Department of Energy
Washington, DC 20585

FEB 05 2016

MEMORANDUM FOR PATRICK W. MCGUIRE
ASSISTANT MANAGER FOR NUCLEAR
MATERIALS STABILIZATION PROJECTS
SAVANNAH RIVER OPERATIONS OFFICE

FROM: FRANK MARCINOWSKI
HEADQUARTERS CERTIFYING OFFICIAL
ACTING ASSOCIATE PRINCIPAL DEPUTY ASSISTANT
SECRETARY FOR ENVIRONMENTAL MANAGEMENT

SUBJECT: Revision 13 to Certificate of Compliance Number 9975

This memorandum responds to your request dated September 30, 2014 for revision of Department of Energy (DOE) Certificate of Compliance (CoC) Number 9975, based on Revision 4 page changes to the Safety Analysis Report for Packaging for Engineered Materials and revised thermal calculations under Hypothetical Accident Conditions. Attached is Revision 13 of the CoC with its Safety Evaluation Report. Additionally, DOE authorization to use 9975-85 packagings expired June 30, 2015; consequently, the CoC was revised to require an upgrade of 9975-85 packaging to 9975-96 packaging prior to use for transportation. Changes made to the certificate are indicated by vertical lines in the margin.

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

The expiration date of Revision 13 is June 30, 2018.

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

Attachment

cc: H. Allen Gunter, SR
Yung Liu, ANL
Steve Bellamy, SRNL

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U.S. DEPARTMENT OF ENERGY

DOE Packaging Certification Program 618)

CERTIFICATE OF COMPLIANCE
For Radioactive Materials Package

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

1a. Certificate Number	1b. Revision No.	1c. Package Identification No.	1d. Page No.	1e. Total No. Pages
9975	13	USA/9975/B(M)F-96 (DOE)	1	14

2. PREAMBLE

2a. This certificate is issued under the authority of 49 CFR Part 173.7(d).

2b. The packaging and contents described in item 5 below meet the safety standards set forth in subpart E, "Package Approval Standards" and subpart F, "Package, Special Form, and LSA-III Tests" Title 10, Code of Federal Regulations, Part 71.

2c. This certificate does not relieve the consignor from compliance with any requirement of the regulations of the U.S. Department of Transportation or other applicable regulatory agencies, including the government of any country through or into which the package will be transported.

3. This certificate is issued on the basis of a safety analysis report of the package design or application --

(1) Prepared by *(Name and address)*:	(2) Title and Identification of report or application:	(3) Date:
U.S. Department of Energy Savannah River Operations Office P.O. Box A Aiken, South Carolina 29808	Safety Analysis Report for Packaging Model 9975, S-SARP-G-00003, Revision 2, June 2013, as supplemented [See 5(e)]	June 2013

4. CONDITIONS

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

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

(a) Packaging

(1) Model: 9975

(2) Description:

The components of the packaging include the drum, insulation, bearing plates, primary containment vessel (PCV), secondary containment vessel (SCV), lead shielding, and aluminum honeycomb spacers. An aluminum PCV sleeve or 3013 top and bottom spacer may be used, depending on the type of product can to be transported. The nominal net weight of the packaging ranges from 350-374 lb. The drum is fabricated as a 35-gallon bolted lid drum of 18-gauge Type 304L stainless steel. Four ½-inch diameter vent holes are drilled into the drum, approximately 90 degrees apart, 1 inch below the drum flange and are covered with plastic Caplugs (fusible plugs). The plugging devices prevent water from entering the drum through the vent holes under normal conditions of transport. In the event a fire occurs, the plugs melt, allowing the drum to vent gases generated from the insulation to prevent rupture of the drum. The drum lid is bolted to a 1¼ inch wide by ⅛-inch thick angle flange welded to the top of the drum body using ½-inch high-strength bolts.

6a. Date of Issuance: 2/5/16	6b. Expiration Date: June 30, 2018
FOR THE U.S. DEPARTMENT OF ENERGY	
7a. Address *(of DOE Issuing Office)* U.S. Department of Energy Office of Packaging and Transportation, EM-33 1000 Independence Avenue, SW Washington, DC 20585	7b. Signature, Name, and Title *(of DOE Approving Official)* Frank Marcinowski Headquarters Certifying Official Acting Associate Principal Deputy Assistant Secretary for Environmental Management

The lid is recessed 0.55 inches. A ⅛-inch thick by 1¼ inch wide circular ring is welded to the outer section of the lid. The ring serves to reinforce the lid and prevents the lid from shearing away from the bolts during a hypothetical accident condition event. Nuts are tack welded to the flange underside to ease assembly operations. The bolts are tightened to 30 ± 2 ft-lbs of torque.

The insulation material that surrounds the containment vessels is fiberboard/Celotex® (cane or softwood, Type IV Grade 1 per ASTM C-208-95, density 14-16 lb/ft^3), which is manufactured per ASTM Specification C-208-95. The fiberboard is regular grade wall sheathing material with a nominal density of 15 lb/ft^3 and comes in ½-inch thick sheets that are bonded together into top and bottom subassemblies with a water-based carpenter's glue. The insulation subassemblies are fitted to the drum so that the radial clearances between the insulation, the lead cylinder, and the drum do not exceed ¼ inch. The radial thickness of the insulation is 4¾ inches. In the axial direction, the top thickness of fiberboard/Celotex® is 3.5 inches and the bottom thickness is 3.4 inches. Placed over and glued to the top fiberboard/Celotex® subassembly is an air shield made of stainless steel.

