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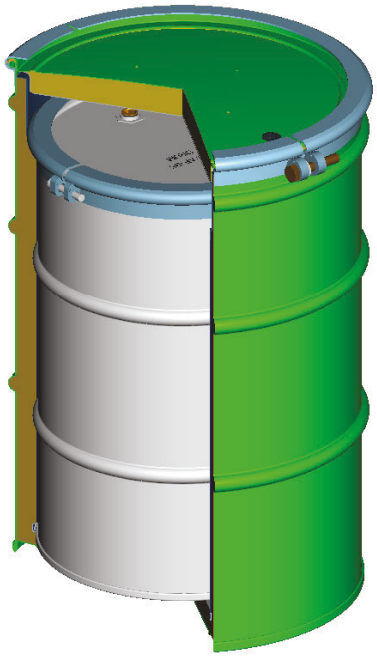
S-SARP-G-00006
Revision 7

Safety Analysis Report for Packagings

Model 9979
Type AF Shipping Package



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Disclaimer:

APPROVALS

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REVISION LOG

Revision #	Date	Description
0	2/27/2009	Initial release
1	5/12/2010	Q1 Response Incorporation
2	October 2011	Issued for Release
3	July 2013	Issued for Regulatory Review; added LEU Contents
4	March 2015	Issued for Release
5	February 2018	Issued for Release
6	N/A	Not Issued.
7	December 2020	Issued for Release (Dockets 19-06-9979 & 19-77-9979)

Preface

This Safety Analysis Report for Packaging (SARP) documents the performance of the Department of Energy (DOE) Model USA/9979/AF-96 shipping package and compliance with the regulatory safety requirements of Title 10 and Title 49 of the Code of Federal Regulations. The SARP is prepared in accordance with U.S. Department of Energy (DOE) Order 460.1D.

The Model 9979 Type A Fissile shipping package replaces the Department of Transportation (DOT) UN1A2 Specification Packaging. Formerly, the UN1A2 was authorized under Title 49 of the Code of Federal Regulations, Section 173.417 (2004) for transport of Type A quantities of fissile material over public highways.

In accordance with the Federal Register, final rule making issued on January 26, 2004, the Nuclear Regulatory Commission, in a joint effort with the Department of Transportation, initiated a planned phase out of multiple Specification Packagings from 49 CFR 173, the UN1A2 being one. The rulemaking mandated, by law, removal of these specification packagings from service no later than September 30, 2008. The 9979 is a Performance Packaging and replaces the UN1A2 Specification Packaging.

The Packaging Technology and Transportation Engineering (PT&TE) organization of the Savannah River National Laboratory (SRNL) is the Design Authority and Design Agency for the 9979.

ACRONYMS AND ABBREVIATIONS

ALARA	As Low as Reasonably Achievable
ANSI	American National Standards Institute
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
B&PVC	Boiler and Pressure Vessel Code
CG	Center of Gravity
CL	Centerline
CoC	Certificate of Compliance
CFR	Code of Federal Regulations
CQF	Cognizant Quality Function
CRCQ	Cold Rolled Commercial Quality
CS	Carbon Steel
CSI	Criticality Safety Index
DOE	U.S. Department of Energy
EPDM	Ethylene Propylene Diene M-class
LEU	Low Enriched Uranium
HAC	Hypothetical Accident Conditions
HCO	Headquarters Certifying Official
HEPA	High Efficiency Particulate Air
HEU	High Enriched Uranium
IAEA	International Atomic Energy Agency
NCSE	Nuclear Criticality Safety Evaluation
MNOP	Maximum Normal Operating Pressure
MP/T	MSC.PATRAN/THERMAL®
NCT	Normal Conditions of Transport
NNSA	National Nuclear Security Administration
NRC	Nuclear Regulatory Commission
QA	Quality Assurance
POP	Plutonium Oxide Pod
PRG	Packaging Review Guide
PSD	Power Spectral Density
PSI	Pounds per Square Inch
PT&TE	Packaging Technology and Transportation Engineering
RG	Regulatory Guides
SAR	Safety Analysis Report
SARP	Safety Analysis Report for Packagings
SHSC	Socket Head Screw
SNM	Special Nuclear Materials
SRNL	Savannah River National Laboratory
SRNS	Savannah River Nuclear Solutions
SS	Stainless Steel
SST/SGT	Safe Secure Trailer/Safeguards Transporters

TI	Transport Index
TID	Tamper Indicating Device
UN	United Nations
U-FGE	Uranium-Fissile Gram Equivalent
UNC	Unified National Course
WAC	Waste Acceptance Criteria
WIPP	Waste Isolation Pilot Plant
WSMS	Washington Safety Management Solutions

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Safety Analysis Report – 9979 Type AF Packaging

CHAPTER 1

GENERAL INFORMATION

Preface

This chapter presents a general description of the 9979 Type AF Shipping Package, the contents that have been evaluated as its payload, acceptable payload shipping configurations and features special to its use. This Safety Analysis Report for Packaging (SARP) documents compliance with the regulatory safety requirements of Title 49 of the Code of Federal Regulations (CFR) Part 173[1] and Title 10 of the Code of Federal Regulations Part 71[2] and is prepared in accordance with U.S. Department of Energy (DOE) Order 460.1D [3] and in the format specified in the Nuclear Regulatory Commission (NRC) Regulatory Guides (RGs) 7.9 and 7.10.[4,5]

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

1.0 GENERAL INFORMATION

1.1 INTRODUCTION

The results of analysis and testing of the 9979 design presented in this SARP demonstrate compliance with the regulatory safety requirements for Type A fissile packages specified in 49 CFR 173 and 10 CFR 71.

Heat transfer from the 9979 contents to the ambient surroundings is passive. The maximum nuclear Criticality Safety Index (CSI) calculated for the package is 1.0 based on the content mass and number of packages shipped in one conveyance. The calculated Transport Indexes (TI) are 0.7 for Table 1.2, 0.7 for Table 1.3, 0.3 for Table 1.4, and 12.3 for Table 1.5, however, the TI to be placed on the package label is established by measurement at time of shipment. Packages may be shipped by commercial carrier (in a closed or covered conveyance) under non-exclusive use as determined by DOE Order 470.4B Change 2 (MinChg)[6] for Table 1.2 - Table 1.4. Packages containing Table 1.5 contents shall be shipped under exclusive use in accordance with the requirements of 49 CFR 173.441 and S-SARP-G-00006 Chapter 7.

The radioactive contents of the 9979 are limited to one A_1 or A_2. Therefore the 9979 design is not governed by the activity release limits specified as additional requirements for Type B packages per 10 CFR 71.51.

