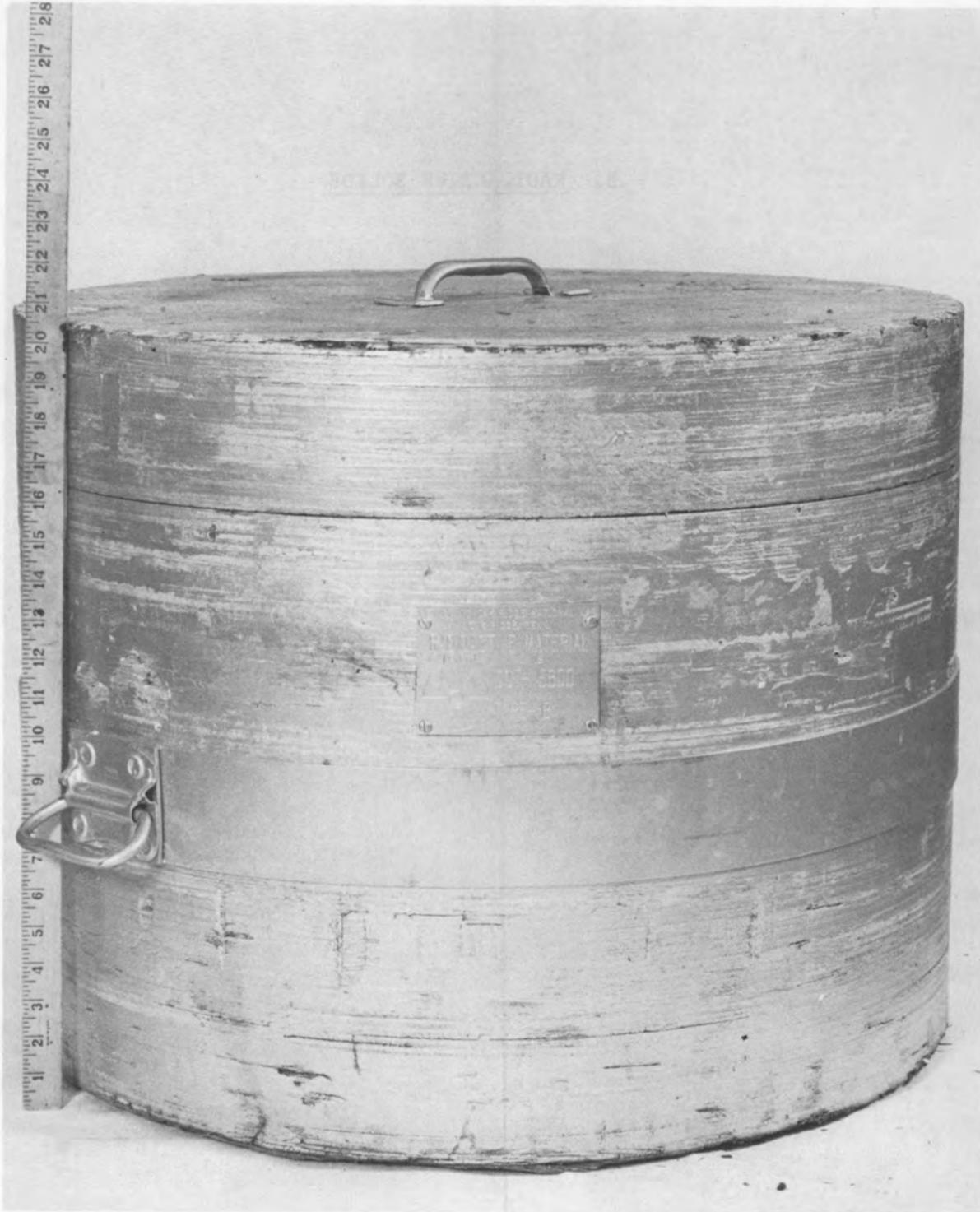
II.B.117

B. RADIOACTIVE SOLIDS

ORNL TRITIUM TARGET SHIPPING CONTAINER

II.B.118

ORNL Photo 2866-78



ORNL Tritium Target Shipping Container

FEB 27 1984



U.S. Department
of Transportation

Research and
Special Programs
Administration

IAEA CERTIFICATE OF COMPETENT AUTHORITY

Type B(U) Radioactive Materials Package Design

Certificate Number USA/0321/B(U)
(Revision 0)

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(U) packaging for radioactive materials as prescribed in IAEA 1/ Regulations and in accordance with §§ 49 CFR 173.472 of the USA 2/ Regulations for the transport of radioactive materials.

- I. Package Identification - ORNL Tritium Target Shipping Assembly.
- II. Packaging Description - Packaging authorized by this certificate consists of a Specification 20WC-1 wooden outer protective jacket, used with a single, snug-fitting inner specification 2R (Appendix A) inner containment. The 2R is a bolted and gasketed flanged closure configuration. Construction and preparation for shipment must be in accordance with Union Carbide Drawing No. DSK 2330 and the October 28, 1983, letter from K.W. Sommerfeld to J.A. Lenhard.
- III. Authorized Radioactive Contents - The authorized contents consist of not more than 10,000 curies of tritium adsorbed on a solid, metallic carrier.
- 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, shall register his identify in writing to the Office of Hazardous Materials 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 - Each package must also bear the marking USA/0321/B(U), as well as the other markings and labels prescribed by the USA Regulations.
- VI. Expiration Date - This certificate, unless renewed, expires on February 28, 1989.

Certificate Number USA/0321/B(U), Revision

This certificate is issued in accordance with the requirement of the IAEA and USA Regulations and in response to the March 22, 1983 petition by the Department of Energy, Washington, D.C. and in consideration of the associated information provided in DOT Regulations 49 CFR Parts 173 and 178, the DOE application and related correspondence.

Certified by:



Richard R. Rawl
Chief, Radioactive Materials Branch
Office of Hazardous Materials Regulation
Materials Transportation Bureau

February 22, 1984
(Date)

1/ "Safety Series No. 6, Regulations for the Safe Transport of Radioactive Materials, 1973 Revised Edition," published by the International Atomic Energy Agency (IAEA), Vienna, Austria.

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

III.1

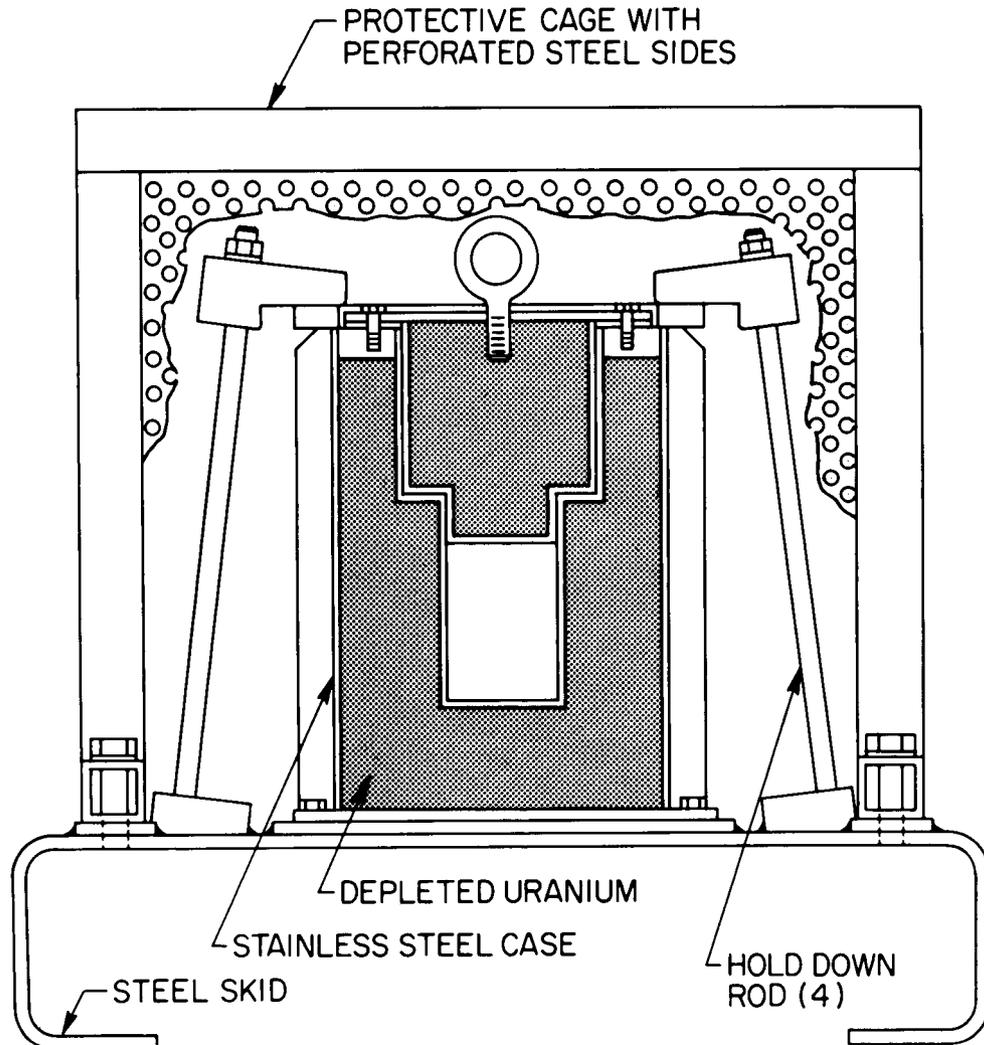
III. COMMERCIAL PACKAGES SHIPPED FROM ORNL

(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
 IRIDIUM-192 SHIPPING CONTAINER

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

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

MAY 24 1982

1.(a) Certificate Number	1.(b) Revision No.	1.(c) Package Identification No.	1.(d) Pages No.	1.(e) Total No. Pages
6613	1	USA/6613/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): Technical Operations, Inc. Northwest Industrial Park Burlington, MA 01803	3.(b) Title and identification of report or application: Technical Operations, Inc. application dated February 11, 1982, as supplemented 71-6613
	3.(c) Docket No.

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 19"x21"x20". The cask is a stainless steel weldment containing depleted uranium shielding. The cask has a central cavity which is 2.26 inches in diameter by 3.25 inches long. Closure is accomplished by a neoprene gasket, six 3/8 inch bolts and a stainless steel stepped plug containing depleted uranium shielding. The closure is equipped with an eye bolt and two drain and vent plugs. The cask is mounted on a 19"x21" rectangular steel skid with four 1/2-inch bolts and a tie down system consisting of four 1/2-inch diameter threaded rods which connect a clamp ring at the top of the cask to channel brackets welded to the skid. A protective cage constructed of 1-1/4 inch square steel tubing and perforated 18 gauge steel sheets tack welded to the tubular frame surrounds the cask and is bolted to the skid by four 1/2-inch bolts. Maximum gross weight of the packaging is 370 pounds.

Page 2 - Certificate No. 6613 - Revision No. 1 - Docket No. 71-6613

5. (a) Packaging (continued)

(3) Drawings

The cask and other system components are constructed in accordance with the following Technical Operations, Inc. Drawing Nos.: 70290, Sheet 1 of 4, Rev. A; 70290, Sheet 2 of 4, Rev. None; 70290, Sheet 3 of 4, Rev. None; 70290, Sheet 4 of 4, Rev. A.

(b) Contents

(1) Type and form of material

Metallic iridium 192 sources which meet the requirements of special form as defined in 10 CFR §71.4(o).

(2) Maximum quantity of material per package

10,000 curies.

(3) Maximum decay heat per package

100 watts.

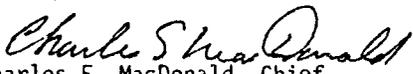
6. The name plate must be fabricated of materials capable of resisting the fire test of 10 CFR Part 71 and maintaining their legibility.
7. The package authorized by this certificate is hereby approved for use under the general license provisions of 10 CFR §71.12(b).
8. Expiration date: March 31, 1987.

REFERENCES

Technical Operations, Inc. application dated February 11, 1982.

Supplement dated: March 26, 1982.