A ½ inch thick Firemaster® encapsulated blanket is placed between the top insulation subassembly and the drum closure lid. The blanket is manufactured from a ceramic fiber (Kaowool®), encapsulated in stainless steel foil and heat-sealed.

The radiation shielding configuration is a lead cylinder assembly that surrounds the PCV/SCV double containment assembly. The shielding assembly consists of an approximately 7¼-inch ID x 20-gauge 304L stainless steel cylinder with a 20-gauge bottom, surrounded by lead that is nominally ½ inch thick. An aluminum lid, ½ inch thick, completes the assembly. The lid has four equally spaced bolt holes near the edge for attachment to the cylinder body (¼-20 UNC threaded steel inserts). The shielding assembly has no lead top piece as the thicknesses of stainless steel in the PCV and SCV closure provide equivalent shielding. Alternate Lead Shielding Body design (Drawing R-R2-F-0020-C) incorporates a SS outer jacket.

Two ½-inch thick aluminum bearing plates are added to the packaging to provide additional load-bearing surfaces against the fiberboard/Celotex® insulation.

The PCV consists of a stainless steel pressure vessel that is designed, analyzed, and fabricated in accordance with Section III, Subsection NB of the ASME Boiler and Pressure Vessel Code (B&PVC), 1992 edition, with a design condition of 900 psig at 300°F. The PCV is fabricated from 5-inch, Schedule 40, seamless, Type 304L stainless steel pipe (0.258-inch nominal wall) and has a standard Schedule 40, Type 304L stainless steel pipe cap (0.258-inch nominal wall) at the blind end. A 304L stainless steel cone seal flange is welded at the open end. Both vessel body joints are circumferential full-penetration butt welds examined by radiographic and liquid penetrant methods. These welds satisfy ASME B&PVC Section III, Subsection NB requirements.

A 4-inch, Schedule 40 pipe of the same material is welded to the convex side of the cap to form a skirt to vertically support the PCV.

The PCV closure consists of a male-female cone joint with surfaces that have been machined to identical angles so that they mate with zero clearance. Two grooves for O-rings have been machined into the face of the Type 304L stainless steel male cone. A leak test port is provided between the two O-ring grooves. A small (0.063-inch wide by 0.06-inch deep) rectangular groove is recessed into the face of the male cone between the two O-ring grooves, to ensure helium detection during leakage testing. Two Viton® GLT and/or Viton® GLT-S fluoroelastomer O-rings (greased with high-vacuum silicone grease) are placed in the grooves to form a leaktight seal (less than 10^{-7} ref. cm^3/sec air). A Nitronic 60 seal nut, which forces the male cone against the female cone, is threaded into the containment vessel body. The PCV has a gross internal volume of approximately 313 inch^3, weighs 34 lbs, and is 18.6 inches long, with a usable inside cavity 15 inches deep with a minimum diameter of 5 inches. For certain oxide contents, the PCV (or PCV and SCV) is backfilled with an inert gas prior to closing.

An aluminum honeycomb spacer is inserted into the concave cavity of the PCV to provide a flat horizontal surface for the product cans. For some containment vessels, an additional bottom spacer is used.

The SCV consists of a stainless steel pressure vessel that is designed, analyzed, and fabricated in accordance with Section III, Subsection NB of the ASME B&PVC, 1992 edition, with design conditions of 800 psig at 300°F. The SCV is fabricated from 6-inch, Schedule 40, seamless, Type 304L stainless steel pipe (0.280-in nominal wall) and has a standard Schedule 40, Type 304L stainless steel pipe cap (0.280-inch nominal wall) at the blind end. A 304L stainless steel cone seal flange is welded at the open end. Both vessel body joints are circumferential full-penetration butt welds examined by radiographic and liquid penetrant methods. These welds satisfy ASME B&PVC Section III, Subsection NB requirements.

A 5-inch, Schedule 40 pipe of the same material is welded to the convex side of the cap to form a skirt to vertically support the SCV. The SCV closure is identical to that used on the PCV except that the SCV is 1 inch larger in diameter.