1.2 PACKAGE DESCRIPTION

The 9979 is an extension of a drum style package and is designed to ship fissile Uranium metals, oxides and other solid compounds totaling less than one A_1 or A2.

1.2.1 Packaging

The 9979 packaging assembly is defined by Drawing R-R1-G-00030 given in Appendix 1.1 and is illustrated in Figure 1.1. Figure 1.2 shows the general dimensions of an empty packaging assembly.

The 9979 is comprised of two primary assemblies: an insulated 55-gallon drum overpack and an internal 30-gallon drum. The 55-gallon drum overpack incorporates a steel liner which serves as the form for polyurethane foam that provides thermal insulation and structural support. The 30-gallon drum, positioned centrally (both radially and axially) within the 55-gallon overpack liner, secures the payload and provides containment for the radioactive contents. Table 2.4 lists detailed material specifications. Section 9.3, Packaging Design Control, specifies how the packaging design is controlled.

Reinforced split-ring devices provide secure closures for the 30- and 55-gallon drums. There are no external impact limiters or other energy-absorbing features, nor any engineered structural features for lifting or tie-down.

Two weights limits are applicable to the 9979. The gross weight of a fully loaded 9979 package shall not exceed 415 lb. The package contents including radioactive material is limited to 200 lb. Component weights are, unless otherwise specified, based on the materials and nominal dimensions documented on the Engineering Drawings, Appendix 1.1. These weights agree with those measured for prototype packagings. Nominal and maximum estimated weights of the packaging components are reported in Section 2.1.3.

The content envelope limits, listed in Tables 1.2, 1.3, 1.4, and 1.5, restrict package contents to materials with low decay-heat rates.

The 30-gallon drum closure lid includes a pressure relief device to ensure that an over pressure condition does not occur during transport. This device does not permit continuous venting under normal conditions of transport.

The 9979 design does not incorporate any specific shielding features. Distance between the contents and points external to the package provides sufficient dose-rate attenuation. Chapter 5 quantifies dose rates under Normal Conditions of Transport (NCT).

The 9979 design does not incorporate any specific criticality-control features. The 9979 design ensures subcriticality by limiting package contents and maintaining a minimum distance between adjacent fissile material sources. Chapter 6 explains how these restrictions prevent the criticality of both single packages and arrays of packages under NCT and under HAC-damaged package conditions.