FOR THE U.S. NUCLEAR REGULATORY COMMISSION


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

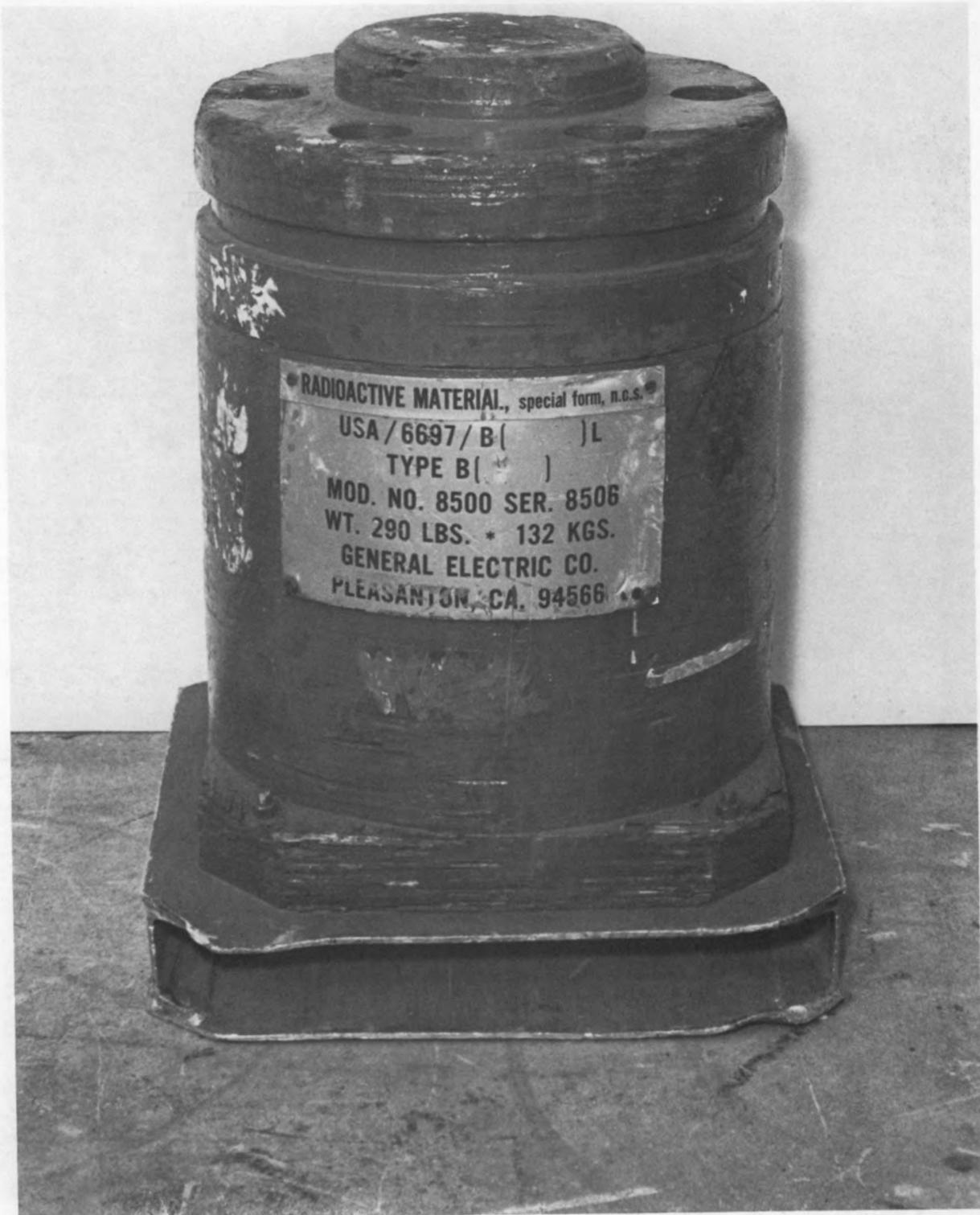
Date: APR 01 1982

III.7

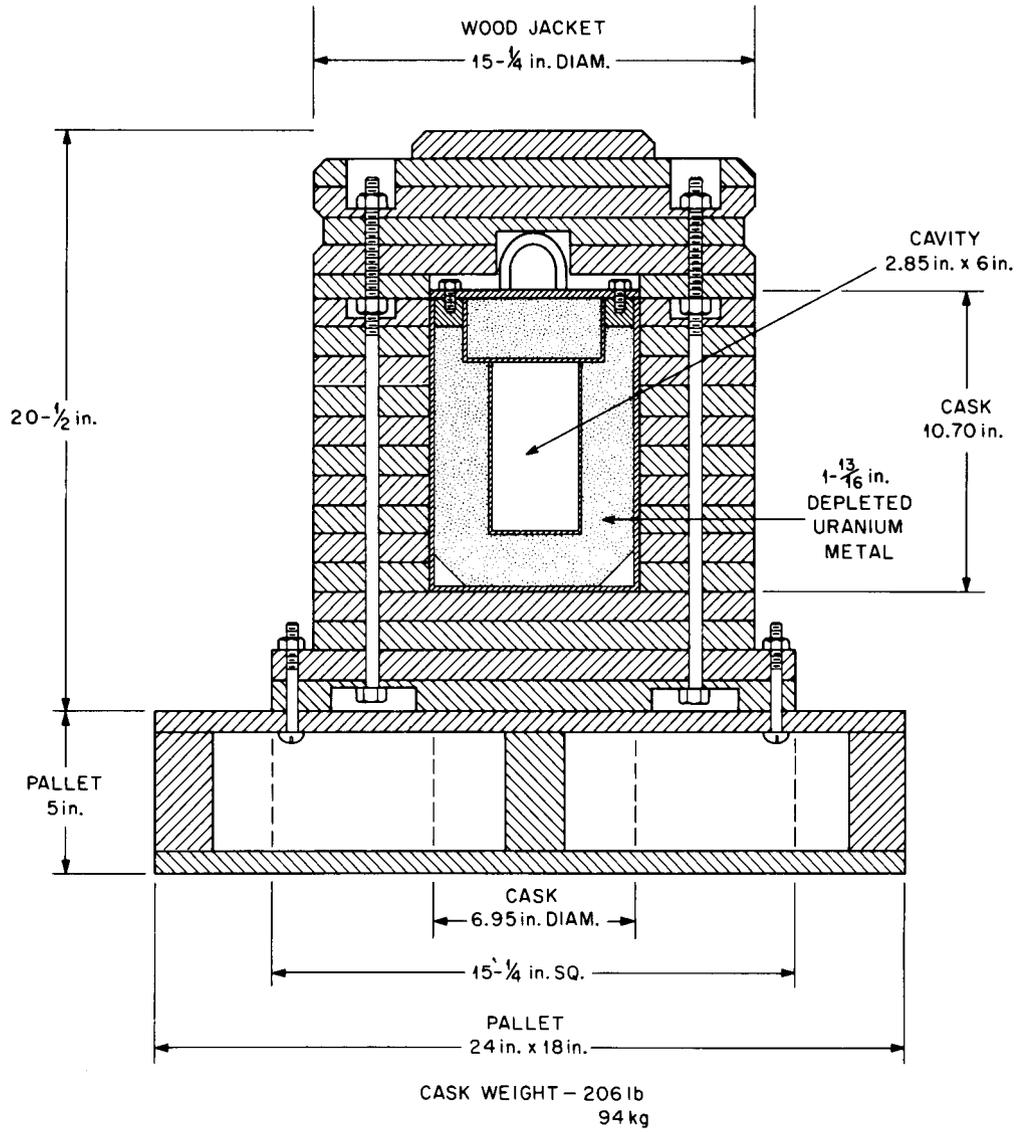
III. COMMERCIAL PACKAGES SHIPPED FROM ORNL

(NRC or DOT Approved)

GENERAL ELECTRIC COMPANY MODEL NO. 8500



General Electric Shipping Container
Type B



GENERAL ELECTRIC - MODEL 8500 SHIELDED CONTAINER

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	6	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--

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

General Electric Company
P.O. Box 460
Pleasanton, California 94566

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

General Electric Company application dated
November 29, 1979.

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. 3 (the latter to be used with the liner shown on 153C4613, Rev. 1). The gross weight of the loaded package is approximately 285 pounds.

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 in solid or liquid form.

(2) Maximum quantity of material per package

Greater than Type A quantities of solid 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.

Liquid radioactive material is limited to 100 ci of Mo-Tc solution.

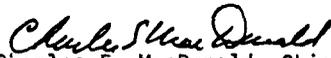
6. Liquids shall be further packaged in a leak tight polyethylene bottle within the 2R insert. Each polyethylene bottle shall be sealed and tested in accordance with Attachment D of General Electric's letter dated November 29, 1979.
7. Prior to each shipment, the package lid Neoprene gasket shall be 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.
8. 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.
9. 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.
10. The package authorized by this certificate is hereby approved for use under the general license provisions of 10 CFR §71.12(b).
11. Expiration date: February 28, 1985.

Page 3 - Certificate No. 6697 - Revision No. 6 - Docket No. 71-6697

REFERENCE

General Electric Company application dated November 29, 1979.

FOR THE U.S. NUCLEAR REGULATORY COMMISSION


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

Date: FEB 21 1980

III. COMMERCIAL PACKAGES SHIPPED FROM ORNL

(NRC or DOT Approved)

J. L. SHEPHERD AND ASSOCIATES



J. L. Shepherd and Associates Shipping Container
(Model A-0109 irradiator and Model A-0117 overpack)

NRC FORM 618 (6-83) 10 CFR 71		U.S. NUCLEAR REGULATORY COMMISSION		
CERTIFICATE OF COMPLIANCE FOR RADIOACTIVE MATERIALS PACKAGES				
1. a. CERTIFICATE NUMBER 6280	b. REVISION NUMBER 3	c. PACKAGE IDENTIFICATION NUMBER USA/6280/B()	d. PAGE NUMBER 1	e. TOTAL NUMBER PAGES 2
2. PREAMBLE				
<p>a. This certificate is issued to certify that the packaging and contents described in Item 5 below, meets the applicable safety standards set forth in Title 10, Code of Federal Regulations, Part 71, "Packaging of Radioactive Materials for Transport and Transportation of Radioactive Material Under Certain Conditions."</p> <p>b. This certificate does not relieve the consignor from compliance with any requirement of the regulations of the U.S. Department of Transportation or other applicable regulatory agencies, including the government of any country through or into which the package will be transported.</p>				
3. THIS CERTIFICATE IS ISSUED ON THE BASIS OF A SAFETY ANALYSIS REPORT OF THE PACKAGE DESIGN OR APPLICATION				
a. PREPARED BY (Name and Address):		b. TITLE AND IDENTIFICATION OF REPORT OR APPLICATION:		
J. L. Shepherd and Associates 740 Salem Street Glendale, CA 91203		J. L. Shepherd and Associates application dated September 5, 1979.		
c. DOCKET NUMBER 71-6280				
4. CONDITIONS				
This certificate is conditional upon fulfilling the requirements of 10 CFR Part 71, as applicable, and the conditions specified below.				
5. (a) Packaging				
(1) Model No.: A-0109 Irradiator in A-0117 Overpack				
(2) Description				
<p>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.</p>				
(3) Drawings				
<p>The overpack and irradiator are constructed in accordance with J. L. Shepherd and Associates Drawing Nos. A-0109-A1, A-0109-10, A-0109-20, A-0117B, A-0117C, and A-0117-C1.</p>				

Page 2 - Certificate No. 6280 - Revision No. 3 - Docket No. 71-6280

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 requirements of special form radioactive material.

(2) Maximum quantity of material per package

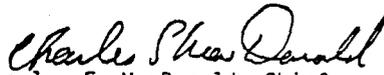
30,000 curies

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 10 CFR §71.12.
8. Expiration date: November 30, 1984.

REFERENCE

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, NMSS

Date: SEP 06 1983

III.17

III. COMMERCIAL PACKAGES SHIPPED FROM ORNL

(NRC or DOT Approved)