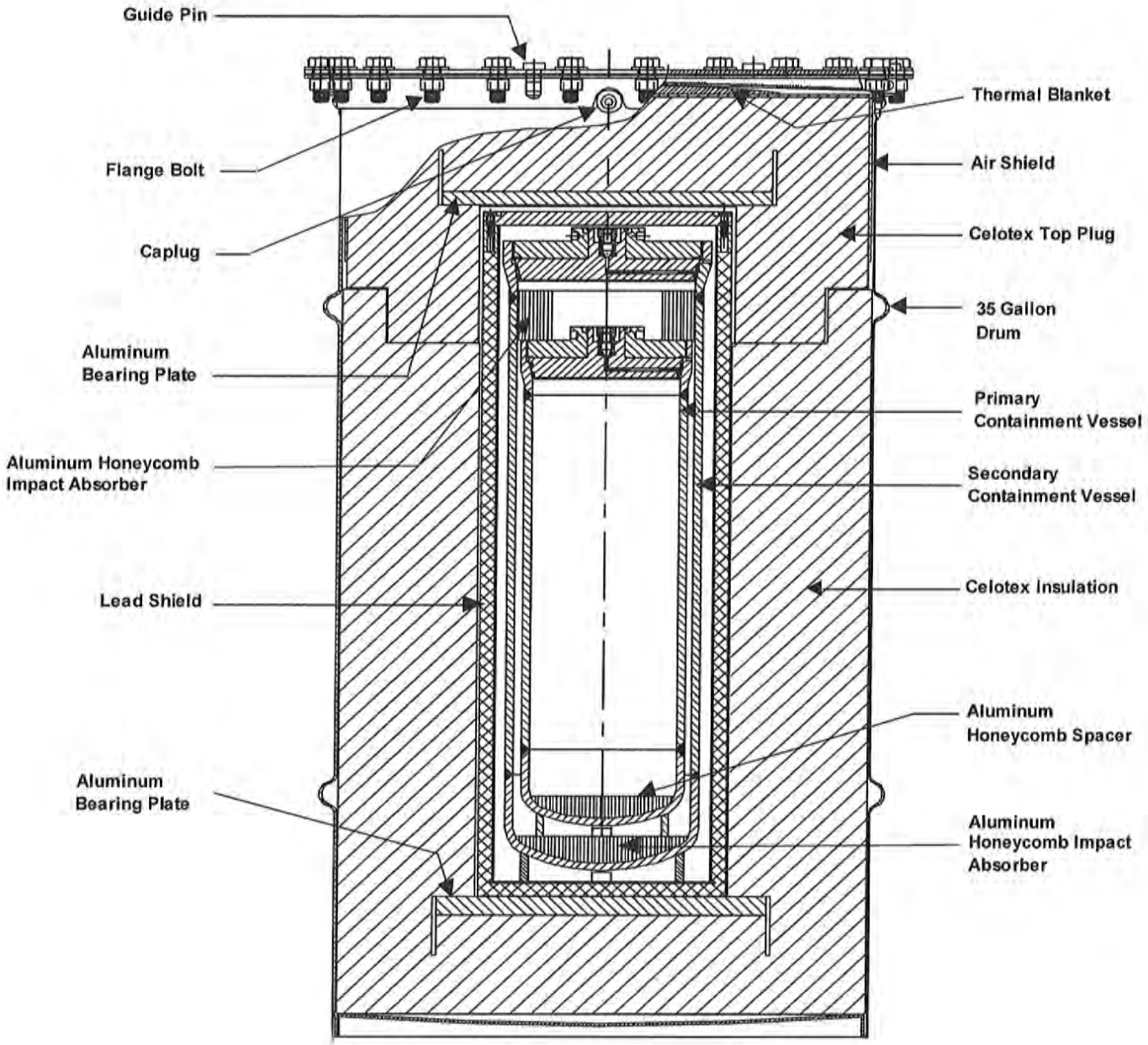
The SCV has a gross internal volume of approximately 604 inch^3, weighs 56 lbs, and is 24 inches long. It has a usable cavity approximately 21.5 in. deep, with a minimum diameter of 6 in.

The aluminum honeycomb impact absorbers that fit axially between the PCV and SCV are fabricated from 3-mil minimum foil thickness. The impact absorbers are rated for an axial compressive strength before deformation of 1500 ± 500 psi. The top impact absorber has the shape of a ring. The bottom impact absorber is machined on the bottom face to roughly fit the contour of the inside of the SCV.

In some cases for Content Envelope C.9, for added shielding, a Shielded-Pig Convenience Container configuration, with a machined lead pig and an engineered, aluminum convenience can, is placed inside the PCV, using top and bottom, aluminum honeycomb spacers [see 5(e)(1)].

Option to use the radiofrequency identification (RFID) system: The option to use the ARG-US RFID system is authorized. The RFID guide [See 5(e)(2)] provides procedures for using the ARG-US RFID system. The ARG-US RFID tag is not considered a part of the package. The ARG-US RFID tag is equipped with a suite of sensors to monitor seal integrity, temperature, humidity, shock, radiation, and battery status. The seal sensor is a thin flexible membrane that sits under the flange bolts of the drum cover when installed. The seal sensor may be credited as a Tamper-Indicating Device (TID) for enhanced security and safeguards, and the seal has been evaluated, and judged to be adequate, following the NRC Regulatory Guide 5.80 "Pressure Sensitive (PS) and Tamper Indicating Device Seals for Material Control and Accounting (MC&A) of Special Nuclear Material," dated December 2010. Therefore, the ARG-US RFID tag may be used as TID seal [See 5(e)(3)]. The ARG-US RFID tag has a robust plastic front cover and the stainless-steel back plate which provide adequate protection of the tag against damage under normal handling and transport. The tag weighs approximately 2.4 lb (with four batteries) and is approximately 8 inches wide x 7 inches high x 1.5 inches tall. Appendix B of the RFID guide provides documentation that the batteries used in the ARG-US RFID tag are not subject to the hazardous material regulations and also contains the Material/Product Safety Data Sheet for the batteries.