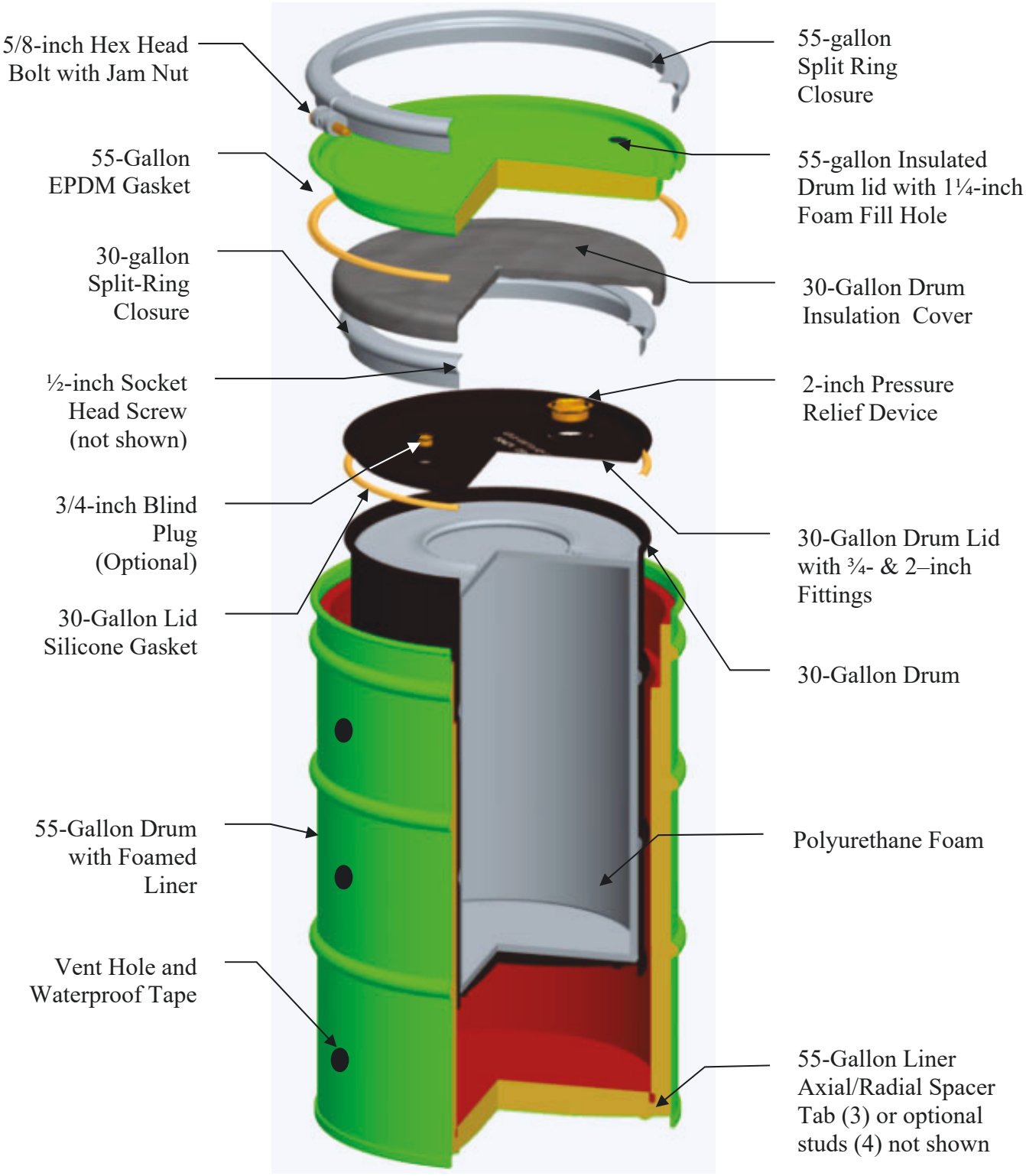

Figure 1.1 – 9979 Type AF Shipping Packaging Configuration

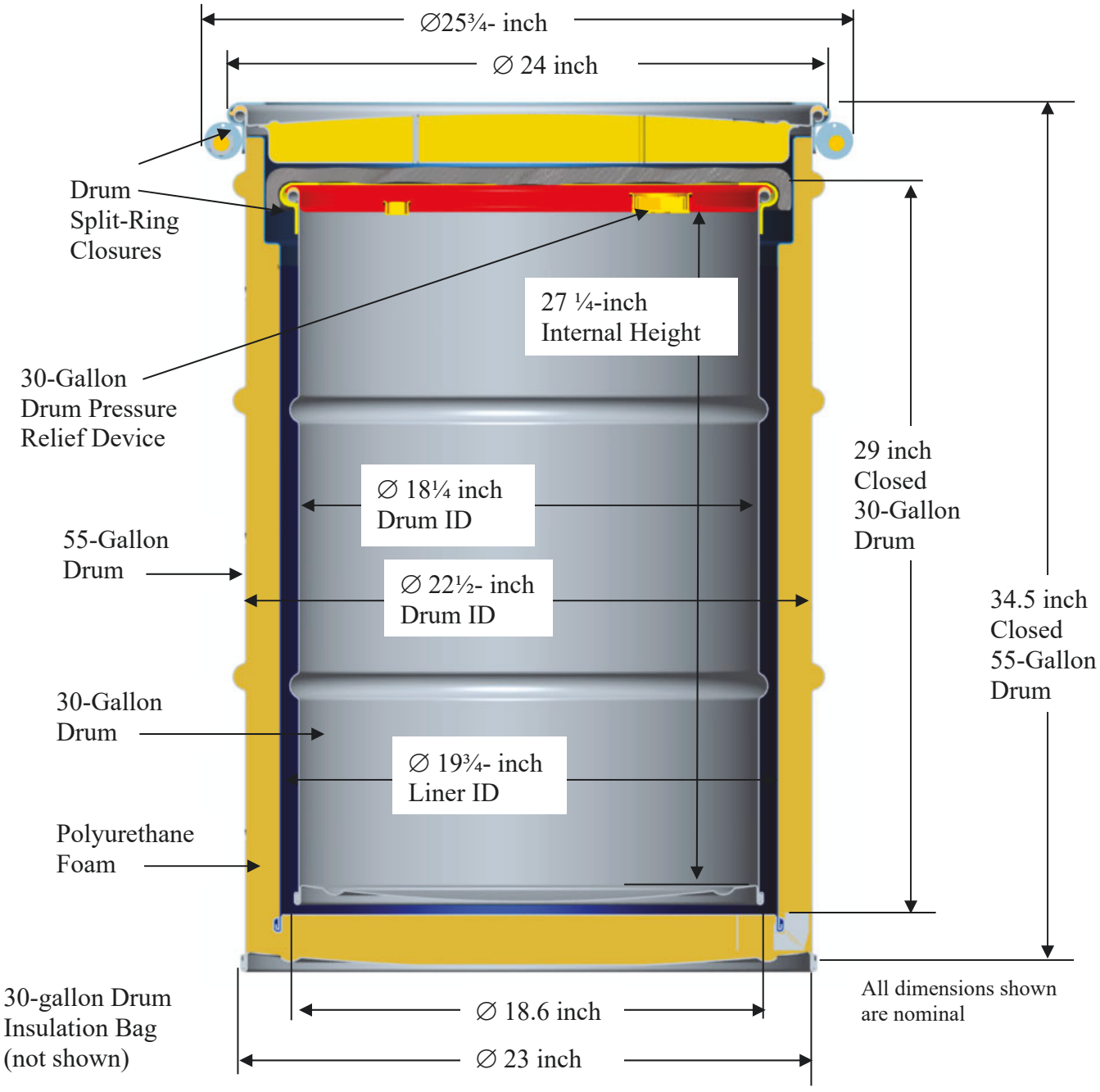

Figure 1.2 – 9979 Packaging General Dimensions

1.2.1.1 Drums and Closures

The 9979 Type AF packaging design incorporates two commercial removable-head drums (30- and 55-gallon) produced in accordance with *standards for steel drums* per 49 CFR 178.504, except marking per 178.504(b)(1) is not required. The drums used comply with applicable provisions for 7A Type A packaging in 49 CFR 178.350. The 55-gallon drum is modified to include a steel liner welded to the inside of the drum body and under its closure lid. Polyurethane foam insulation fills the cavities formed between the liner and drum/lid components. The insulated 55-gallon drum functions as an overpack enclosing the 30-gallon drum. The 30-gallon drum assembly functions as the containment boundary for the package's radioactive contents.

55-Gallon Drum Overpack

The general outside dimensions of the closed 55-gallon overpack are approximately 24 inches in diameter by 34½ inches high. The 55-gallon drum body and lid both incorporate liners fabricated from carbon steel. The liner assemblies are welded to the inside of the drum body and lid forming cavities which are filled with 24 lb/ft^3 Dow Automotive polyurethane foam, called BETAFOAM™. Nondestructive methods are used to verify complete filling of each 55-gallon drum body and drum lid.

The drum body is fabricated from 16 gauge carbon steel and the welded liner is fabricated from 16 and 18 gauge carbon steel. The 55-gallon closure lid and its liner are fabricated from 16 gauge carbon steel. The cavities formed by the liner between the drum and lid is filled with the 24 lb/ft^3 Dow Automotive polyurethane foam (i.e., BETAFOAM™). The polyurethane foam is used for thermal insulation and energy (shock) absorption. The weight of the 55-gallon drum overpack without its lid is approximately 140 lbs. The 55-gallon drum lid weighs approximately 24 lbs. When installed the lid assembly extends into the drum body liner. An ethylene propylene diene M-class (EPDM) gasket seals the overpack closure. Figure 1.2 illustrates the overpack assembly, and Drawings R-R2-G-00057 and R-R2-G-00059, given in Appendix 1.1, define the design.

The drum body and lid include external penetrations that permit venting of gases generated from the thermal decomposition of the polyurethane foam in a fire. The 55-gallon drum wall includes nine ½-inch holes uniformly spaced axially and circumferentially. Two holes are placed in the bottom of the drum, a 1¼-inch diameter hole used for filling the drum with foam and a ½-inch hole used for a vent. The drum lid includes a single 1¼-inch diameter hole used for filling the lid with foam. All holes are covered with a waterproof tape to prevent water or moisture from entering the drum through the holes under NCT, even though the polyurethane foam is not functionally affected by the presence of moisture. During the HAC-fire the tape disintegrates.