GAMMA INDUSTRIES

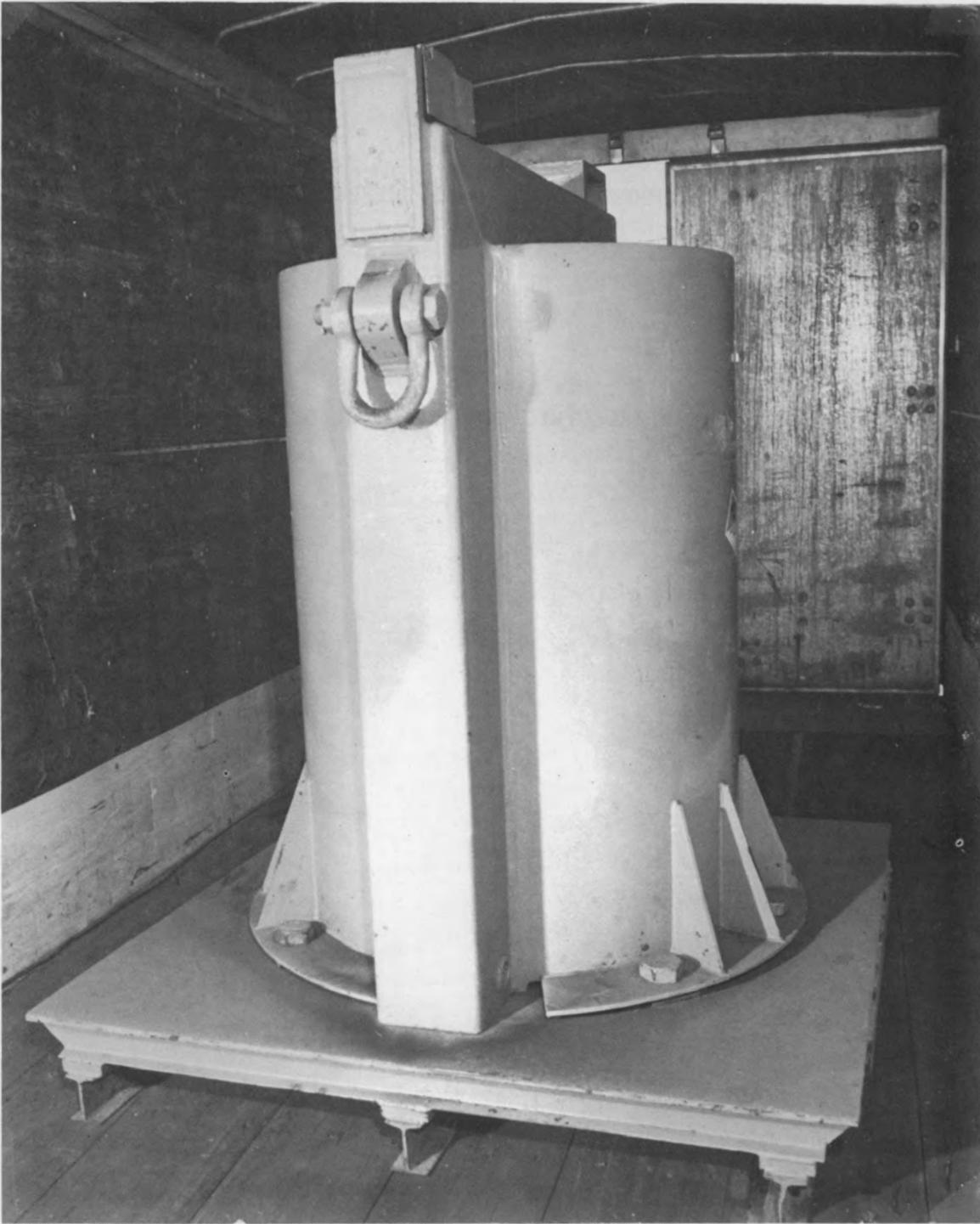


GAMMA INDUSTRIES DOT 20WC-1 - TYPE B

III. COMMERCIAL PACKAGES SHIPPED FROM ORNL

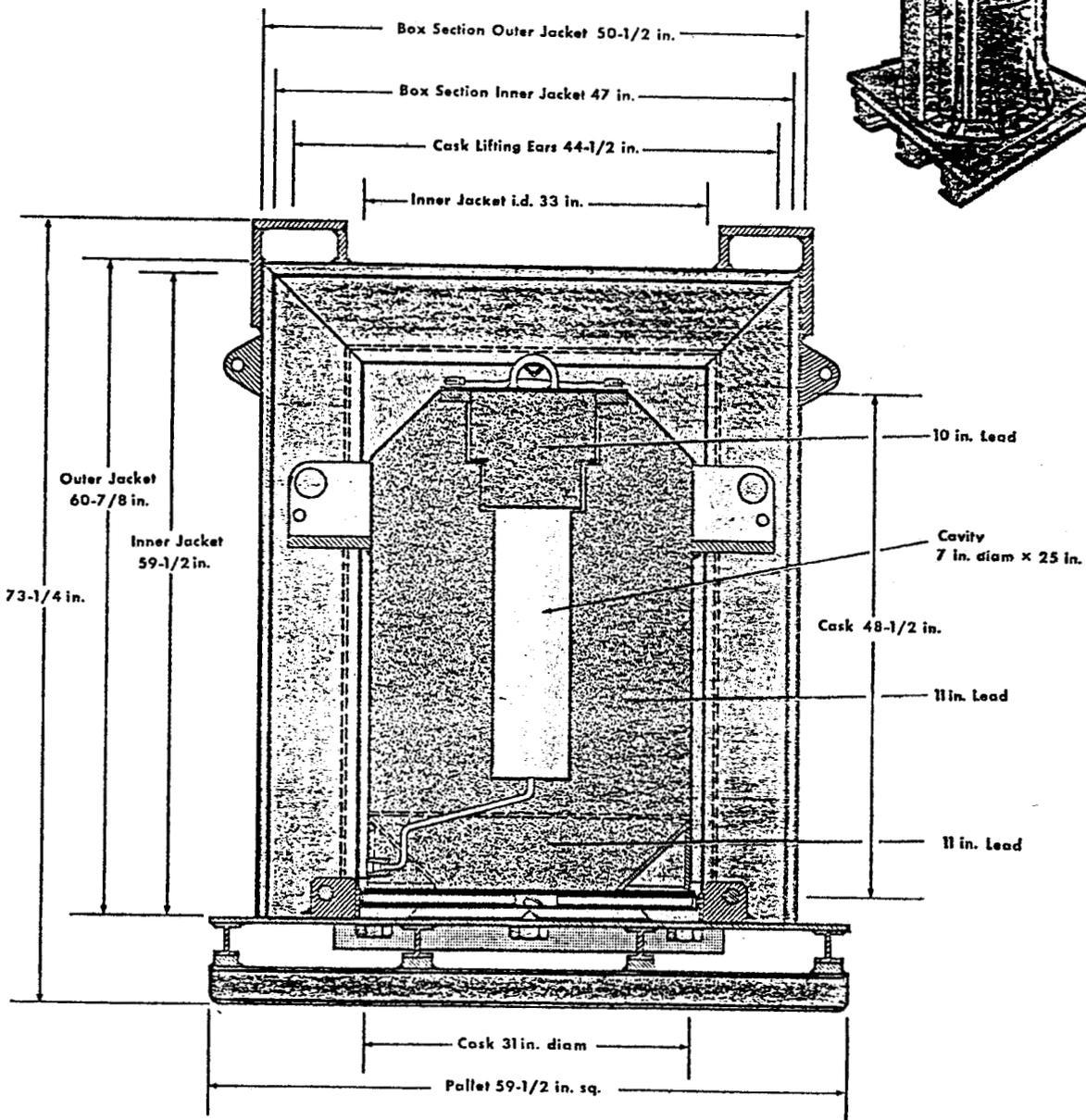
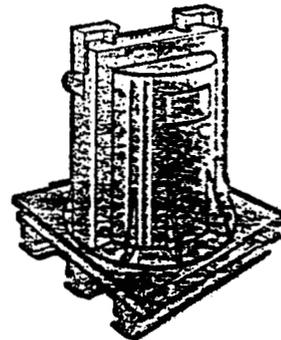
(NRC or DOT Approved)

GENERAL ELECTRIC COMPANY MODEL GE-1500



GE-1500 Shipping Cask

1500 Series Certification No. 5939 (& I.A.E.A. Certified)
 Cask Weight 12,000 Lbs. - 5455 Kgs.
 Assembly Weight 15,160 Lbs - 6890 Kgs.
 Assembly Drawing No. 106D3870G1
 Modes of Transportation - ALL EXCEPT PASSENGER AIRCRAFT
 Watt Load at 100°F Ambient 3120 Watts
 Fissile Load 500/300/300 Grams as Fissile Class III
 Watt Load at 100°F Ambient 600 Watts



GENERAL ELECTRIC - MODEL 1500 SHIELDED CONTAINER

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

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

1.(a) Certificate Number 5939	1.(b) Revision No. 9	1.(c) Package Identification No. USA/5939/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 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):

General Electric Company
P.O. Box 460
Pleasanton, CA 94566

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

General Electric Company application dated
February 21, 1980, as supplemented.

3.(c) Docket No. 71-5939

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-1500

(2) Description

A steel encased lead shielded shipping cask. The cask is a double-walled steel circular cylinder, 31-inch-diameter by 48 inches high with a central cavity 7-inch-diameter by 25 inches high. The diameter is reduced from 31 inches to 17-1/2 inches by cone construction at the top 7-1/2 inches of the cask. Approximately 11 inches of lead surround the central cavity. The cask is equipped with a cavity drain line and lifting device. Closure is accomplished by a gasketed and bolted steel lead-filled plug. A protective jacket consisting of an upright circular cylinder with open bottom and a protruding box section diametrically across the top and vertically down the sides attaches to a square pallet. Dimensions of the protective jacket are 60-7/8 inches high by 49-3/4 inches wide across the box section. The outer cylindrical diameter is 36-1/2 inches and the pallet is 59-1/2 inches square. The maximum weight of the packaging is approximately 15,000 pounds.

5. (a) Packaging (continued)

(3) Drawings

The packaging is constructed in accordance with the following General Electric Company Drawing Nos.: 129D4748, Rev. 3; 129D4749, Rev. 3; and 129D4750, Rev. 3.

Lifting and/or tie-down devices which are a structural part of the package must be in accordance with the above drawings.

(b) Contents

(1) Type and form of material

(i) Byproduct material and special nuclear material meeting special form requirements of 10 CFR §71.4(o) and antimony pins encased in stainless steel; or

(ii) Byproduct material in the form of $^{90}\text{SrF}_2$ or $^{137}\text{CsCl}$.

(2) Maximum quantity of material per package

Not to exceed a decay heat generation of 3,120 watts and

(i) Item 5(b)(1)(i) above:

Plutonium in excess of twenty (20) curies per package must be in the form of metal, metal alloy or reactor fuel elements, and 500 grams U-235 equivalent mass. (U-235 equivalent mass equals U-235 mass plus 1.66 times Pu mass.)

(ii) Item 5(b)(1)(ii) above:

458,000 Ci.

(c) Fissile Class

III

Maximum number of packages per shipment

22

6. For the contents described in Item 5(b)(1)(ii) above:

$^{90}\text{SrF}_2$ must be encapsulated in accordance with Vitro Drawing Nos. H-2-66759, Rev. 0; and H-2-66758, Rev. 0; or

$^{137}\text{CsCl}$ must be encapsulated in accordance with Vitro Drawing Nos. H-2-66760, Rev. 0; and H-2-66761, Rev. 0.

The $^{90}\text{SrF}_2$ and $^{137}\text{CsCl}$ capsules after fabrication must be leak tested using a method having sufficient sensitivity to detect a leak rate (air at standard

Page 3 - Certificate No. 5939 - Revision No. 9 - Docket No. 71-5939

temperature and pressure leaking to 10^{-2} atm) of 10^{-8} atm cc/sec. Any capsule with a detectable leak may not be delivered to a carrier for transport.

7. The package authorized by this certificate is hereby approved for use under the general license provisions of 10 CFR §71.12(b).
8. Expiration date: December 31, 1987.

REFERENCES

General Electric Company application dated February 21, 1980.

Supplement dated: September 8, 1982.

Oak Ridge National Laboratory letter dated April 3, 1980.

Supplement dated: May 7, 1980.

FOR THE U.S. NUCLEAR REGULATORY COMMISSION


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

Date: DEC 22 1982

III. COMMERCIAL PACKAGES SHIPPED FROM ORNL

(NRC or DOT Approved)

TELEDYNE ENERGY SYSTEMS SENTINEL IS

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
9153	1	USA/9153/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):
Teledyne Energy Systems
110 West Timonium Road
Timonium, MD 21093

3.(b) Title and identification of report or application:
Teledyne Energy Systems application
dated October 5, 1981, as supplemented.

3.(c) Docket No. 71-9153

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.: SENTINEL 1S
(2) Description

The packaging contains a thermoelectric generator with 10,100 Ci of strontium 90 fluoride. The dimensions are 32.2 inches in height by 37.53 inches in diameter. The package is welded to a 39.5 inch square, steel pallet, which is 4 inches high.

The contents are housed in a Hastelloy C-276 liner. The liner, with its pressed cap, is contained within a fuel capsule (1.871" OD x 4.194"). The capsule lid is threaded for strength and welded (minimum weld penetration of 0.055" is specified) to give a positive seal. The wall thickness of the capsule is a minimum of 0.198 inches. The fuel capsule is constructed of Hastelloy C-276. The capsule is inserted into the stainless steel canned depleted uranium biological shield (1.898" ID x 4.320" OD x 5.885" or 5.978"), and the shield plug is bolted into place using three steel bolts, equally spaced on a 3.25-inch bolt circle.

The biological shield is held in a horizontal position within the generator's aluminum housing by the sized Min-K-1301 thermal insulation. Min-K and load bearing plates are used to support the shield base. Spring washers are used to preload the Min-K supporting the biological shield.

Page 2 - Certificate No. 9153 - Revision No. 1 - Docket No. 71-9153

(2) Description (continued)

The finned (13" OD x 14.5") aluminum housing (7" OD x 8.97") forms the outer protective shell of the generator (70 lbs). The generator is held in place within the cask by a hold down assembly with a rubber pad on top and a 2-inch thick (1/8"-0.001" core) aluminum honeycomb with a 97 square inch effective area, on the bottom. The total system weight is approximately 7,190 pounds.

(3) Drawings

The packaging is constructed in accordance with Teledyne Energy Systems Drawing Nos.: 013-01000, Rev. 0; 013-01001, Rev. 0; 013-01002, Sheets 1 and 2, Rev. 0; and assembled in accordance with Figure 2.7-1, p 3-17 of the application.

(b) Contents

(1) Type and form of material

Strontium fluoride ($^{90}\text{SrF}_2$) doubly encapsulated in a Hastelloy C-276 fuel capsule, with a Hastelloy C-276 liner which meets the requirements of special form as defined in 10 CFR §71.4(o).

(2) Maximum quantity of material per package

12,000 curies.

6. The lifting rings must be either removed, securely covered, or locked during transport to prevent their use as tie-down devices.
7. The package authorized by this certificate is hereby approved for use under the general license provisions of 10 CFR §71.12(b).
8. Expiration date: October 31, 1986.

REFERENCES

Teledyne Energy Systems application dated October 5, 1981.

Supplements dated: October 21 and November 30, 1981.