The performance evaluation documents the compliance of the 9975 package to the regulatory safety requirements for a Type B(M)F-96 package. No design change to the 9975 package was necessary for compliance to the -96 requirements. Therefore, 9975 packages currently labeled as USA/9975/B(M)F-85 meet the performance criteria for a Type B(M)F-96. The SARP consolidates the -85 packagings described in WSRC-SA-2002-00008 into one SARP bearing the document number S-SARP-G-00003 Revision 2.



9975 PACKAGING

(3) Drawings:

The packaging design is defined by the following Savannah River Site drawings:

Drawing No.	Rev	Title/Notes
R-R2-F-0026	5	9975 Shipping Package Drum with Flange Closure Assembly (U)
R-R2-F-0019	8	9975 Shipping Package Insulation Assembly, Subassemblies and Details (U)
R-R2-F-0020	11	9975 Shipping Package Shielding (U)
R-R2-F-0025	7	9975 Drum with Flange Closure Subassembly and Details (U) Sheets 1 &2
R-R2-F-0018	10	9975 Shipping Package Primary and Secondary Containment Vessel Subassemblies (U)
R-R3-F-0016	13	9975 Shipping Package Containment Vessel Weldments (U)
R-R3-F-0015	6	9975 Shipping Package Air Shield Weldment (U)
R-R4-F-0054	14	9975 Shipping Package Primary (PCV) & Secondary (SCV) Containment Vessel Details (U)
R-R4-F-0055	5	9975 Shipping Package PCV Sleeve and 3013 Top Spacer Details (U)
R-R2-F-0037	1	9975 Packaging Alternate 3013 Spacer Components Details (U)
R-R4-G-00047	1	U-233 Lead Pig Details and Subassembly (U)
R-R4-G-00048	1	U-233 Container Details and Subassembly (U)
R-R4-G-00051	3	U-233 Spacers (U)

(b) Contents:

(1) Type and Form of Material: (See Table 1)

(i) Uranium metal or oxide as specified in Content Envelope C.1.

(ii) Plutonium-238 heat sources as specified in Content Envelope C.2.

(iii) Plutonium and/or uranium metal as specified in Content Envelope C.3 or C.10.

(iv) Plutonium and/or uranium oxide as specified in Content Envelope C.4 or C.11.

(v) Plutonium composites as specified in Content Envelope C.5.

(vi) Plutonium/tantalum composites as specified in Content Envelope C.6.

(vii) Plutonium-238 oxide/beryllium metal as specified in Content Envelope C.7.

(viii) Neptunium oxide as specified in Content Envelope C.8.

(ix) Uranium 233 oxides and metals as specified in Content Envelope C.9.

Table 1 - Content Envelopes

	Material [a, b]	C.1 [c, d] U Metal/Oxide	C.2 ^{238}Pu Heat Sources	C.3 [d, e, f, g] Pu/U Metals	C.4 [e, g, h, i] Pu/U Oxides	C.5 [d, f, g, j] Pu Composites	C.6 [d, f, k] Pu/Ta Composites	C.7 ^{238}Pu Oxide/ Be Metal	C.8 [l] Neptunium Oxide
Radioisotope [m] (Weight Percent of Radioactive Material Mass)	^{236}Pu		1×10^{-4}					1×10^{-4}	
	^{238}Pu [n]		100	2	2	0.05	0.05	80	5×10^{-2}
	^{239}Pu [o]		40	100	100	100	100	40	gg
	^{240}Pu		13	50	50	6.5	6.5	13	gg
	^{241}Pu [o, p]		1	15	15	1	1	1	gg
	^{242}Pu		1.5	5	5	0.1	0.1	1.5	gg
	^{241}Am + ^{241}Pu		1	15	15	1	1	1	hh
	^{243}Am		1×10^{-4}	1×10^{-4}	1×10^{-4}	1×10^{-4}	1×10^{-4}	1×10^{-4}	
	^{244}Cm		1×10^{-4}	1×10^{-4}	1×10^{-4}	1×10^{-4}	1×10^{-4}	1×10^{-4}	
	^{237}Np		0.5	5.0	5.0				100
	^{232}U	1×10^{-5}	4×10^{-6}	1×10^{-5}	1×10^{-5}				
	^{233}U [o]	0.5	0.2	0.5	0.5				ii
	^{234}U [q]	100	40	100	100				ii
	^{235}U [o]	100	40	100	100				ii
	^{236}U	40	16	40	40				ii
	^{238}U	100	40	100	100				ii
	^{232}Th		10	23 [x]	23 [x]				ii
Impurities (grams)	Al, B, F, Li, Mg, Na			r	r				jj
	Be			500	500	4,400		200 [s]	jj
	V					4,400			jj
	Ta					4,400	6,000		jj
	C			1,000	1,000				jj
Total Mass (kilograms)	Radioactive Materials	13.5	0.1	4.4	4.4	4.4	2	0.02	6
	Impurities			3.08 [t]	3.08 [t]	4.4	6 [u, v]	0.2	0.15
	All Contents	13.5	0.1	4.4	5	4.4	8	0.22	6.81