The overpack assembly is closed with a split-ring closure device which secures the closure lid to the drum. The closure consists of two identical half or split-rings fabricated from 12-gauge carbon steel connected by bolted lugs. The closure device is similar to standard commercial C-ring closures used on commercial open-head drums but is halved and incorporates two 1-inch flange extensions, one extending horizontally and the other vertically from the C-ring. Lugs are welded at each end of the two split ring. Each split-ring is identical, with one 1½-inch lug threaded with ⅝-11UNC-2B thread and the other with a ¾-inch diameter through hole. The closure device secures the closure lid to the drum via two 3½ inch long, ⅝ carbon

steel hex head bolts and jam nuts. Each lug includes a 0.13-inch hole to receive a tamper-indicating device (TID) as defined in Drawing R-R1-G-00027, given in Appendix 1.1. The 55-gallon split-ring closure weighs approximately 9.8 lb. Figure 1.3 shows a split-ring closure device installed on a 55-gallon drum overpack.

The nominal weight of the 9979 55-gallon overpack assembly (body, closure lid and split-ring closure device) is 174.5 lb, Drawing R-R1-G-00029, Appendix 1.1.

30-Gallon Containment Drum

The general outside dimensions of the closed 30-gallon drum are 18.6 inches in diameter by 29 inches high, see Figure 1.2. The drum and its closure lid are fabricated from 18- and16-gauge carbon steel, respectively. The lid incorporates a standard commercially stamped and threaded 2-inch diameter bung-hole flange, Figure 1.3. The 2-inch bung-hole is fitted with a formed neoprene gasket and a 2-inch pressure release plug that is designed to open between 12-15 psig to limit buildup of internal pressure during HAC. The lid may also optionally incorporate a standard commercially stamped and threaded ¾-inch bung-hole flange which is sealed with a formed neoprene gaskets and a standard ¾-inch non-venting drum plug. A formed silicon gasket between the drum and lid seals the 30-gallon drum closure. Drawing R-R1-G-00028 given in Appendix 1.1 defines the design. The 30-gallon drum with lid and split-ring closure weighs approximately 50 lbs.

The 30-gallon drum split-ring closure device is similar to the closure device used to close the 55-gallon overpack except for the smaller size and low profile lugs as shown in Figure 1.3. The drum split-ring closure device is fabricated from 12-gauge carbon steel. Low profile lugs are welded at each end of the two split rings. Each split-ring is identical, with one lug threaded with 1/2-13UNC-2B thread and the other with a through hole. The split-ring secures the closure lid to the drum via two 2½ inch long, ½-inch carbon steel socket head screws. Each lug includes a 0.13-inch hole to receive a tamper-indicating device (TID) as defined in Drawing R-R1-G-00026. The 30-gallon split-ring closure weighs approximately 7.2 lb. Figure 1.3 shows a split-ring closure device installed on a 30-gallon drum.

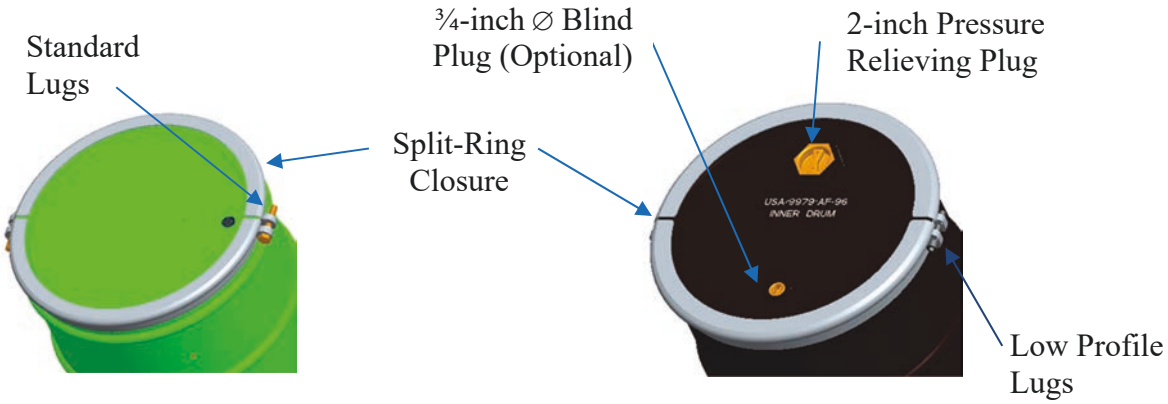

Figure 1.3 - Split-Ring Closure Installed on 30- and 55-Gallon Drum Assemblies

1.2.2 Contents

1.2.2.1 Contents of Packaging

The payload for the 9979 includes all radioactive (fissile and non-fissile) and non-radioactive materials contained within the 30-gallon drum.

The radioactive contents for the 9979 grouped broadly into two payload categories for each material form are listed in Table 1.1.

- non-combustible materials, and
- combustibles materials.

The radioactive material and payload mass limits for the 9979 are defined in Table 1.2 – Table 1.5.

- Table 1.2 - *High Enriched Uranium (HEU) Content Envelope Limits* for HEU U-235 with a maximum mass of 350 grams
- Table 1.3 - *Low Enriched Uranium (LEU) Content Envelope Limits* for LEU with a maximum mass of 19.192 Kg
- Table 1.4 - *Low Enriched Uranium Content Envelope* with 1.25% or less U-235
- Table 1.5 – *Vogan/POP, Am1.N02, Cs-137, & Th-232 Content Envelope*

Table 1.1 – Radioactive Content Description

Payload Categories	Material Form	General Description
COMBUSTIBLE[a]	Filters	Roughing, sock, demister, HEPA and other uranium filters
	Rubber, Plastics, Cellulose Products	Clothing, gaskets, bottles, filter frames, paper, wood, mop heads etc.
	Floor Sweepings	Miscellaneous materials collected from cleaning activities
	Process Solids	Furnace residues. (pan filter cloth and scrapings, wipes/sponges, etc.)
NON-COMBUSTIBLE	Graphite/Carbon	Carbon and graphite scrap molds
	Slag and Liner	Residue that contains magnesium oxide, calcium fluoride and/or lithium fluoride
	Ceramics/Glass	Crucibles, glassware and borosilicate rings
	Borax Pellets	From analytical x-ray operations.
	Reduction Sand	Granular magnesium oxide (MgO)
	Asbestos/Firebrick	Insulation, floor tiles, etc.
	Solid Compounds and metal	Uranyl Fluoride, UO_4, ammonium diuranate and residues and solid mixtures, scrapped unirradiated fuel rods and pellets, e.g., size reduced Light Water Breeder Reactor (LWBR) fuel rods[7], TRISO Fuel and process materials[15], metal waste forms [8], Vogan Assemblies[9, 10], Plutonium Oxide Pods (POP) Assemblies[11, 12], Am1.N02 Assemblies[14], Cesium & Thorium samples.
	Standards and Sources	Encapsulated calibration standards, LEU Plates/Cube

- a) May also include non-combustible material that is mixed with combustible materials e.g. bags, rags, filters, etc.