FOR THE U.S. NUCLEAR REGULATORY COMMISSION


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

Date: JAN 25 1982

III. COMMERCIAL PACKAGES SHIPPED FROM ORNL

(NRC or DOT Approved)

TELEDYNE ENERGY SYSTEMS SENTINEL-8S

NRC FORM 618 (6-83) 10 CFR 71		U.S. NUCLEAR REGULATORY COMMISSION								
CERTIFICATE OF COMPLIANCE FOR RADIOACTIVE MATERIALS PACKAGES										
1. CERTIFICATE NUMBER	2. REVISION NUMBER	3. PACKAGE IDENTIFICATION NUMBER	4. PAGE NUMBER	5. TOTAL NUMBER PAGES						
9085	3	USA/9085/B()	1	2						
<p>2. PREAMBLE</p> <p>a. This certificate is issued to certify that the packaging and contents described in Item 5 below, meets the applicable safety standards set forth in Title 10, Code of Federal Regulations, Part 71, "Packaging of Radioactive Materials for Transport and Transportation of Radioactive Material Under Certain Conditions."</p> <p>b. This certificate does not relieve the consignor from compliance with any requirement of the regulations of the U.S. Department of Transportation or other applicable regulatory agencies, including the government of any country through or into which the package will be transported.</p>										
<p>3. THIS CERTIFICATE IS ISSUED ON THE BASIS OF A SAFETY ANALYSIS REPORT OF THE PACKAGE DESIGN OR APPLICATION</p> <table border="1"> <thead> <tr> <th>a. PREPARED BY (Name and Address):</th> <th>b. TITLE AND IDENTIFICATION OF REPORT OR APPLICATION:</th> </tr> </thead> <tbody> <tr> <td>Teledyne Energy Systems 110 West Timonium Road Timonium, MD 21093</td> <td>Teledyne Energy Systems application dated March 3, 1977, as supplemented.</td> </tr> <tr> <td></td> <td>c. DOCKET NUMBER 71-9085</td> </tr> </tbody> </table>					a. PREPARED BY (Name and Address):	b. TITLE AND IDENTIFICATION OF REPORT OR APPLICATION:	Teledyne Energy Systems 110 West Timonium Road Timonium, MD 21093	Teledyne Energy Systems application dated March 3, 1977, as supplemented.		c. DOCKET NUMBER 71-9085
a. PREPARED BY (Name and Address):	b. TITLE AND IDENTIFICATION OF REPORT OR APPLICATION:									
Teledyne Energy Systems 110 West Timonium Road Timonium, MD 21093	Teledyne Energy Systems application dated March 3, 1977, as supplemented.									
	c. DOCKET NUMBER 71-9085									
<p>4. CONDITIONS</p> <p>This certificate is conditional upon fulfilling the requirements of 10 CFR Part 71, as applicable, and the conditions specified below</p>										
<p>5.</p> <p>(a) Packaging</p> <p>(1) Model No.: SENTINEL 8S</p> <p>(2) Description</p> <p>The packaging contains a thermoelectric generator with 55,000 ci of strontium 90 titanate or strontium 90 fluoride. The dimensions are 32.2 inches in height by 37.53 inches in diameter. The package is welded to a 39.5-inch square, steel pallet, which is 4 inches high.</p> <p>The contents are housed in a stainless steel or Hastelloy C-276 liner. The liner, with its pressed cap, is contained within a fuel capsule (5.5" x 3.735" OD). The capsule lid is threaded for strength and welded (minimum weld penetration of 0.055" is specified) to give a positive seal. The wall thickness of the capsule is a minimum of 0.3475 inch. The fuel capsule is constructed of Hastelloy C-276 (or Uniloy HC). The capsule is inserted into the tungsten biological shield (8.367" x 6.467" OD), and the shield plug is bolted into place using three steel bolts, equally spaced on a 5.093-inch bolt circle.</p> <p>The tungsten shield is held in a horizontal position within the generator's aluminum housing by the sized Min-K-1301 thermal insulation. Min-K and load bearing Glasrock are used to support the shield base. A retaining ring is used to preload the Min-K and to dampen any vibrational loads.</p>										

Page 2 - Certificate No. 9085 - Revision No. 3 - Docket No. 71-9085

(2) Description (continued)

The finned 6061-T6 aluminum housing forms the outer protective shell of the generator. During shipment, the detachable fin extensions will be bolted to the fins. This increases the fin diameter from 22 inches to 26 inches, holding the generator securely in the shipping cask body (5.68" min. wall thickness, ASTM A-181 grade 2 forged steel). The interface between the overlapping fin surfaces is coated with a heat transfer compound (DOW Corning 340). The total system weight is approximately 7,400 pounds.

(3) Drawings

The principal features of the package are shown in the drawings contained in the Teledyne Energy Systems application, dated March 3, 1977.

(b) Contents

(1) Type and form of material

- (i) Strontium 90 titanate doubly encapsulated in a stainless steel liner and Hastelloy or Uniloy HC capsule which meet the requirements of special form radioactive material; or
- (ii) Strontium fluoride ($^{90}\text{SrF}_2$) doubly encapsulated in a Hastelloy or Uniloy fuel capsule, with a Hastelloy C-276 liner which meets the requirements of special form radioactive material.

(2) Maximum quantity of material per package

55,000 curies

- 6. The package authorized by this certificate is hereby approved for use under the general license provisions of 10 CFR 671.12.
- 7. Expiration date: April 30, 1987.

REFERENCES

Teledyne Energy Systems application dated March 3, 1977.

Supplement dated: March 17, 1978.

FOR THE U.S. NUCLEAR REGULATORY COMMISSION

Charles E. MacDonald
 Charles E. MacDonald, Chief
 Transportation Certification Branch
 Division of Fuel Cycle and
 Material Safety, M55

Date: _____

SEP 06 1983

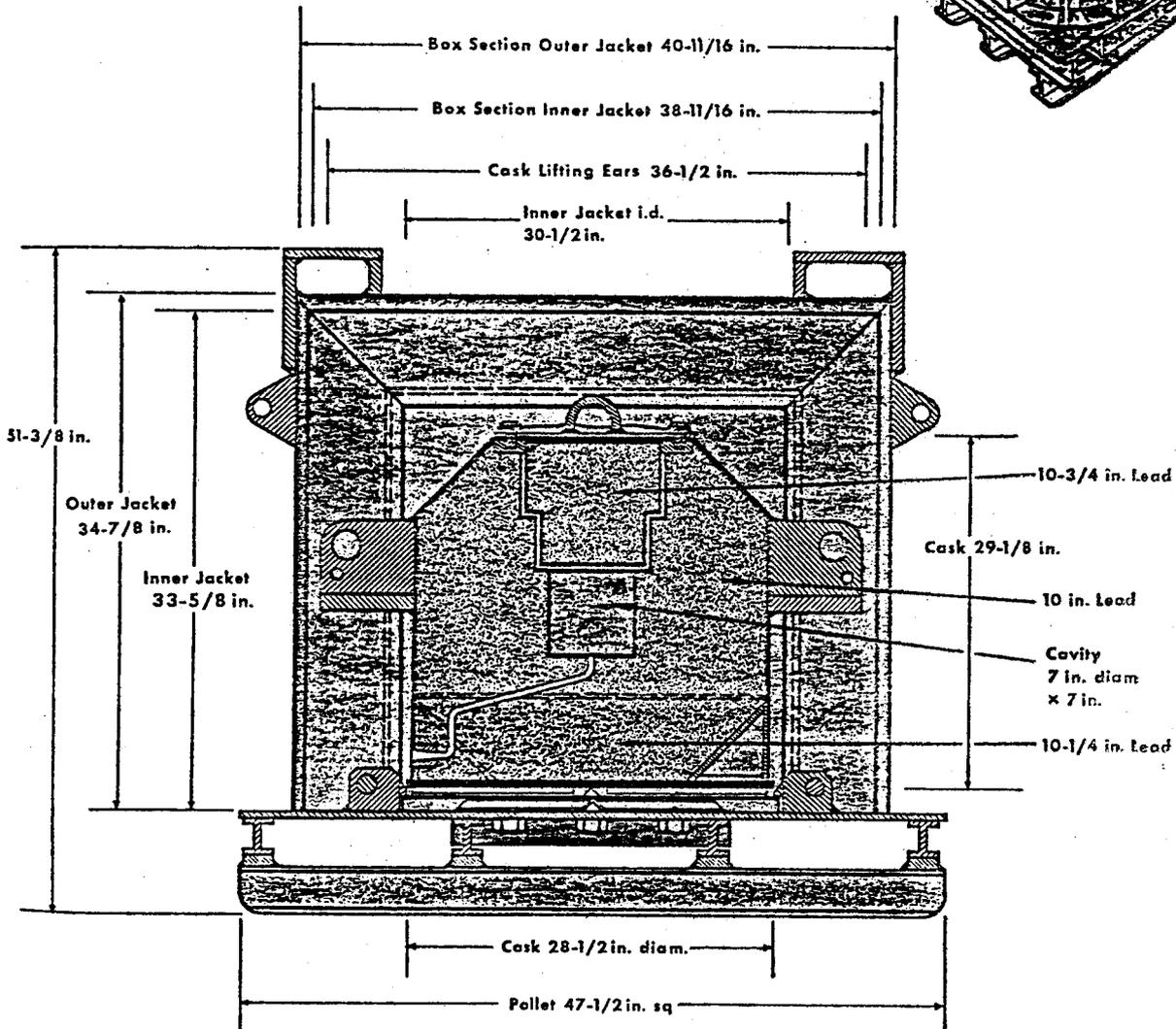
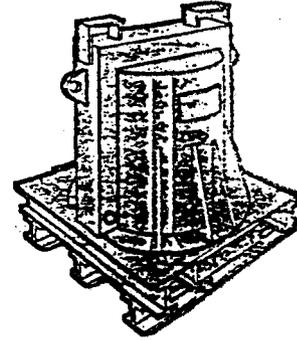
430

III. COMMERCIAL PACKAGES SHIPPED FROM ORNL

(NRC or DOT Approved)

GENERAL ELECTRIC COMPANY MODEL GE-500

500 Series Certification No. 5998 (& I.A.E.A. Certified)
 Cask Weight 6300 Lbs. -2865 Kgs.
 Assembly Weight 8100 Lbs -3680 Kgs.
 Assembly Drawing No. 106D3870G2
 Modes of Transportation - All Except Passenger Aircraft
 Watt Load at 100°F Ambient 780 Watts
 Fissile Load ≤15 Grams



GENERAL ELECTRIC - MODEL 500 SHIELDED CONTAINER

NRC FORM 618 (5-83) 10 CFR 71	CERTIFICATE OF COMPLIANCE FOR RADIOACTIVE MATERIALS PACKAGES			U.S. NUCLEAR REGULATORY COMMISSION	
1. a. CERTIFICATE NUMBER	b. REVISION NUMBER	c. PACKAGE IDENTIFICATION NUMBER	d. PAGE NUMBER	e. TOTAL NUMBER PAGES	
9049	4	USA/9049/B()	1	2	
2. PREAMBLE a. This certificate is issued to certify that the packaging and contents described in Item 5 below, meets the applicable safety standards set forth in Title 10, Code of Federal Regulations, Part 71, "Packaging of Radioactive Materials for Transport and Transportation of Radioactive Material Under Certain Conditions." b. This certificate does not relieve the consignor from compliance with any requirement of the regulations of the U.S. Department of Transportation or other applicable regulatory agencies, including the government of any country through or into which the package will be transported.					
3. THIS CERTIFICATE IS ISSUED ON THE BASIS OF A SAFETY ANALYSIS REPORT OF THE PACKAGE DESIGN OR APPLICATION a. PREPARED BY (Name and Address): General Electric Company P.O. Box 460 Pleasanton, CA 94566					
b. TITLE AND IDENTIFICATION OF REPORT OR APPLICATION: General Electric Company application dated February 21, 1980, as supplemented.					
c. DOCKET NUMBER 71-9049					
4. CONDITIONS This certificate is conditional upon fulfilling the requirements of 10 CFR Part 71, as applicable, and the conditions specified below					
5. (a) Packaging (1) Model No.: GE-500 (2) Description Steel encased lead shielded shipping cask. A double-walled steel cylinder protective jacket encloses the cask during transport. It is bolted to a steel pallet. The cask is closed by a lead-filled flanged plug fitted with a silicone rubber gasket and bolted closure. The cavity drain line is closed by either a stainless steel or fusible plug (melting point 500°F). The physical description is as follows:					
Cask height, in 29.0 Cask diameter, in 28.0 Cavity height, in 7.0 Cavity diameter, in 7.0 Lead shielding, in 10.0 Protective jacket height, in 38.9 Protective jacket width, in 40.75 Packaging weight, lb 7,800					
(3) Drawings The packaging is constructed in accordance with the following General Electric Company Drawing Nos.:					
212E246, Rev. 7 106D3855, Rev. 4 106D3870, Rev. 11 129D4690, Rev. 0 706E790, Rev. 4					

Page 2 - Certificate No. 9049 - Revision No. 4 - Docket No. 71-9049

5. (b) Contents

(1) Type and form of material

- (i) Byproduct material meeting the requirements of special form radioactive material; or
- (ii) Solid nonfissile irradiated metal hardware and reactor control rods (blades).

(2) Maximum quantity of material per package

Radioactive decay heat not to exceed 780 watts.

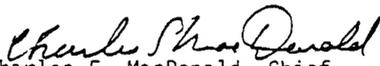
- 6. Shoring shall be provided to minimize movement of contents during accident conditions of transport.
- 7. Package contents shall be delivered to a carrier dry.
- 8. Prior to each shipment the silicone rubber lid gasket shall be inspected. This gasket shall be replaced if inspection shows any defects or every twelve (12) months, whichever occurs first. Cavity drain line shall be sealed with appropriate sealant applied to threads of pipe plug.
- 9. The package authorized by this certificate is hereby approved for use under the general license provisions of 10 CFR §71.12.
- 10. Expiration date: July 31, 1985.

REFERENCES

General Electric Company application dated February 21, 1980.