Table 1 - Content Envelope (Continued)

	Material [a,b]	C.9 ^{233}U Metal/ Oxides grams	C.10 [d,e,f,g] P/U Metals grams	C.11 [e,g,h,i] Pu/U Oxides grams
Radioisotope [m] (Radioactive Material Mass Grams)	^{236}Pu [z]			
	^{238}Pu [n]		34	34
	^{239}Pu [o]	aa	4400	4400
	^{240}Pu	bb	1450 [y]	2200
	^{241}Pu [o, p]	bb	188.9	188.9
	^{242}Pu		400 [y]	2200
	$^{241}Am + ^{241}Pu$	bb	188.9	188.9
	^{243}Am		1.00	1.00
	^{244}Cm		0.0044	0.0044
	^{237}Np		220	220
	^{232}U	0.0018 [cc]	0.00044	0.00044
	^{233}U [o]	500 [dd]	427	427
	^{234}U [q]	aa	4400	4400
	^{235}U [o]	aa	4400	4400
	^{236}U	4400	2640	2640
	^{238}U	4400	4400	4400
	^{232}Th		4400	4400
Impurities [ee] (grams)	Al, B, F, Li, Mg, Na		r	r
	Be		500	500
	V			
	Ta			
	C		1000	1000
Total Mass (kilograms)	Radioactive Materials	4.4	4.4	4.4
	Impurities		3.08 [t]	3.08 [t]
	All Contents	4.4	4.4	5

Table 1 – Table Notes

a	Except as permitted for oxides, all contents shall be dry.
b	Pu/U content bulk density shall be no greater than 19.84 g/cc. No minimum bulk density is specified. However, low bulk densities require dilution of the local atmosphere within the content container by a specific gas (helium or nitrogen) and/or reduction in the allowable decay heat as summarized in Table 3.4 of SARP.
c	Up to 1 gram of plutonium contamination is permitted.
d	Each unclad metal piece shall have a minimum thickness of 1.0 mm (0.04 inches) and a specific surface area less than 100 mm^2/gram (71 in^2/lb) per DOE-STD-3013-2004. A minimum 50-gram mass per metal piece conservatively meets these criteria.
e	Mass limit due to shielding. The heat loading of each mixture needs to be determined. The 188.9 gram limit based on estimate of heat load from WCID-2009-0002 Revision 0.
f	Contents shall be stabilized in accordance with DOE-STD-3013-2004, Section 6.1. Engineered metal materials with intact cladding meet the requirements for stabilized metals under content envelopes C.3 and C.10
g	Plutonium plus uranium mass shall not be less than 30 weight percent of the total content mass.
h	Contents shall be stabilized in accordance with DOE-STD-3013-2004, Section 6.1. Engineered oxide materials with intact cladding meet the requirements for stabilized oxides under content envelopes C.4 and C.11
i	The moisture content of the oxide shall be less than 0.5 weight percent of the total content mass.
j	Depleted Uranium or Enriched Uranium may be substituted for any amount of plutonium on a gram-for gram basis.
k	The Be, V, and Ta each form a composite with the radionuclide content and, as such, are not homogeneously mixed with the Pu. A maximum of 50 pieces of composite material is permitted.
l	Material to be prepared in accordance with WSRC-TR-2003-00388 which limits the moisture content of the material.
m	Maximum amounts by constituent.
n	^{238}Pu decays to ^{234}U, which will result in significant concentrations of ^{234}U over time. ^{234}U growth will not adversely impact package performance.
o	Nuclide classified as "fissile" per DOE Good Practices Guide, Criticality Safety Good Practices Program, Guide For DOE Nonreactor Nuclear Facilities, DOE G 421.1-1, 3.79 *Fissile Nuclide*, 8-25-99.
p	^{241}Pu must be less than ^{240}Pu.
q	Applies to ^{234}U other than ^{234}U resulting from ^{238}Pu decay.
r	The listed light element impurities have a combined mass limit of 3080 grams minus the mass of Be and C present.
s	The beryllium is assumed to be physically separated from the plutonium oxide. The 200 grams of beryllium can be in any configuration with up to 275 cm^2 in direct contact with plutonium contents. The surface area restriction is based on shielding.
t	Total impurity limit is based on the minimum 30% Pu + U mass within DOE-STD-3013-2004. The limit was calculated from the maximum radioactive material mass (4.4 kg). [4.4 kg × 70% = 3.08 kg]