Table 1.2 –Envelope Limits including Highly Enriched Uranium (HEU) Content

Feature	Material	Mass (g)			
Radioisotopes	Tc-99	1,428			
	Th-228[g]	7.15E-07			
	Th-229[g]	3.17E-02			
	Th-230[g]	5.42E-01			
	Th-232	90,000			
	U-232	5.00E-05			
	U-233	16.6			
	U-234	26.1			
	U-235	350			
	U-236	2,500			
	U-238	90,000			
	Np-237	76.9			
	Pu-238	1.58E-03			
	Pu-239	0.435			
	Pu-240	0.119			
	Pu-241	1.58E-02			
	Am-241	7.69E-03			
	Cs-137[g]	2.30E-05			
	Eu-155[g]	1.10E-03			
	Sr-90[g]	3.09E-04			
	Cm-243[g]	5.19E-04			
Impurities	Carbon	1,000[d]	unlimited[b,e]	1,000[d]	90,000[c,e]
	Beryllium		0		0
	Hydrocarbons[f]	1,000	1,000	unlimited[e]	1,000
Total Mass[a]	Fissile Material [U-235 (eq)]*	350	350	300	150
	Radioactive Material	90,000			
	Package Payload	90,000			

Note: With the exception of U-235, U-232, Th-228, Th-229, Th-230, Cs-137, Eu-155, Sr-90, & Cm-243, the mass of each isotope listed is based on a single A_2 or 90,000 grams.

a.) Package contents are limited to specified mass of U-235 (eq) and to a maximum composite A_2 of one.

b.) Fissile material must be fixed on graphite pieces.

c.) Fissile material is not fixed on graphite pieces.
d.) This limit applies to sum of beryllium and carbon in the payload.
e.) Subject to payload limit.
f.) Materials predominantly containing hydrogen and carbon (i.e., molecular formula involving $C_xH_y\ldots$) such as plastics, polyethylene, and oil.
g) In addition to the requirements of note a), the sum of mass fractions for Th-228, Th-229, Th-230, Cs-137, Eu-155, Sr-90, & Cm-243 are limited to 1 to control dose rate (see below).

$$\frac{m_{Th_{228}}}{M_{Th_{228}}} + \frac{m_{Th_{229}}}{M_{Th_{229}}} + \frac{m_{Th_{230}}}{M_{Th_{230}}} + \frac{m_{Cs_{137}}}{M_{Cs_{137}}} + \frac{m_{Eu_{155}}}{M_{Eu_{155}}} + \frac{m_{Sr_{90}}}{M_{Sr_{90}}} + \frac{m_{Cm_{243}}}{M_{Cm_{243}}} \leq 1$$

Where, m = isotope mass | M = maximum Table 1.2 isotope mass

* U-235(eq) = U-235 + [4.1 × U-233] + [4.1 × Pu] (The sum of U-233 and Pu must be ≤ 5 wt% total fissile mass.) All other fissile isotopes, not addressed in Table 1.2 (excluding transuranics), are only allowed in trace quantities (i.e., <0.015 grams)).

Table 1.3 – Low Enriched Uranium (LEU) Content Envelope ≤ 19.9% U-235

Feature	Material	Weight Fraction	Mass (kg)
Radioisotopes [a]	U-235	0.199	3.819
	U-238	0.801	15.373
Total Mass	Radioactive Material	-	19.192
	Package Payload	-	90

a.) Low Enriched Uranium (LEU) ≤19.9 weight % U-235 and 80.1 weight % U-238.

Table 1.4 - Low Enriched Uranium (LEU) Content Envelope ≤ 1.25% U-235

Feature	Material	Mass (g)
Radioisotopes	Tc-99	4.00E+00
	Th-228	6.72E-09
	Th-230	3.84E-03
	Th-232	1.76E+00
	U-232	6.13E-08
	U-234	2.20E+01
	U-235	2.00E+03
	U-236	1.72E+02
	U-238[b]	9.0E+04
	Np-237	6.15E-02
	Pu-238	1.22E-06
	Pu-239	5.63E-03
	Pu-241	3.41E-05
	Am-241	9.97E-07
Total Mass[a]	Radioactive Material	9.0E+04
	Package Payload	9.0E+04

a.) Nuclear Critical Safety Evaluation conservatively assumes 160Kg of radioactive material. Maximum RAM and packaging payload mass shall not exceed 90Kg.
b.) Includes contributions from daughter products, e.g., Th-234, etc.

Table 1.5 - Vogan/POP, Am1.N02, Cs-137, & Th-232 Content Envelope[a]

Radioactive Material[b]					
Type	**Content**	**Material**	**Mass per Capsule (g)**	**Qty.**	**Total Mass (g)**
Special Form	Vogan Assemblies[f]	Pu-239[c]	16.3625	8[d]	1.309E+02
		Pu-240[c]	1.05		8.400E+00
		Pu-241[c]	0.0875		7.000E-01
	POP Assemblies[f]	Pu-239[c]	16.83		1.3464E+02
		Pu-240[c]	1.08		8.640E+00
		Pu-241[c]	0.09		7.200E-01
	Am1.N02	Am-241[e]	1.60E-2	10	1.600E-01
Normal Form	Cesium	Cs-137	N/A		1.300E-06
	Thorium	Th-232			3.000E+02
Total Radioactive Material					4.4416E+02

Authorized Gross Mass per Capsule	
Content	**Mass (g)**
Vogan	7.95E+01
POP	5.34E+01
Am1.N02	6.84E+00

a.) Table 1.5 contents shall be shipped under exclusive use in accordance with the requirements of 49 CFR 173.441 and S-SARP-G-00006 Chapter 7.

b.) Table 1.5 contents meet the requirements for activity limits established in Appendix A Section IV Part (c) to 10 CFR 71.

c.) Isotopic masses represent bounding mass of plutonium. A total mass of 200 grams is used in the criticality analysis of Chapter 6. The maximum decay heat is < 0.5 watts (See Appendix 4.1)

d.) Up to 8 Vogan or POP special form assemblies, or any combination of the two, may be shipped at one time.

e.) Am-Be masses were conservatively calculated in Origin based on the maximum activity of the special form capsules.

f.) Plutonium contents may include up to 4.5% gallium as an alloying metal.