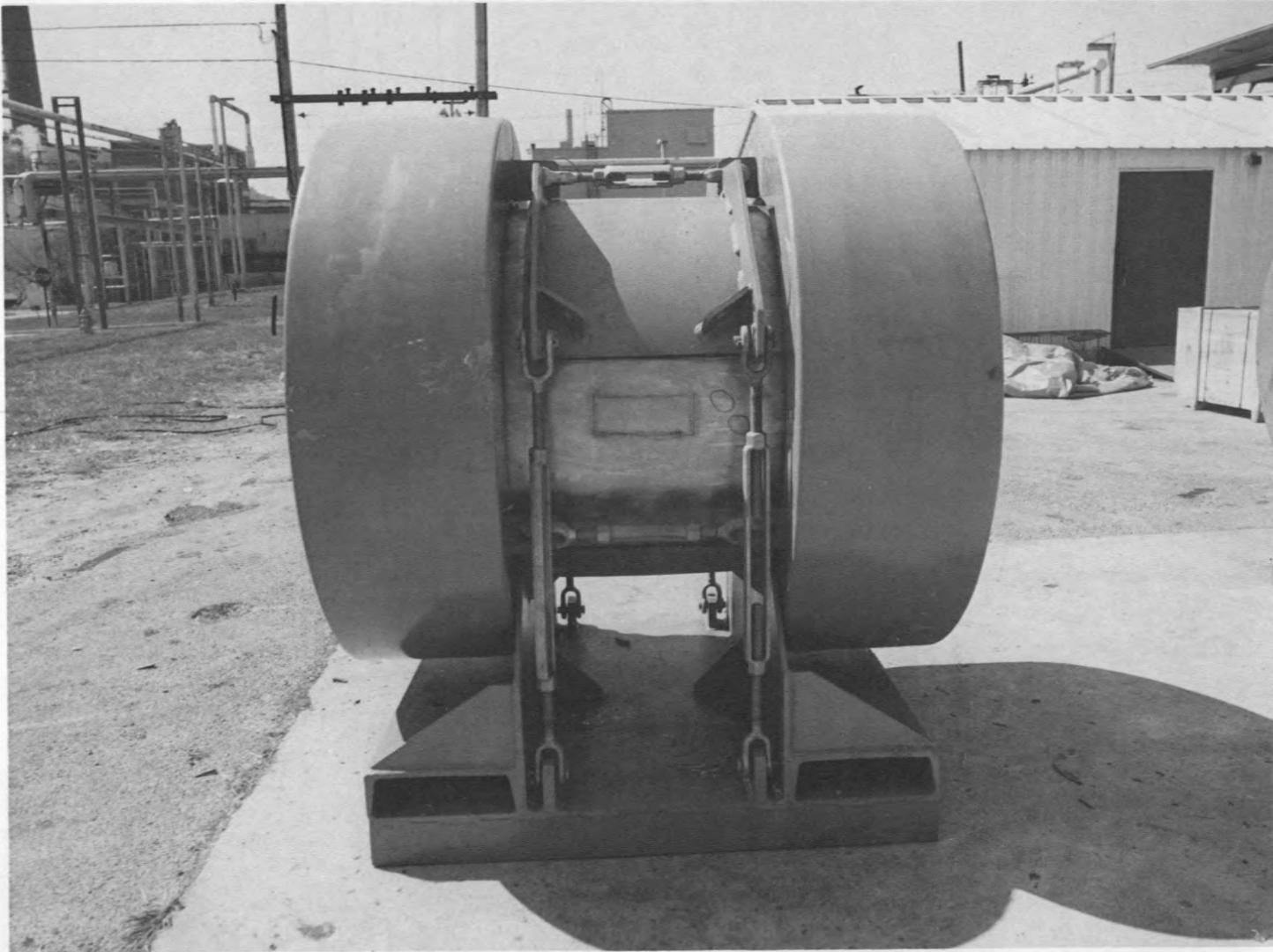
Supplement dated: August 26, 1980.

FOR THE U.S. NUCLEAR REGULATORY COMMISSION


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

Date: SEP 06 1983

ORNL Photo 5900-84



Isomedix, Inc., Husman Irradiator

III.37

III. COMMERCIAL PACKAGES SHIPPED FROM ORNL

(NRC or DOT Approved)

ISOMEDIX, INC., HUSMAN IRRADIATOR

RC 1 QHM 518 1 83, 3 CFR 71		U.S. NUCLEAR REGULATORY COMMISSION		
CERTIFICATE OF COMPLIANCE FOR RADIOACTIVE MATERIALS PACKAGES				
a. CERTIFICATE NUMBER	b. REVISION NUMBER	c. PACKAGE IDENTIFICATION NUMBER	d. PAGE NUMBER	e. TOTAL NUMBER PAGES
9182	0	USA/9182/B(U)	1	2
1 PREAMBLE a This certificate is issued to certify that the packaging and contents described in Item 5 below meets the applicable safety standards set forth in Title 10, Code of Federal Regulations, Part 71, Packaging of Radioactive Materials for Transport and Transportation of Radioactive Material Under Certain Conditions. b This certificate does not relieve the consignor from compliance with any requirement of the regulations of the U.S. Department of Transportation or other applicable regulatory agencies, including the government of any country through or into which the package will be transported.				
3 THIS CERTIFICATE IS ISSUED ON THE BASIS OF A SAFETY ANALYSIS REPORT OF THE PACKAGE DESIGN OR APPLICATION a. PREPARED BY (Name and Address) U.S. Department of Agriculture Radiological Safety Staff Beltsville, MD 20705				
b. TITLE AND IDENTIFICATION OF REPORT OR APPLICATION Nuclear Packaging, Inc. application dated May 16, 1983, as supplemented.				
c. DOCKET NUMBER 71-9182				
4 CONDITIONS This certificate is conditional upon fulfilling the requirements of 10 CFR Part 71, as applicable, and the conditions specified below.				
5 (a) Packaging				
(1) Model No.: Husman Irradiator				
(2) Description The package is a cylindrical, steel-encased, lead filled weldment 36.4" OD by 39.6" high. The package is provided with two foam impact limiters. The dimensions of the package with the attached impact limiters is 53.5" OD by 56.0" high. The impact limiters are held in place by three (3) turnbuckles. The irradiator consists of a rotating annular rotor between an integral central core and the outer annular shell. Three equally spaced specimen chambers in the rotor are used to transport pupae containers to the irradiation position. The entire cask assembly is welded closed to preclude removal of the sealed sources. The package weight is 17,000 pounds.				
(3) Drawings The packaging is constructed in accordance with Nuclear Packaging, Inc. Drawing No. SK-209, Sheets 1 and 2, Revision B.				
(b) Contents				
(1) Type and form of material Cesium 137 sources meeting requirements for special form radioactive material.				
(2) Maximum quantity of material per package 50,000 ci.				

CONDITIONS (continued)

Page 2 - Certificate No. 9182 - Revision No. 0 - Docket No. 71-9182

6. The package authorized by this certificate is hereby approved for use under the general license provisions of 10 CFR §71.12.
7. Expiration date: October 31, 1988.

REFERENCES

Nuclear Packaging, Inc. application dated May 16, 1983.

Supplements dated: October 3 and 21, 1983.

FOR THE U.S. NUCLEAR REGULATORY COMMISSION


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

Date: OCT 26 1983

DEC 13 1983



U.S. Department
of Transportation

Research and
Special Programs
Administration

COMPETENT AUTHORITY CERTIFICATION
FOR A TYPE B (U)
RADIOACTIVE MATERIALS PACKAGE DESIGN
CERTIFICATE USA/9182/B(U), REVISION 0

400 Seventh Street, S.W.
Washington, D.C. 20590

This certifies that the radioactive materials package design described below has been certified by the competent authority of the United States as meeting the regulatory requirements for a Type B (U) packaging for fissile radioactive materials as prescribed in the IAEA 1/ and USA 2/ regulations.

1. Package Identification - Husman Irradiator
2. Packaging Description and Authorized Radioactive Contents - as described in U.S. Nuclear Regulatory Commission Certificate of Compliance No. 9182, Revision 0 (attached).

Contents must be of a design which has been tested and demonstrated to be leaktight to a sensitivity of 10^{-5} atm - cm³/sec or less.

3. GENERAL CONDITIONS -

- a. Each user of this certificate must have in his possession a copy of this certificate and all documents necessary to properly prepare the package for transportation.
 - b. Each user of this certificate, other than the original petitioner, 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.
4. The package shall bear the marking USA/9182/B(U) in addition to other required markings and labeling.
 5. This certificate, unless renewed, expires on October 31, 1988

Certified by:

Richard R. Rawl
Richard R. Rawl
Chief, Radioactive Materials Branch
Office of Hazardous Materials Regulation
Materials Transportation Bureau

December 5, 1983
(DATE)

1/ "Safety Series No. 6, Regulations for the Safe Transport of Radioactive Materials, 1973 Revised Edition" published by the International Atomic Energy Agency (IAEA), Vienna, Austria. 330

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

IV.1

IV. ORNL SPECIAL FORM CONTAINERS



US Department
of Transportation

400 Seventh Street, S.W.
Washington, D.C. 20590

Research and
Special Programs Administration IAEA CERTIFICATE OF COMPETENT AUTHORITY

Special Form Radioactive Material Encapsulation

Certificate Number USA/0156/S

Revision 2

This certifies that the encapsulated source, as described, when loaded with the authorized radioactive contents, has been demonstrated to meet the regulatory requirements for special form radioactive materials as prescribed in IAEA 1/ and USA 2/ regulations for the transport of radioactive materials.

I. Source Description - The source described by this certificate is identified as the Type 1 Powder Shipping Can which is a 304-L stainless steel welded encapsulation measuring 0.75 inches in diameter by 3.0 inches in length constructed as described in Union Carbide Nuclear Division drawing B-RD 3092.

II. Radioactive Contents - The authorized radioactive contents of this source consist of not more than:

<u>Radionuclide</u>	<u>Form</u>	<u>Maximum Content, Curies, per Capsule</u>
Americium-241	Oxide, AmO ₂	50
Americium-243	Oxide, AmO ₂	3
Cesium-137	Chloride, CsCl	375
Cobalt-60	Metal	5,000
Curium-244	Oxide, CmO ₂	1,000
Iridium-192	Metal	5,000
Neptunium-237	Oxide, NpO ₂	0.01
Plutonium-238	Oxide, PuO ₂	250
Plutonium-239	Oxide, PuO ₂	0.900
Plutonium-240	Oxide, PuO ₂	3.40
Plutonium-241	Oxide, PuO ₂	1,500
Plutonium-242	Oxide, PuO ₂	0.06
Promethium-147	Oxide, Pm ₂ O ₃	5,000
Strontium-90	Fluoride, SrF ₂	450
Strontium-90	Oxide, SrO	450
Strontium-90	Titanate, SrO·(TiO ₂) _x where x ≥ 0.5	450
Thorium-230	Oxide, ThO ₂	0.30
Uranium-233	Oxide, U ₃ O ₈	0.14
Uranium-233	Metal	0.14
Uranium-234	Oxide, U ₃ O ₈	0.09

Certificate Number USA/0156/S, Revision 2

Page 2

III. This certificate, unless renewed, expires February 28, 1988.

This certificate is issued in accordance with paragraph 803 of the IAEA Regulations 1/, and in response to the February 10, 1983 petition by the Department of Energy, Washington, D.C., and in consideration of the associated information therein.

Certified by:



Richard R. Rawl
Chief, Radioactive Materials Branch
Office of Hazardous Materials Regulation
Materials Transportation Bureau

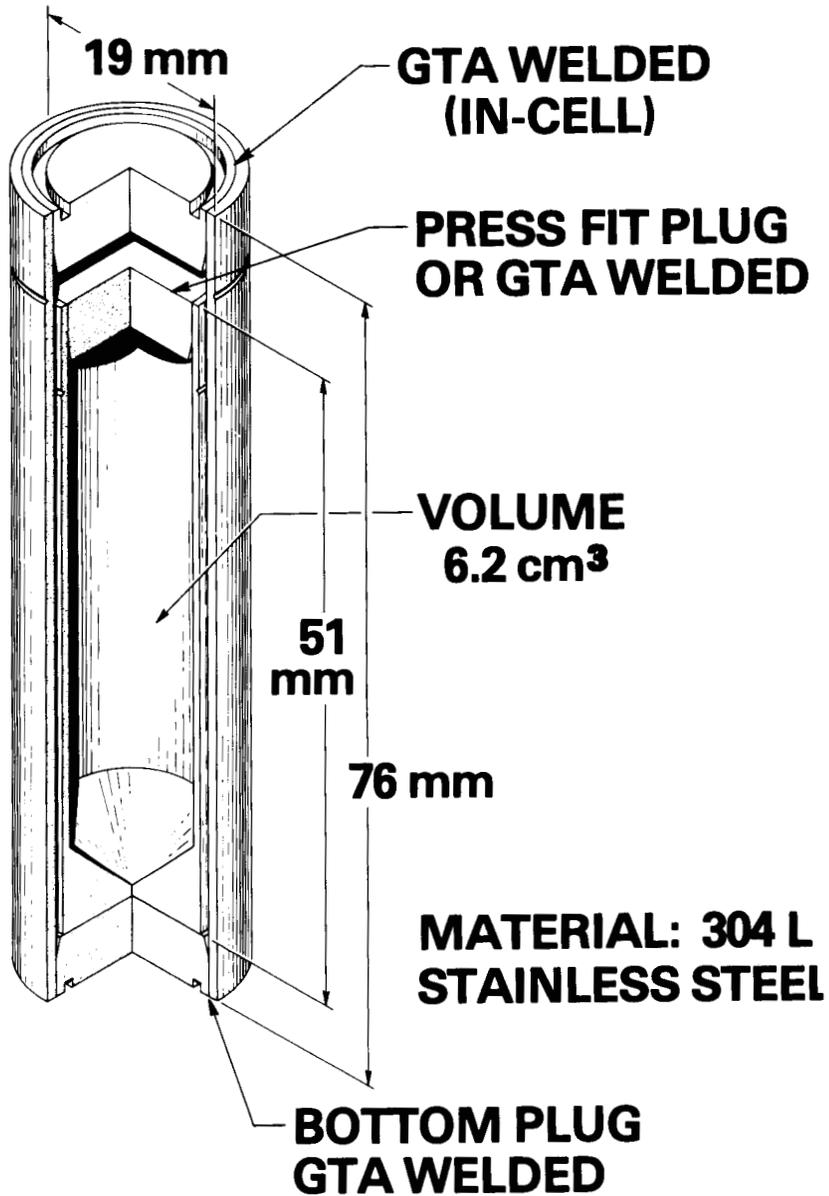
March 17, 1983
(Date)

1/ "Safety Series No. 6, Regulations for the Safe Transport of Radioactive Materials, 1973 Revised Edition" published by the International Atomic Energy Agency (IAEA), Vienna, Austria.