Table 1 – Table Notes (continued)

u	Plutonium mass is assumed bonded to the tantalum (as an outer/inner reflector) and is not readily separable.
v	For analytical purposes there are no mixing assumptions for the Ta with the radionuclide content.
w	Reserved
x	Not to exceed 1000 grams total ^{232}Th.
y	The ^{240}Pu and the ^{242}Pu mass limits may be adjusted per the equation: ^{242}Pu + 0.596 ^{240}Pu < 1290, Where ^{240}Pu and ^{242}Pu are the mass limits in grams.
z	^{236}Pu is not expected to be present in significant amounts
aa	These isotopes may be present as long as their contribution as equivalent ^{233}U in the package combined with the actual ^{233}U content present does not exceed the ^{233}U mass content limit. The "equivalent ^{233}U" mass is given by the equation ^{233}U(eq) = ^{233}U + ^{235}U/1.4 + ^{239}Pu/0.83 for the three primary fissile isotopes where each isotope name indicates the mass of that isotope. Any ^{234}U present shall be considered ^{233}U for this equation.
bb	Small quantities (< 1 g) of these isotopes may be present as long as the ^{240}Pu mass exceeds the ^{241}Pu mass, their combined mass is less than the ^{239}Pu mass, and these isotopes are treated as ^{239}Pu mass in the determination of ^{233}U(eq) mass.
cc	0.0018 grams is the limiting mass of ^{232}U based on the 9975 package shielding. This mass limit increases to 0.0101 gram if the material is shipped in the Shielded-Pig Convenience Container Configuration (Figure 1.8).
dd	This mass value is the minimum subcritical mass limit for ^{233}U (ANSI/ANS-8.1).
ee	When present, nickel is plating used to fix contamination on the welded stainless steel capsule encasing the uranium source material for content envelope C.9
ff	^{237}Np must comprise at least 97.5 % weight percent of the Radioactive Material Mass
gg	The listed plutonium isotopes have a combined mass limit of 6.11×10^{-2} Wt % of the Radioactive Material Mass minus the mass of ^{238}Pu present
hh	Random material sampling for ^{241}Am has shown that the levels are "Less than Detectable". Since ^{241}Am is only a shielding concern, conformance to 10 FR 71 dose rate limits shall be demonstrated through the Dose Rate Measurement Methodology described in the 9975 SARP. Therefore the measurement of ^{241}Am is not required. The ^{241}Pu limit in Table note gg applies.
ii	The total amount of all radioisotopes other than neptunium must be less than 2.5 wt %. For plutonium isotopes, the more restrictive limits of Table note gg apply.
jj	The total non-radioactive impurities must be less than 2.2 wt% of the neptunium oxide mass.

(2) Maximum Quantity of Material per Package: as specified in Tables 1, 2 or 3.

(i) For all Content Envelopes:

(a) The maximum decay heat per package may not exceed 19 watts. Content envelopes C.4 and C.11 are shown in Table 2 below for the decay heat limits.

Table 2. Requirements for Local Atmosphere Dilution and Decay Heat

C.4 &C.11 Density (g/cm^3)	Local Atmospheres Inside PCV		Maximum Decay Heat (Watts)
	Inside Content Container	Outside Content Container	
2.0 to 19.84	N_2 or Helium dilution to: ≤ 5% O_2	≥ 75% CO_2 ≤ 25% air	19
1.0 to < 2.0	Helium dilution to: ≤ 5% O_2	↓	19
1.0 to < 2.0	N_2 dilution to: ≤ 5% O_2	↓	18
< 1.0	Helium dilution to: ≤ 5% O_2	↓	18.4
< 1.0	N_2 dilution to: ≤ 5% O_2	↓	16.5

The maximum weight of all material (radioactive contents, product cans, spacer, shielded pig, etc.) inside the PCV may not exceed 20.1 kg (44.4 lbs).

(c) Except as permitted for oxides, all contents shall be dry.

(d) Pu/U content bulk density shall be no greater than 19.84 g/cc. No minimum bulk density is specified. However, low bulk densities may require dilution of the local atmosphere within the content container by a specific gas (helium or nitrogen) and/or reduction in the allowable decay heat as summarized in Table 3.4 of the SARP. Not applicable to Content Envelope C.9.

(e) Except as stated in Table 1, small concentrations (<1000 ppm each) of other actinides, fission products, decay products, and neutron activation products are permitted.

(ii) For Content Envelope C.1:

(a) Up to 1 gram of plutonium contamination is permitted.

(b) Each metal piece shall have a minimum thickness of 1.0 mm (0.04 inches) and a specific surface area less than 100 mm^2/g (71 in^2/lb) per DOE-STD-3013-2004.

(iii) For Content Envelopes C.3 or C.10:

(a) Each unclad metal piece shall have a minimum thickness of 1.0 mm (0.04 inches) and a specific surface area less than 100 mm^2/g (71 in^2/lb) per DOE-STD-3013-2004.

(b) Contents shall be stabilized in accordance with DOE-STD-3013-2004, Section 6.1. Engineered metal materials with intact cladding meet the requirements for stabilized metals under content envelopes C.3 and C.10.

(c) Plutonium plus uranium mass may not be less than 30 weight percent of the total content mass.

(iv) For Content Envelopes C.4 or C.11:

(a) Plutonium plus uranium mass may not be less than 30 weight percent of the total content mass.

(b) Contents shall be stabilized in accordance with DOE-STD-3013-2004, Section 6.1. Engineered oxide materials with intact cladding meet the requirements for stabilized

oxides under content envelopes C.4 and C.11.