1.2.2.2 Payload Limits and Restrictions

The following limits apply to all 9979 contents:

- Payload decay heat is limited to a maximum of 3.5 watts.
- Payload mass is limited to a maximum of 200 lbs (90 kg).
- Moisture within the payload is limited to a maximum of one weight percent.

The following forms of materials are prohibited as content in the 9979:

- Pyrophoric materials
- Cryogenic liquids
- Compressed gasses
- Visible liquids
- Chemically reactive substance

Payload is all radioactive and non-radioactive material; non-radioactive contents includes all secondary containers, wrapping, shoring, convenience cans, plastic bagging, polyurethane foam, polyethylene, packing and other dunnage material.

1.2.2.3 General Payload Configuration

All contents are required to be packaged in the 9979 30-gallon drum. For all contents categorized as combustible a thermal Insulation Bag as described in Section 1.2.4 is required. Drawing R-R4-G-00064 given in Appendix 1.1 defines the Insulation Bag design. This bag is optional dunnage for non-combustible contents.

1.2.2.4 HEU Content Configuration – Table 1.2

The following are requirements for payload packing configurations for Table 1.2.

- Sharp edges and corners must be padded.
- Liquid waste and waste containing free liquids must be processed to a solid form or be collected on sorbent material sufficient to retain twice the volume of the liquid. Sorbents must be non-biodegradable in accordance with 40 CFR 265.314(e).
- Handling containers must be packed with closures upright.
- Tri-Structural Isotropic (TRISO) fuel and process materials are limited to the physical and chemical forms of Highly Enriched Uranium and Thorium defined in Tables 2-1 through 2-6 of N-NCS-G-00174 Rev. 1 (Appendix 6.5). TRISO fuel and process materials shall be placed in convenience containers such as steel cans (carbon or stainless) with slip top or press fit lids; miscellaneous small glass vials, less than 1/2 pint; or poly-bottles with screw top lids. Convenience containers may be placed in plastic bags, which are taped closed for contamination control.

1.2.2.5 LEU Content Configuration – Table 1.3

The following are requirements for payload packing configurations for Table 1.3. The LEU payload consists of a maximum of five LEU plates of uranium metal (≤ 19.9% U-235). Each plate has nominal dimensions of 10-cm by 10-cm by 2-cm and weighs approximately 8.5 lbs. The LEU plates may be shipped as a Cube (Assembly) or individually. Figure 1.4 illustrates a plate and Cube configuration.

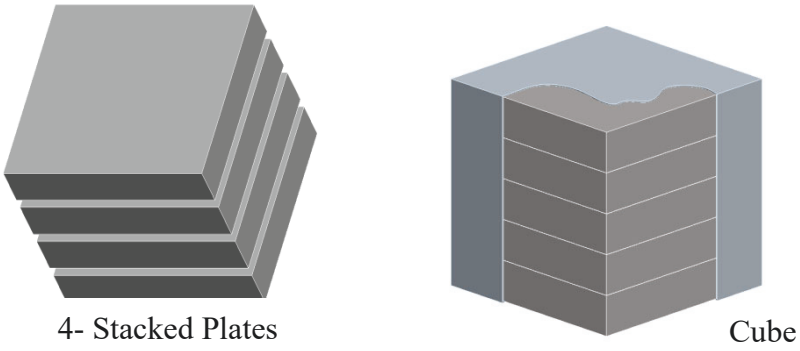

Figure 1.4 - LEU Plate and Cube Configuration

LEU Cube Content

When shipped as a Cube, five plates are arranged in a 10 cm cubic assembly and encased in a 30 mil thick stainless steel welded shell. The Cube Assembly weighs approximately 43 lbs. The Cube is typically loaded into a 3-quart stainless steel (SS) can for ease of operational handling; the 'convenience can' is not required. The LEU Cube, convenience can and packing material is loaded into the 30-Gallon Drum Assembly. Figure 1.5 illustrates the packing configuration for the LEU Cube.