2/ Title 49, Code of Federal Regulations, Parts 170-178, USA

Revision 1-amended contents, reflected conformance with 1973 IAEA regulations and extended expiration date.

Revision2-extended expiration date.



**ORNL SPECIAL FORM
CAPSULE - TYPE I**



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

IAEA CERTIFICATE OF COMPETENT AUTHORITY

Special Form Radioactive Materials Encapsulation

REFER TO:

Certificate Number USA/0202/S

This certifies that the encapsulated source, as described, when loaded with the authorized radioactive contents, has been demonstrated to meet the regulatory requirements for special form radioactive material as prescribed in IAEA/ and USA2/ regulations for the transport of radioactive materials.

I. Source Description - The source described by this certificate is identified as Oak Ridge National Laboratory (ORNL) Powder Shipping Can Type 2 which is a tungsten-inert gas welded double encapsulation constructed of stainless steel. The capsule is cylindrical with external dimensions of 5" in length by 1.25" in diameter.

II. Radioactive Contents - The authorized radioactive contents of this source consist of not more than the following:

<u>Radionuclide</u>	<u>Form</u>	<u>Maximum Content, Curies per Capsule</u>
Americium-241	Oxide, AmO ₂	200
Americium-243	Oxide, AmO ₂	12
Cesium-137	Chloride, CsCl	1,500
Cobalt-60	Metal	5,000
Curium-244	Oxide, CmO ₂	4,000
Iridium-192	Metal	5,000
Neptunium-237	Oxide, NpO ₂	0.04
Plutonium-238	Oxide, PuO ₂	1,000
Plutonium-239	Oxide, PuO ₂	3.6
Plutonium-240	Oxide, PuO ₂	14.0
Plutonium-241	Oxide, PuO ₂	5,000
Plutonium-242	Oxide, PuO ₂	0.25
Promethium-147	Oxide, Pm ₂ O ₃	5,000
Strontium-90	Fluoride, SrF ₂	2,000
Strontium-90	Oxide, SrO	2,000
Strontium-90	Titanate, SrO·(TiO ₂) _x where x ≥ 0.5	2,000
Thorium-230	Oxide, ThO ₂	1.2
Uranium-233	Oxide, U ₃ O ₈	0.6
Uranium-233	Metal	0.6
Uranium-234	Oxide, U ₃ O ₈	0.4

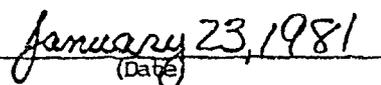
III. This certificate, unless renewed, expires on February 1, 1984.

This certificate is issued in accordance with paragraph 803 of the IAEA Regulations^{1/}, and in response to the October 24, 1980 petition by Oak Ridge National Laboratory and in consideration of the associated information therein.

Certified by:

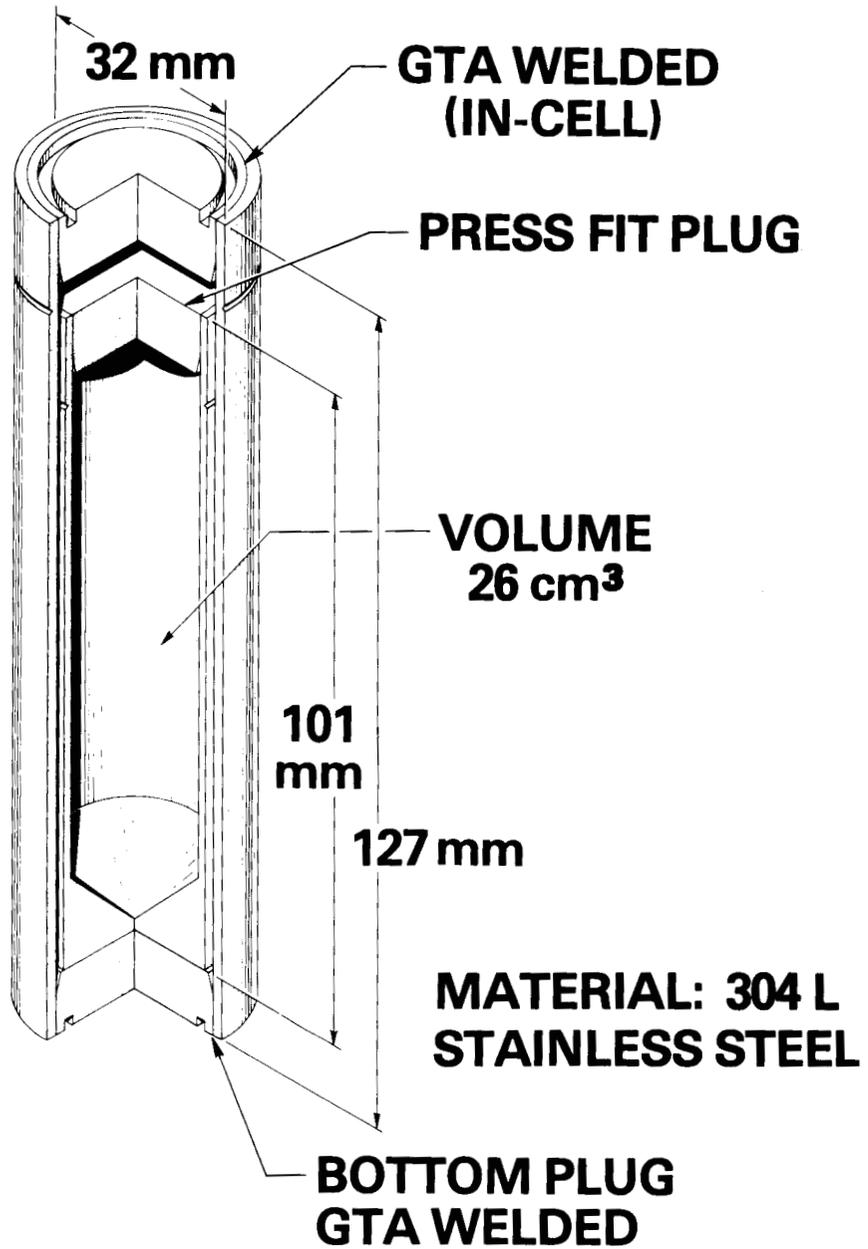


R. R. Rawl
Chief, Radioactive Materials Branch
Office of Hazardous Materials Regulation
Materials Transportation Bureau


(Date)

1/ "Safety Series No. 6 Regulations for the Safe Transport of Radioactive Materials 1973 Revised Edition", published by the International Atomic Energy Agency (IAEA), Vienna, Austria.

2/ Title 49, Code of Federal Regulations, Part 170-178, USA.



**ORNL SPECIAL FORM
CAPSULE - TYPE II**



U.S. Department
of Transportation
**Research and
Special Programs
Administration**

400 Seventh Street, S.W.
Washington, D.C. 20590

IAEA CERTIFICATE OF COMPETENT AUTHORITY

Special Form Radioactive Material Encapsulation

Certificate Number USA/0203/S

This certifies that the encapsulated source, as described, when loaded with the authorized radioactive contents, has been demonstrated to meet the regulatory requirements for special form radioactive material as prescribed in IAEA 1/ and USA 1/ regulations for the transport of radioactive materials.

I. Source Description - The source described by this certificate is identified as Oak Ridge National Laboratory (ORNL) Powder Shipping Can Type 3 which is a tungsten-inert gas welded double encapsulation constructed of stainless steel. The capsule is cylindrical with external dimensions of 8" in length by 1.25" in diameter.

II. Radioactive Contents - The authorized radioactive contents of this source consist of not more than:

<u>Radionuclide</u>	<u>Form</u>	<u>Maximum Content, Curies per Capsule</u>
Cesium-137	Chloride, CsCl	4,000
Cobalt-60	Metal	5,000
Iridium-192	Metal	5,000
Strontium-90	Oxide, SrO	5,000
Strontium-90	Fluoride, SrF ₂	5,000
Strontium-90	Titanate, SrO.(TiO ₂) _x where x more than 0.05	5,000

III. This certificate, unless renewed, expires on February 1, 1984.

This certificate is issued in accordance with paragraph 803 of the IAEA Regulations 1/, and in response to the October 24, 1980 petition by Oak Ridge National Laboratory and in consideration of the associated information therein.

Certified by:



R. R. Rawl
Chief, Radioactive Materials Branch
Office of Hazardous Materials Regulation
Materials Transportation Bureau

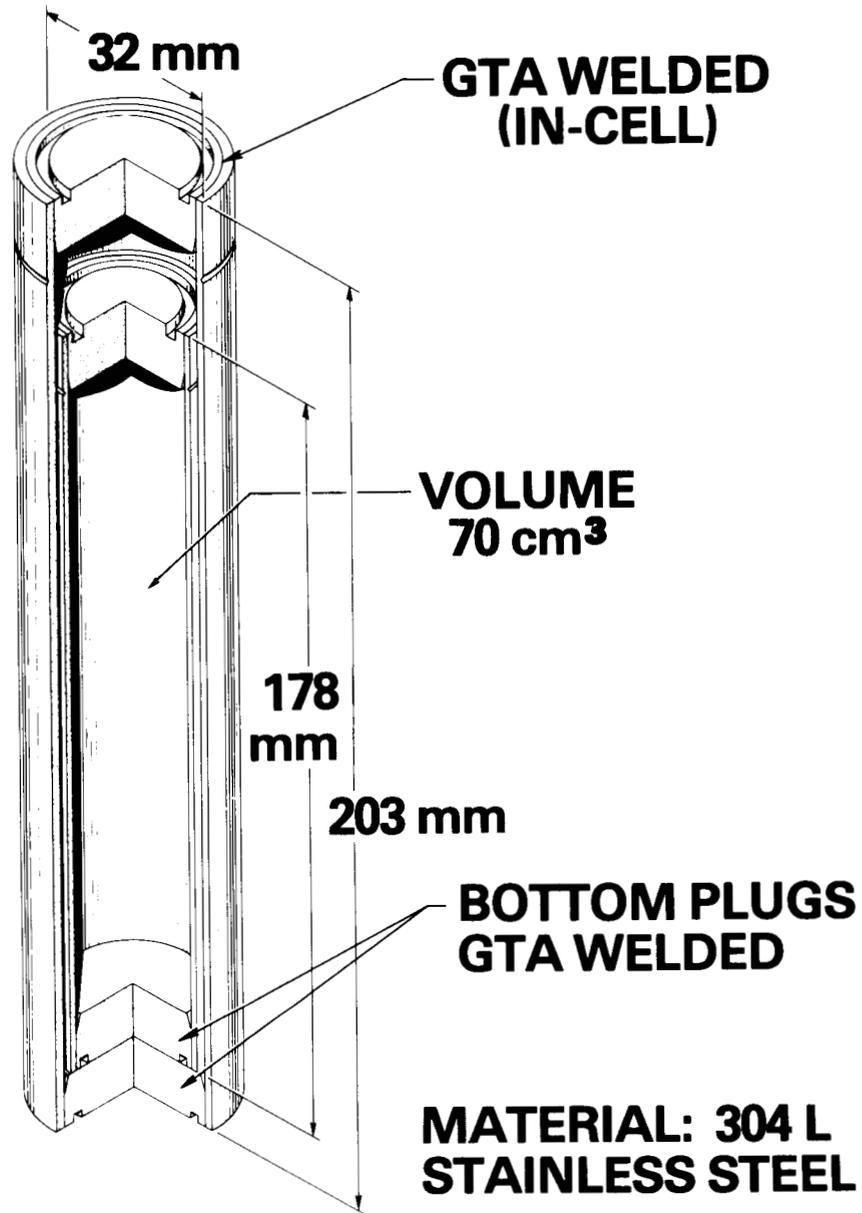
February 6, 1981

(Date)

1/ "Safety Series No. 6, Regulations for the Safe Transport of Radioactive Materials, 1973 Revised Edition", published by the International Atomic Energy Agency (IAEA), Vienna, Austria.

2/ Title 49, Code of Federal Regulations, Part 170-178, USA.