(c) The moisture content of the oxide shall be less than 0.5 weight percent of the total content mass.

(d) The PCV sleeve for food-pa*ck* can configurations is not required when the outer food-pack can diameter exceeds 4.38 inches and the PCV shall be inerted with nitrogen so that at the time of closure the oxygen content is all void spaces is no greater than 5% by volume.[See Addendum, 5(e)(4)]. For oxide contents under this configuration without the PCV sleeve the total mass of empty food-pack cans must be less than 9,000 grams.

(v) For Content Envelope C.5:

(a) Each metal piece shall have a minimum thickness of 1.0 mm (0.04 inches) and a specific surface area less than 100 mm^2/g (71 in^2/lb) per DOE-STD-3013-2004.

(b) Contents shall be stabilized in accordance with DOE-STD-3013-2004, Section 6.1.1.

(c) Plutonium plus uranium mass may not be less than 30 weight percent of the total content mass.

(d) Depleted uranium or enriched uranium may be substituted for any amount of plutonium on a gram-for-gram basis.

(vi) For Content Envelope C.6:

(a) Each metal piece shall have a minimum thickness of 1.0 mm (0.04 inches) and a specific surface area less than 100 mm^2/g (71 in^2/lb) per DOE-STD-3013-2004.

(b) Contents shall be stabilized in accordance with DOE-STD-3013-2004, Section 6.1.1.

(c) A maximum of 50 pieces of composite material is permitted.

(vii) For Content Envelope C.7:

(a) The 200 grams of beryllium can be in any configuration with up to 275 cm^2 in direct contact with plutonium contents.

(viii) For Content Envelope C.8:

(a) Material shall be prepared in accordance with WSRC-TR-2003-00388, which limits the moisture content of the material.

(b) A total of 100 grams of plastic may be present as low-density polyethylene bags or nylon bagging and polyvinyl chloride tape.

(c) Use of the PCV sleeve or aluminum foil packing material is prohibited.

(d) Metal mass of food-pack cans is restricted to 1,000 grams.

(e) ^{240}Pu content must be greater than the ^{241}Pu content.

(f) The measured Loss on Ignition (LOI) of the product must be less than 0.24 wt.%.

(g) Neptunium Oxide content must have a measured assay of at least 86.2 wt.% neptunium, which corresponds to at least 97.5% neptunium of the total radioactive material.

(h) The total plutonium content must not exceed 611 micrograms per gram of neptunium.

(i) The total plutonium α (alpha) activity must not exceed 8,580 microcuries per gram of neptunium.

(j) The total non-radioactive impurities must be less than 2.2 wt.% of the oxide mass.

(j) All containers (food-pack cans, PCV, and SCV) shall be inerted with argon, such that

oxygen content in all void spaces is no greater than 3% by volume at closure.

(ix) For Content Envelope C.9:

(a) PCV bottom spacer is required.

(b) Shipments are not authorized in a 3013 or Hex-can

(c) If ≤ 0.0018 grams ^{232}U contents can be in Food-Pack Can. The food-pack can have a maximum of 100 g plastic. Aluminum pellets or foil for packaging is allowed.

(d) If > 0.0018 grams and ≤ 0.0101 grams ^{232}U or determined by dose-rate measurements the Shielded-Pig Convenience Container will be used. The Shielded-Pig and aluminum convenience can manufactured per listed Addendum 2 drawing are required. PCV spacers replaced by Shielded-Pig honeycomb spacers manufactured per the listed Addendum 2 drawing.

(x) For the shipment of plutonium/uranium mixed oxide in plastic bottles [See Addendum 5(e)(5)]: A typical plastic bottle configuration within the PCV for plutonium oxide contents is shown in Figure 1.1 of the June 2013 Addendum [See 5(e)(5)]. The maximum content loading for packages with plastic bottle configurations is 2,314 grams of plutonium/uranium mixed oxide with up to 410 grams of Plutonium as Pu-239, and 1,580 grams of Uranium as U-235. The radionuclide isotopic distribution is limited to that described in Table 1, Column C.4. Non radionuclide impurities are limited to those described in Table 1, Column C.4. Radionuclides not described in Table 1, Column C.4 are limited to 1000 ppm. The following conditions apply.

(a) The maximum amount of plastic materials in the PCV, including high-density polyethylene, low-density polyethylene, or polyvinyl chloride bottles, low-density polyethylene bagging, and polyvinyl chloride tape, shall be no more than 200 grams.

(b) The plastic bottle shall be placed into a filtered stainless steel or tin-plated carbon steel can. The filtered can shall have a particle removal efficiency of greater than 99% for 5-micron or larger particulates. A perforated stainless steel or tin-plated carbon steel can shall be placed below the filtered can, as a dunnage.

(c) Only one 1,000-mL plastic bottle can be loaded into a 9975 package. The maximum amount of PuO_2 shall be less than 240 grams in each 9975 package.

(d) There must be free communication of gases between the PCV, the steel cans, the plastic bags, and the plastic bottle placed into the PCV.