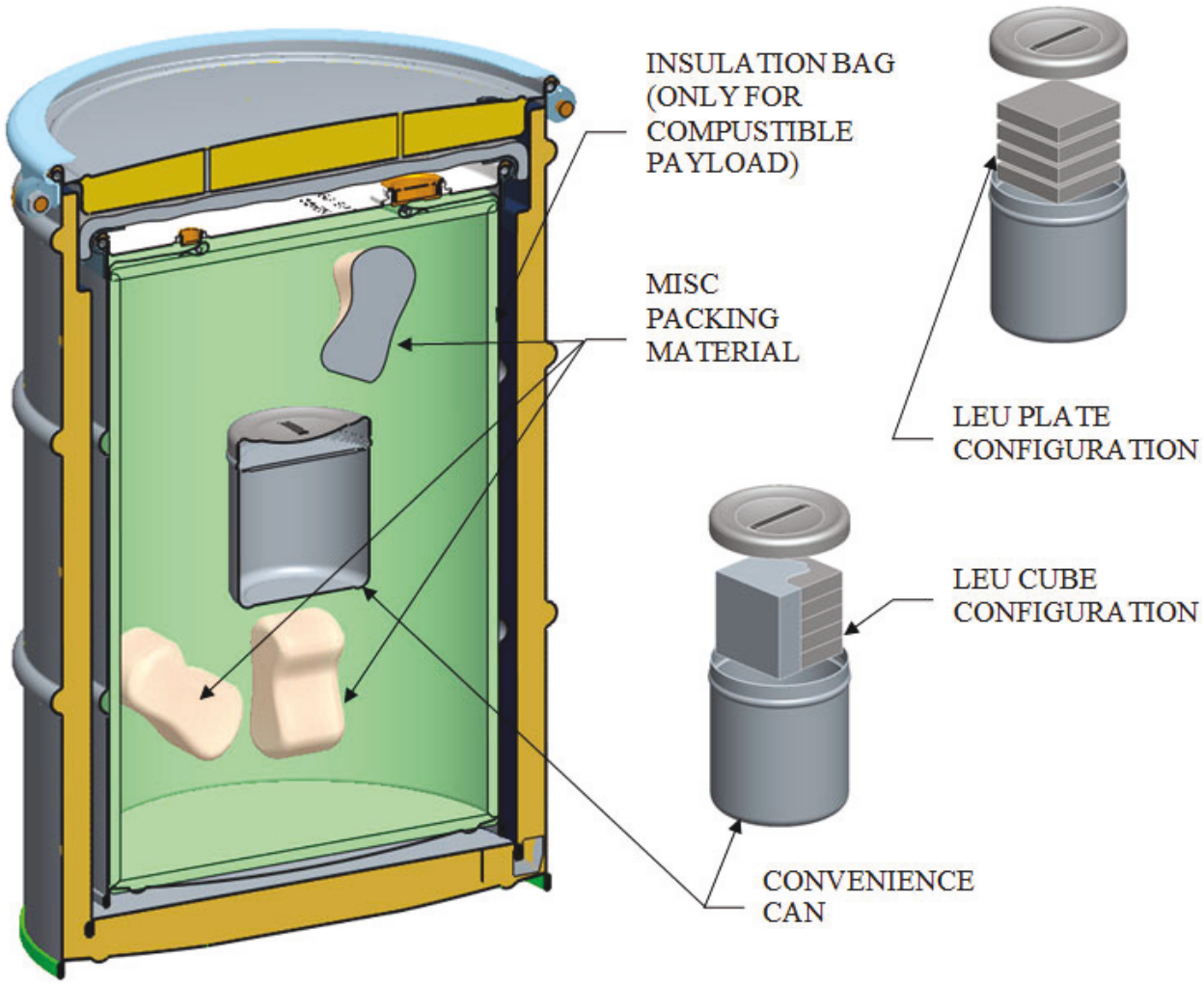

Figure 1.5 - LEU Cube/Plate Packing Configuration

LEU Individual Plates

When shipped individually, no more than four plates may be shipped at one time. The individual plates are typically loaded into a 3-quart stainless steel (stainless steel (SS)) can for ease of operational handling; the 'convenience can' is not required. The LEU Cube and packing material is loaded into the 30-Gallon Drum Assembly. Figure 1.5 illustrates the packing configuration for the LEU plates.

LEU Content Packing Material

Material listed in Table 1.1 and adhering to restrictions in Section 1.2.2.2 (i.e., polyethylene foam) are permitted. If the packing material is combustible, the Insulation Bag shall be used.

Convenience Can for LEU Material (Cube and Plates)

Convenience cans may be used for transport of the LEU material. Figure 1.6 shows the dimensions for a 3-quart (2.8 liter) can that would typically hold the cube and plates. Reference Convenience Can: Medical Action Industries, Inc. Part #88030

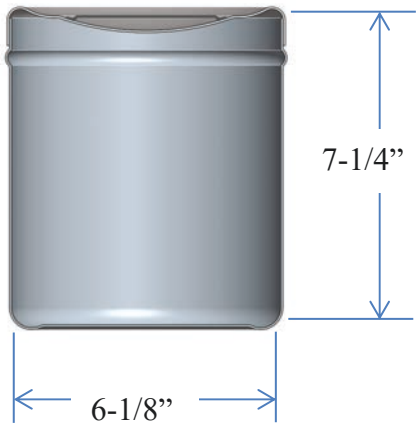

Figure 1.6 - LEU 3 Quart Material Convenience Can

1.2.2.6 LEU Content Configuration – Table 1.4

The LEU material is in the form of miscellaneous metal waste including secondary waste (e.g., paper, plastic, PPE, tape, wood) associated with waste packaging operations.

The following are requirements for payload packing configurations for Table 1.4.

- Sharp edged waste must be padded if shipped without handling containers.
- Handling containers must be packed with closures upright.

1.2.2.7 Special Form Pu, Special Form Am1.N02, & Normal Form Cs-137 & Th-232 Configuration – Table 1.5

The content envelope in Table 1.5 consists of three unique special form capsule designs and two normal form radioisotopes. The capsule assemblies, Vogan, POP, and Am1.N02, are designed to contain plutonium metal, plutonium oxide, and an Americium-Beryllium mixture respectively. Each special form capsule has been tested in accordance with the special form requirements of 49 CFR 173.469[13].

Special Form Vogan Assembly

The Vogan Assembly design consists of two nested capsules that encapsulate a plutonium metal disk and an aluminum shim. The outer profile of the Vogan Assembly is approximately 1.30 inches in diameter and 0.50 inches thick. The inner tantalum capsule provides containment and the outer titanium capsule provides structural protection. Each capsule is sealed by either laser beam welding (LBW) or electron beam welding (EBW). The Vogan Assembly design was tested in accordance with 49 CFR 173.469 standards.[9,10] Weights for each component are calculated in Table 1.5.

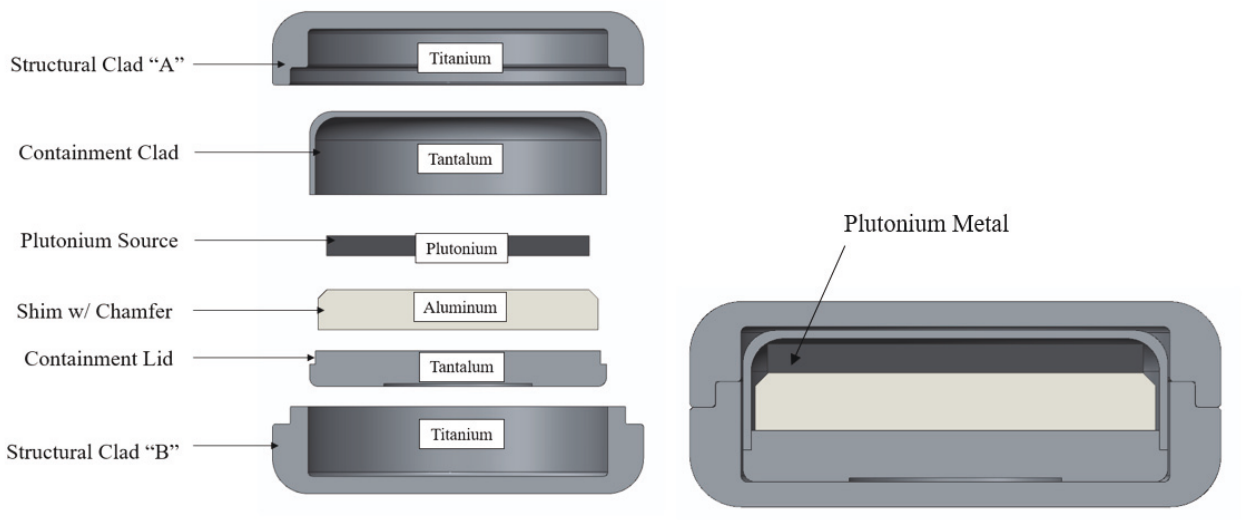

Figure 1.7 – Vogan Capsule Assembly

Special Form Plutonium Oxide Pod (POP)