ORNL-DWG 80-14181



ORNL SPECIAL FORM CAPSULE - TYPE III



US Department
of Transportation

Research and
Special Programs
Administration

400 Seventh Street, S.W.
Washington, D.C. 20590

IAEA CERTIFICATE OF COMPETENT AUTHORITY

Special Form Radioactive Material Encapsulation

Certificate Number USA/0204/S

This certifies that the encapsulated source, as described, when loaded with the authorized radioactive contents, has been demonstrated to meet the regulatory requirements for special form radioactive material as prescribed in IAEA 1/ and USA 2/ regulations for the transport of radioactive materials.

I. Source Description - The source described by this certificate is identified as Oak Ridge National Laboratory (ORNL) Powder Shipping Can Type IV which is a tungsten-inert gas welded double encapsulation constructed of stainless steel. The capsule is cylindrical with external dimensions of 9" in length by 2.5" in diameter.

II. Radioactive Contents - The authorized radioactive contents of this source consist of not more than:

<u>Radionuclide</u>	<u>Form</u>	<u>Maximum Content, Curies per Capsule</u>
Cesium-137	Chloride, CsCl	5,000
Cobalt-60	Metal	5,000
Iridium-192	Metal	5,000
Strontium-90	Oxide, SrO	5,000
Strontium-90	Fluoride, SrF ₂	5,000
Strontium-90	Titanate, SrO.(TiO ₂) _x where x is more than 0.05	5,000

III. This certificate, unless renewed, expires on February 1, 1984.

This certificate is issued in accordance with paragraph 803 of the IAEA Regulations 1/, and in response to the October 24, 1980 petition by Oak Ridge National Laboratory and in consideration of the associated information therein.

Certified by:

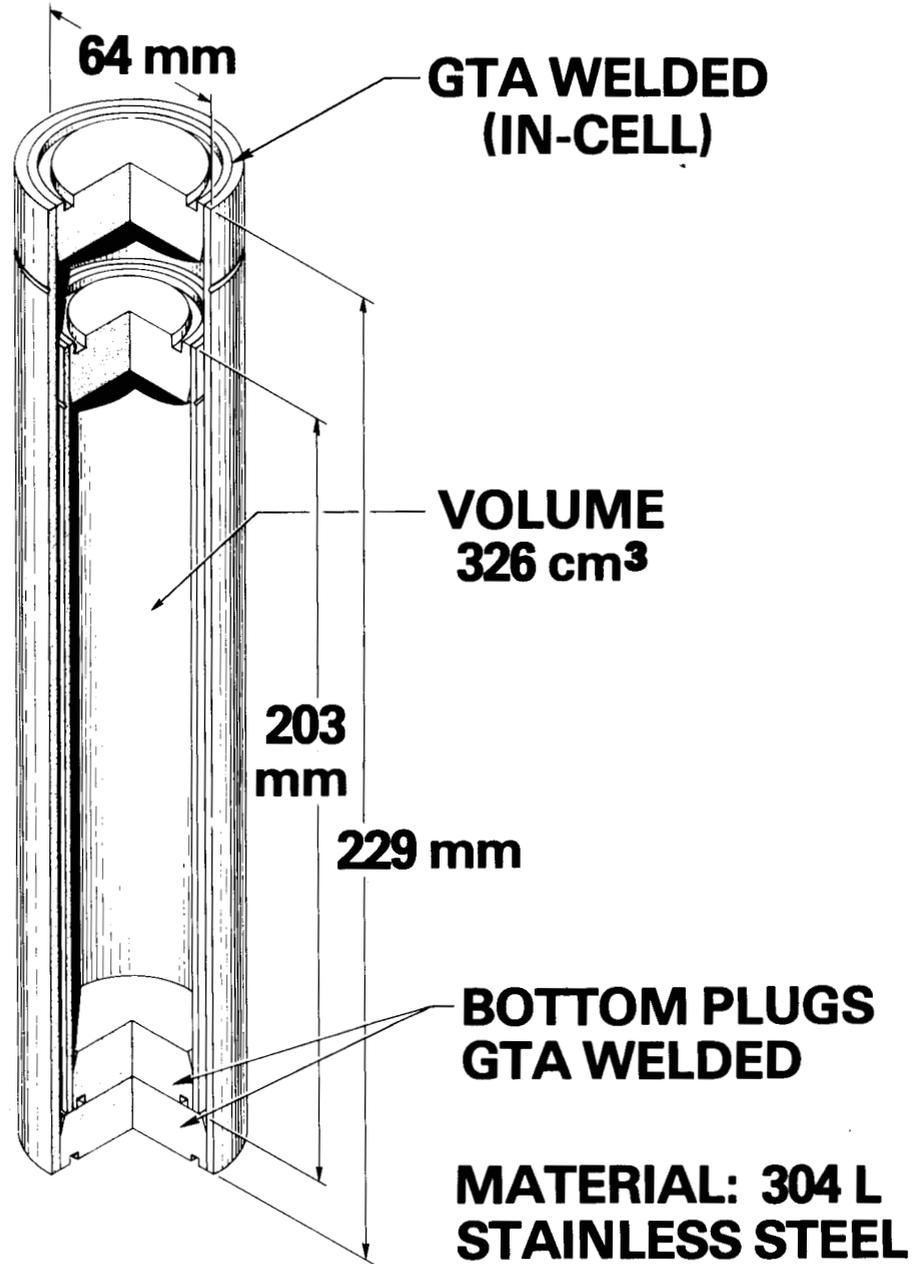


R. R. Rawl
Chief, Radioactive Materials Branch
Office of Hazardous Materials Regulation
Materials Transportation Bureau

February 27, 1981
(Date)

1/ "Safety Series No. 6, Regulations for the Safe Transport of Radioactive Materials, 1973 Revised Edition", published by the International Atomic Energy Agency (IAEA), Vienna, Austria.

2/ Title 49, Code of Federal Regulations, Part 170-178, USA.



**ORNL SPECIAL FORM
CAPSULE - TYPE IV**



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

IAEA CERTIFICATE OF COMPETENT AUTHORITY

Special Form Radioactive Material Encapsulation

REFER TO:

Certificate Number USA/0198/S

This certifies that the encapsulated source, as described, when loaded with the authorized radioactive contents, has been demonstrated to meet the regulatory requirements for special form radioactive materials as prescribed in IAEA 1/ and USA 2/ regulations for the transport of radioactive materials.

I. Source Description - The source described by this certificate is identified as Oak Ridge National Laboratory Capsule Am-1 which is a double cylindrical encapsulation constructed of 304L stainless steel with the outer capsule closed and sealed by welding. The outer capsule measures 1.25" in outside diameter by 7.0" in length.

II. Radioactive Contents - The authorized radioactive contents of this source consist of:

<u>Radionuclide</u>	<u>Form</u>	<u>Maximum Content, Curies per Capsule</u>
Americium-241	Oxide, AmO ₂	130
Americium-243	Oxide, AmO ₂	8
Curium-244	Oxide, CmO ₂	3,000
Neptunium-237	Oxide, NpO ₂	0.03
Plutonium-238	Oxide, PuO ₂	680
Plutonium-239	Oxide, PuO ₂	2.50
Plutonium-240	Oxide, PuO ₂	10.0
Plutonium-241	Oxide, PuO ₂	4,000
Plutonium-242	Oxide, PuO ₂	0.15
Promethium-147	Oxide, Pm ₂ O ₃	5,000
Strontium-90	Fluoride, SrF ₂	1,200
Strontium-90	Oxide, SrO	1,200
Strontium-90	Titanate, SrO·(TiO ₂) _x where x ≥ 0.5	1,200
Thorium-230	Oxide, ThO ₂	0.80
Uranium-233	Oxide, U ₃ O ₈	0.40
Uranium-233	Metal	0.40
Uranium-234	Oxide, U ₃ O ₈	0.25

III. This certificate, unless renewed, expires January 31, 1983.

This certificate is issued in accordance with paragraph 803 of the IAEA Regulations 1/, and in response to the October 24, 1980 petition by Oak Ridge National Laboratory and in consideration of the associated information therein.

Certified by:



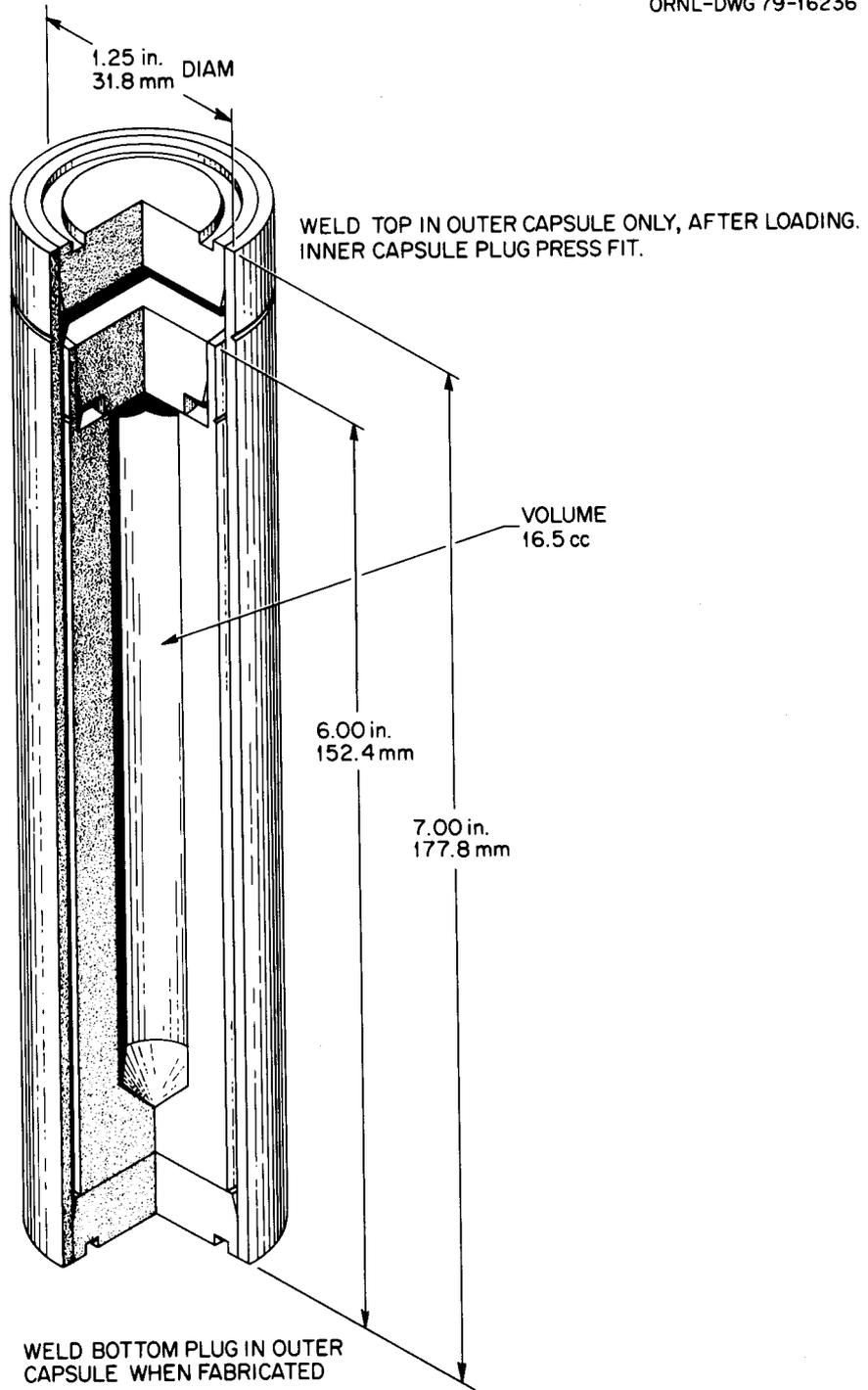
R. R. Rawl
Chief, Radioactive Materials Branch
Office of Hazardous Materials Regulation
Materials Transportation Bureau



Date

1/ "Safety Series No. 6, Regulations for the Safe Transport of Radioactive Materials, 1973 Revised Edition", published by the International Atomic Energy Agency (IAEA), Vienna, Austria.

2/ Title 49, Code of Federal Regulations, Part 170-178, USA.



Am 1 POWDER SHIPPING CAN



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

IAEA CERTIFICATE OF COMPETENT AUTHORITY

FEB 2 1981

Special Form Radioactive Material Encapsulation

Certificate Number USA/0205/S

This certifies that the encapsulated source, as described, when loaded with the authorized radioactive contents, has been demonstrated to meet the regulatory requirements for special form radioactive material as prescribed in IAEA 1/ and USA 2/ regulations for the transport of radioactive materials.

I. Source Description - The source described by this certificate is identified as Oak Ridge National Laboratory (ORNL) Capsule Ir-192 which is a tungsten-inert gas welded stainless steel encapsulation. The source is cylindrical and has external dimensions of 2" in length by 0.5" in diameter.

II. Radioactive Contents - The authorized radioactive contents of this source consist of not more than 5,000 curies of cobalt-60 or iridium - 192 as metal wafers or pellets.

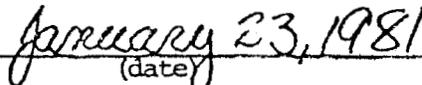
III. This certificate, unless renewed, expires on February 1, 1984.

This certificate is issued in accordance with paragraph 803 of the IAEA Regulations 1/, and in response to the October 24, 1980 petition by Oak Ridge National Laboratory and in consideration of the associated information therein therein.