(e) At the time of closure of the PCV, all void spaces in the PCV, including the void spaces inside the steel cans, the plastic bottles and the plastic bags, shall be inerted with nitrogen so that the initial oxygen concentration is below a selected value of either 1 vol. % or 2 vol.%.

(f) The shipping period of the 9975 package shall be determined on the basis of the moisture level in the mixed oxide (MOX) and the initial oxygen concentration, as shown in Table 3. The shipping period is from the time of PCV closure to the time of delivery.

Table. 3 – Shipping Period Based on Nitrogen Inerting, Moisture Level in MOX and Initial Oxygen Concentration

Moisture (wt%)	Shipping Period (Days)	
	1% initial O_2 (10,000 ppm)	2% initial O_2 (20,000 ppm)
2.42	18	12
2.0	23	15
1.5	32	20
1.0	51	33
.54	115	74
.50	129	83

(c) Minimum Transport Index for Criticality Control (Criticality Safety Index): 2.0

(d) Conditions:

(1) Content envelope loading arrangements/configurations shall comply with the applicable requirements of Sections 1.2.3.1 and 1.2.3.2 of the SARP.

(2) Food-pack cans with organic liners may not be used for any contents.

(3) All food-pack, 3013, or hex cans must be examined for post-sealing bulging or buckling prior to placement inside the PCV. No can that has visibly bulged or buckled may be transported in the package.

(4) Inspect radioactive material outer product containers, i.e., food-pack, 3013, or hex cans, upon removal from the PCV after shipment. Any visible bulging, buckling, or evidence of corrosion on the exterior shall be reported to the Design Agency (DA). The DA shall report to the DOE Headquarters Certifying Official any condition the DA deems significant to safety.

(5) The gross weight of the package may not exceed 404 lbs.

(6) For the contents described in 5(b)(1)(v), any package that is subjected to an impact greater than that of a four-foot drop shall be surveyed for neutron dose rate prior to contact or handling.

(7) In addition to the requirements of Subparts G and H of 10 CFR Part 71, and except as specified in section 5(d) of this certificate, each package must be fabricated, acceptance tested, operated, and maintained in accordance with the Operating Procedures requirements of Chapter 7, Acceptance Tests and Maintenance Program requirements of Chapter 8, and packaging-specific Quality Assurance requirements of Chapter 9 of the SARP [See 5(e)].

(8) Transport by air of fissile material is not authorized.

(9) If the option is chosen to attach a ARG-US RFID tag to the 9975 packaging, the operating procedures must follow the additional steps per Chapter 7 of the SARP, and the guide to RFID monitoring system [See 5(e)(2) and 5(e)(3)]. The RFID guide contains a copy of the Material/Product Safety Data Sheet for the batteries used in the ARG-US RFID tag, which provides guidance on the safe use of the batteries.

(10) Reserved.

(11) 9975-85 packaging must be upgraded to 9975-96 packaging in accordance with Section 8.2 of the SARP, prior to use for transport.

(12) All commercial-grade dedication shall be approved by the design authority.

(13) Revisions 11 and 12 of this certificate may be used until January 31, 2017 for domestic shipments of 9975-96 packages. Revisions 9, 10, 11, and 12 of this certificate may be used until June 30,

2018 when endorsed by DOT Competent Authority Certification (certificate), for international shipments to the USA of 9975-96 packages.

(14) For the shipment of plutonium/uranium mixed oxides in plastic bottles as detailed in 5(b)(2)(x) and Addendum referenced in 5(e)(5), all conditions listed in section 5(b)(2)(x) shall be followed. The Addendum Conditions 1 and 2 in Chapter 1 on page 7 of 54 are not authorized for use. Only 9975 packages certified as "-96" packages shall be used for these shipments. If an abnormality is detected during or after shipment and prior to or upon opening the PCV, or if the shipping period specified in Table 3 is violated, the package shall be placed in a secure area, and a non-conformance report shall be written, evaluated, and dispositioned. In addition, the regulatory agency having jurisdiction shall be notified. When used outside of the United States, the applicable regulatory authority shall review and approve in writing the approval conditions listed in section 5(b)(2)(x).

(e) References

(1) Safety Analysis Report for Packaging Model 9975, S-SARP-G-00003, Revision 2, June 2013

(2) *Guide to the RFID Monitoring System (Models 9975, 9977, and 9978 Packages)*, Argonne National Laboratory, ANL/DIS-09-5, December 3, 2009.

(3) DOE Packaging Certification Program Qualification/Accreditation of ARG-US Tag as TID Seal, July 30, 2012.

(4) Justification for Shipment of Plutonium Oxide in Large Vented Food-Pack Cans, Safety Analysis Report for Packaging Model 9975, Addendum, S-SARA-G-00013, Revision 1, May 2011.

(5) Safety Analysis Report for Packaging Model 9975, Addendum, Shipment of Plutonium/Uranium Mixed Oxide in Plastic Bottles, S-SARA-G-00015, Revision 3, June 2013

(6) Safety Analysis Report for Packaging Model 9975, S-SARP-G-00003, Revision 3, July 2014

(7) Safety Analysis Report for Packaging Model 9975, S-SARP-G-00003, Revision 4, Page Changes (final), December 17, 2015 (approval date).