Certified by:



R. R. Rawl
Chief, Radioactive Materials Branch
Office of Hazardous Materials Regulation
Materials Transportation Bureau



(date)

1/ "Safety Series No. 6, Regulations for the Safe Transport of Radioactive Materials, 1973 Revised Edition", published by the International Atomic Energy (IAEA), Vienna, Austria.

2/ Title 49, Code of Federal Regulations, Part 170-178, USA.

Certificate Number USA/0204/S

Page 2

Certified by:

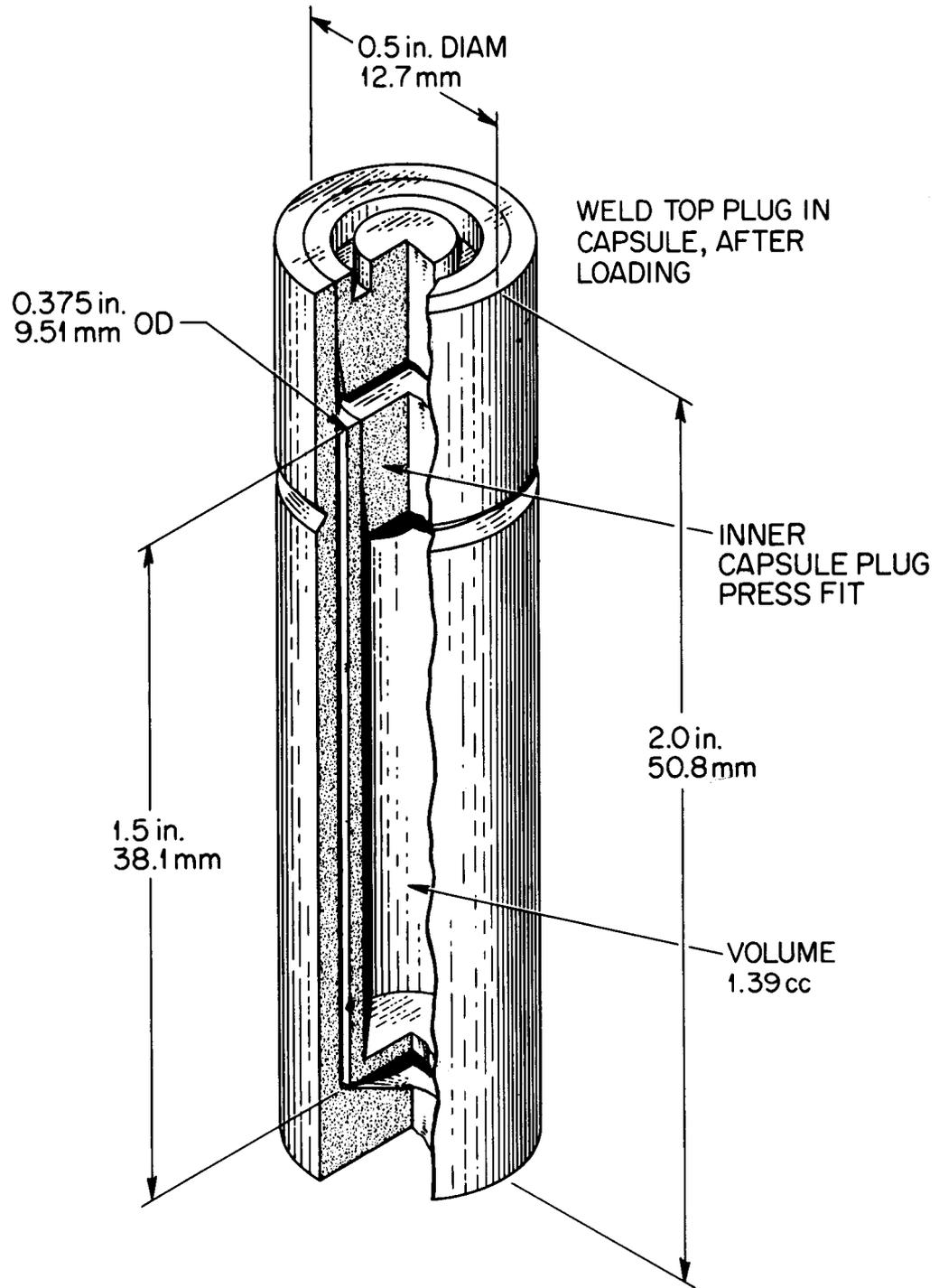


R. R. Rawl
Chief, Radioactive Materials Branch
Office of Hazardous Materials Regulation
Materials Transportation Bureau

February 27, 1981
(Date)

1/ "Safety Series No. 6, Regulations for the Safe Transport of Radioactive Materials, 1973 Revised Edition", published by the International Atomic Energy Agency (IAEA), Vienna, Austria.

2/ Title 49, Code of Federal Regulations, Part 170-178, USA.



IRIDIUM-192 SPECIAL FORM CAPSULE



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

IAEA CERTIFICATE OF COMPETENT AUTHORITY

Special Form Radioactive Materials Encapsulation

REFER TO:

Certificate Number USA/0206/S

This certifies that the encapsulated source, as described, when loaded with the authorized radioactive contents, has been demonstrated to meet the regulatory requirements for special form radioactive material as prescribed in IAEA¹ and USA² regulations for the transport of radioactive materials.

I. Source Description - The source described by this certificate is identified as Oak Ridge National Laboratory (ORNL) Capsule Pm-1 which is a tungsten-inert gas welded double encapsulation constructed of stainless steel. The source is cylindrical with external dimensions of 3" in length by 1.25" in diameter.

II. Radioactive Contents - The authorized radioactive contents of this source consist of not more than:

<u>Radionuclide</u>	<u>Form</u>	<u>Maximum Content, Curies per Capsule</u>
Americium-241	Oxide, AmO ₂	30
Americium-243	Oxide, AmO ₂	2
Curium-244	Oxide, CmO ₂	700
Neptunium-237	Oxide, NpO ₂	0.01
Plutonium-238	Oxide, PuO ₂	155
Plutonium-239	Oxide, PuO ₂	0.60
Plutonium-240	Oxide, PuO ₂	2.20
Plutonium-241	Oxide, PuO ₂	1,000
Plutonium-242	Oxide, PuO ₂	0.04
Promethium-147	Oxide, Pm ₂ O ₃	5,000
Strontium-90	Fluoride, SrF ₂	300
Strontium-90	Oxide, SrO	300
Strontium-90	Titanate, SrO·(TiO ₂) _x where x ≥ 0.5	300
Thorium-230	Oxide, ThO ₂	0.20
Uranium-233	Oxide, U ₃ O ₈	0.10
Uranium-233	Metal	0.10
Uranium-234	Oxide, U ₃ O ₈	0.06

III. This certificate, unless renewed, expires on February 1, 1984,

This certificate is issued in accordance with paragraph 803 of the IAEA Regulations^{1/}, and in response to the October 24, 1980 petition by Oak Ridge National Laboratory and in consideration of the associated information therein.

Certified by:

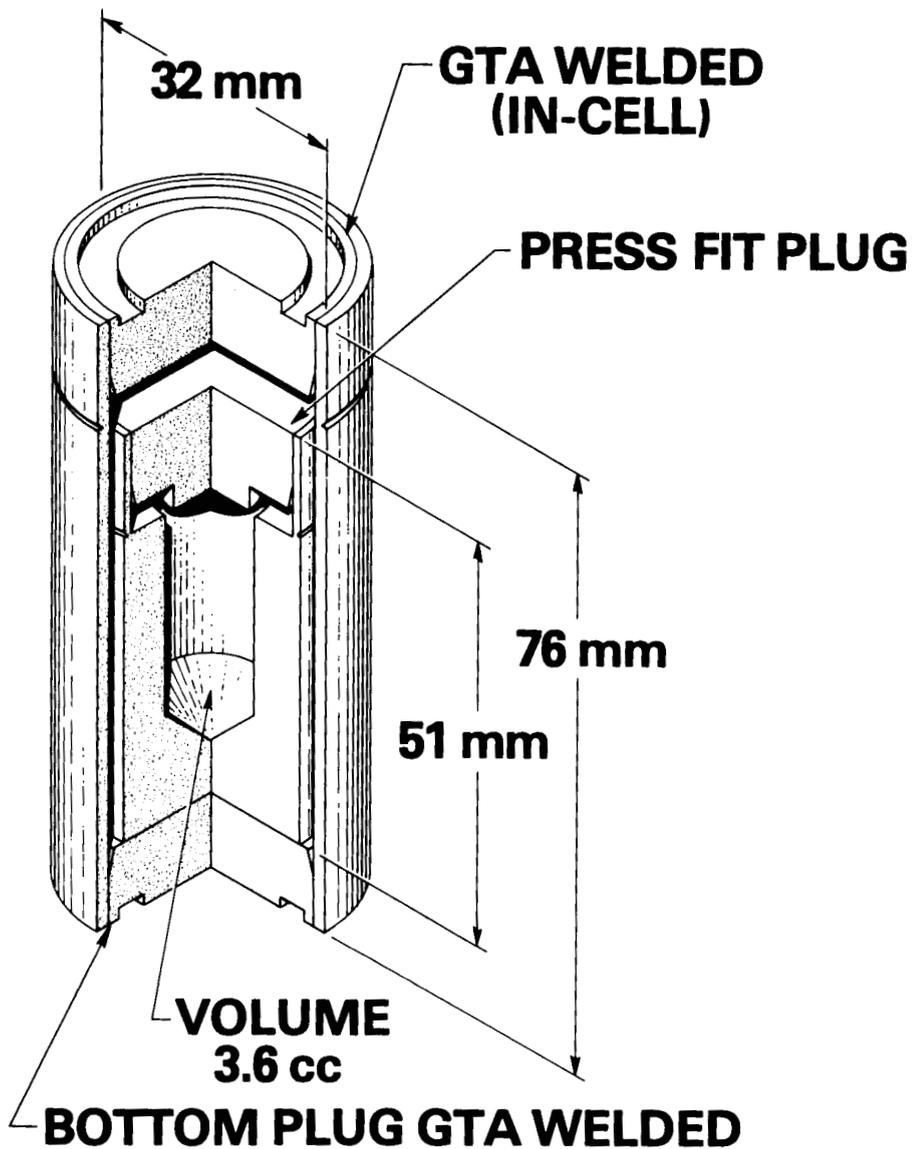


R. R. Fawl
U. S. Department of Transportation
Office of Hazardous Materials Regulation
Washington, D.C. 20590

January 23, 1981
(Date)

1/ "Safety Series No. 6, Regulations for the Safe Transport of Radioactive Materials, 1973 Revised Edition", published by the International Atomic Energy Agency (IAEA), Vienna, Austria.

2/ Title 49, Code of Federal Regulations, Part 170-178, USA.



**ORNL SPECIAL FORM
CAPSULE - TYPE Pm-1**



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

IAEA CERTIFICATE OF COMPETENT AUTHORITY

Special Form Radioactive Material Encapsulation

Certificate Number USA/0207/S

REFER TO:

This certifies that the encapsulated source, as described, when loaded with the authorized radioactive contents, has been demonstrated to meet the regulatory requirements for special form radioactive material as prescribed in IAEA¹ and USA²/ regulations for the transport of radioactive materials.

I. Source Description - The source described by this certificate is identified as Oak Ridge National Laboratory (ORNL) Capsule JAERI which is a tungsten-inert gas welded double encapsulation constructed of stainless steel. The capsule is cylindrical with external dimensions of 5" in length by 0.5" in diameter.

II. Radioactive Contents - The authorized radioactive contents of this source consist of not more than:

<u>Radionuclide</u>	<u>Form</u>	<u>Maximum Content, Curies per Capsule</u>
Americium-241	Oxide, AmO ₂	50
Americium-243	Oxide, AmO ₂	3
Cesium-137	Chloride, CsCl	375
Cobalt-60	Metal	5,000
Curium-244	Oxide, CmO ₂	1,000
Iridium-192	Metal	5,000
Neptunium-237	Oxide, NpO ₂	0.01
Plutonium-238	Oxide, PuO ₂	250
Plutonium-239	Oxide, PuO ₂	0.90
Plutonium-240	Oxide, PuO ₂	3.40
Plutonium-241	Oxide, PuO ₂	1,500
Plutonium-242	Oxide, PuO ₂	0.06
Promethium-147	Oxide, Pm ₂ O ₃	5,000
Strontium-90	Fluoride, SrF ₂	450
Strontium-90	Oxide, SrO	450
Strontium-90	Titanate, SrO·(TiO ₂) _x where x ≥ 0.5	450
Thorium-230	Oxide, ThO ₂	0.30
Uranium-233	Oxide, U ₃ O ₈	0.14
Uranium-233	Metal	0.14
Uranium-234	Oxide, U ₃ O ₈	0.09

III. This certificate, unless renewed, expires on February 1, 1984

This certificate is issued in accordance with paragraph 803 of the IAEA Regulations 1/, and in response to the October 31, 1980 petition by Oak Ridge National Laboratory and in consideration of the associated information therein.

Certified by:



R. R. Rawl
Chief, Radioactive Materials Branch
Office of Hazardous Materials Regulation
Materials Transportation Bureau

January 21, 1981
(Date)

1/"Safety Series No. 6 Regulations for the Safe Transport of Radioactive Materials, 1973 Revised Edition", published by the International Atomic Energy Agency (IAEA), Vienna, Austria.

2/ Title 49, Code of Federal Regulations, Part 170-178, USA.

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