The POP Assembly design consists of two nested steel capsules that encapsulate a plutonium oxide fill. The outer profile of the POP Assembly is approximately 1.30 inches in diameter and 0.48 inches thick. The inner capsule "SNAP" is fabricated from 1018 carbon steel, which provides containment of the plutonium oxide fill. The outer 316 stainless steel capsule adds structural protection. Each capsule is either laser beam welded (LBW) or electron beam welded (EBW) closed. The POP Assembly design was tested in accordance with 49 CFR 173.469. [11,12]

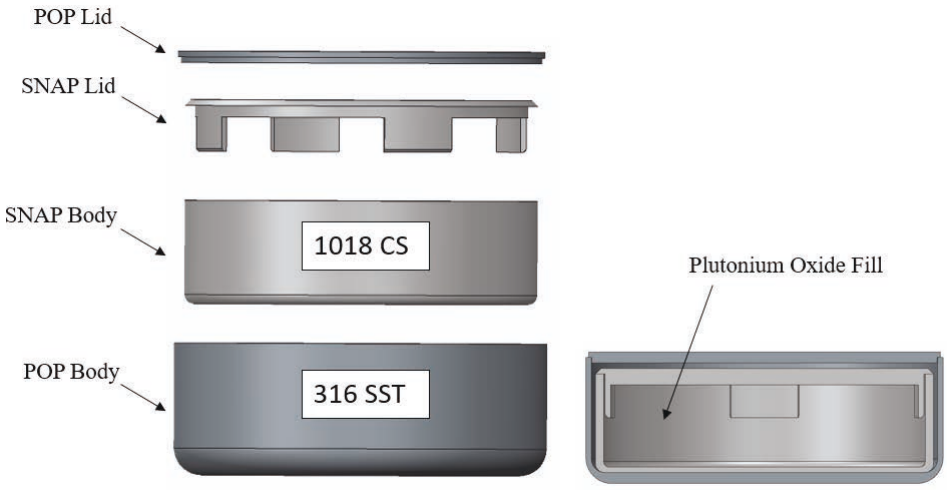

Figure 1.8 – Plutonium Oxide Pod (POP) Assembly

Special Form Am1.N02

The Am1.N02 special form content consists of a mixture of natural beryllium powder and Americium-241 in oxide form. The source is contained in an inner stainless steel capsule and a 7.8 mm diameter, 10 mm long stainless steel outer capsule, both of which are sealed via TIG weld[14].

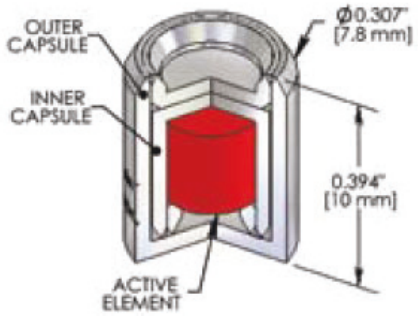

Figure 1.9 – Am1.N02 Capsule

Normal Form Cs-137 & Th-232

Cs-137 and Th-232 contents are typically in the form of discs and strips, but are not limited to these forms.

Packing Configuration

Up to eight (8) Vogan assemblies, POP assemblies, or any combination of the two, may be shipped together with up to ten (10) Am1.N02 assemblies, and the Cs-137 and Th-232 quantities as noted in Table 1.5. Contents may be shipped in any configuration within the 9979 30-gallon drum assembly that meets the general packing configuration requirements. Figure 1.10 illustrates one possible shipping configuration where each of the samples is secured and positioned in a polyurethane foam structure. In this orientation, 3 Vogan/POP capsules are equally spaced axially, 5 Vogan/POP capsules are positioned radially about the center of the 30-gallon drum, and the Am1.N02 capsules, thorium strips, and cesium disks line the outer perimeter. The final packing configuration is specified by the user.

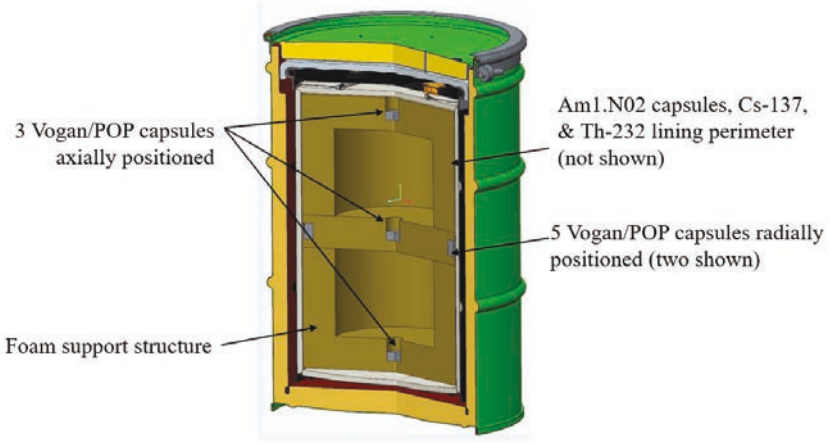

Figure 1.10 – Example Packing Configuration for Table 1.5

1.2.3 Special Requirements for Plutonium

No special plutonium requirements apply.

1.2.4 Operational Features

Split-Ring Closure Installation

Installation of the split-ring requires striking each half with a rubber hammer as the bolts are torqued, and the process continues until sustaining torque values in accordance with Drawings R-R1-G-00028 and R-R1-G-00029 given in Appendix 1.1. The repeated striking and torque sequence is necessary to overcome the static friction between the drum closure and split-ring connection. With fully applied torque, the ends of the split-ring halves must retain a visually discernible gap. Jam nuts are then tightened against the unthreaded lugs on the 55-gallon drum. (The 30-gallon split-ring closure does not include jam nuts.)

Drum Hoisting

A lifting device may be necessary for loading the 30-gallon drum into the 55-gallon drum overpack. Figure 1.11 illustrates a prototype drum lifting device. Users may develop their own lifting apparatus but must obtain final approval from the Design Authority, the SRNL Packaging Technology & Transportation Engineering (PT&TE) group, prior to use.

Figure 1.11 – Drum Lifting Device

Thermal Insulation Bag - Installation and Use

All combustible payload materials are required to be packed inside an insulation bag which is placed inside the 30-gallon drum. Drawing R-R4-G-00064 given in Appendix 1.1 defines the design. Bag installation is performed by folding a portion of the fabric top outside the 30-gallon drum and cinching the bag tight under the drum curl with the supplied draw cord. This secures the bag to the top of drum preventing the Insulation Bag from obstructing loading operations. Following loading operations an insulated top is folded in on top of the packaged materials and the bag is then cinched closed, see Figure 1.12.

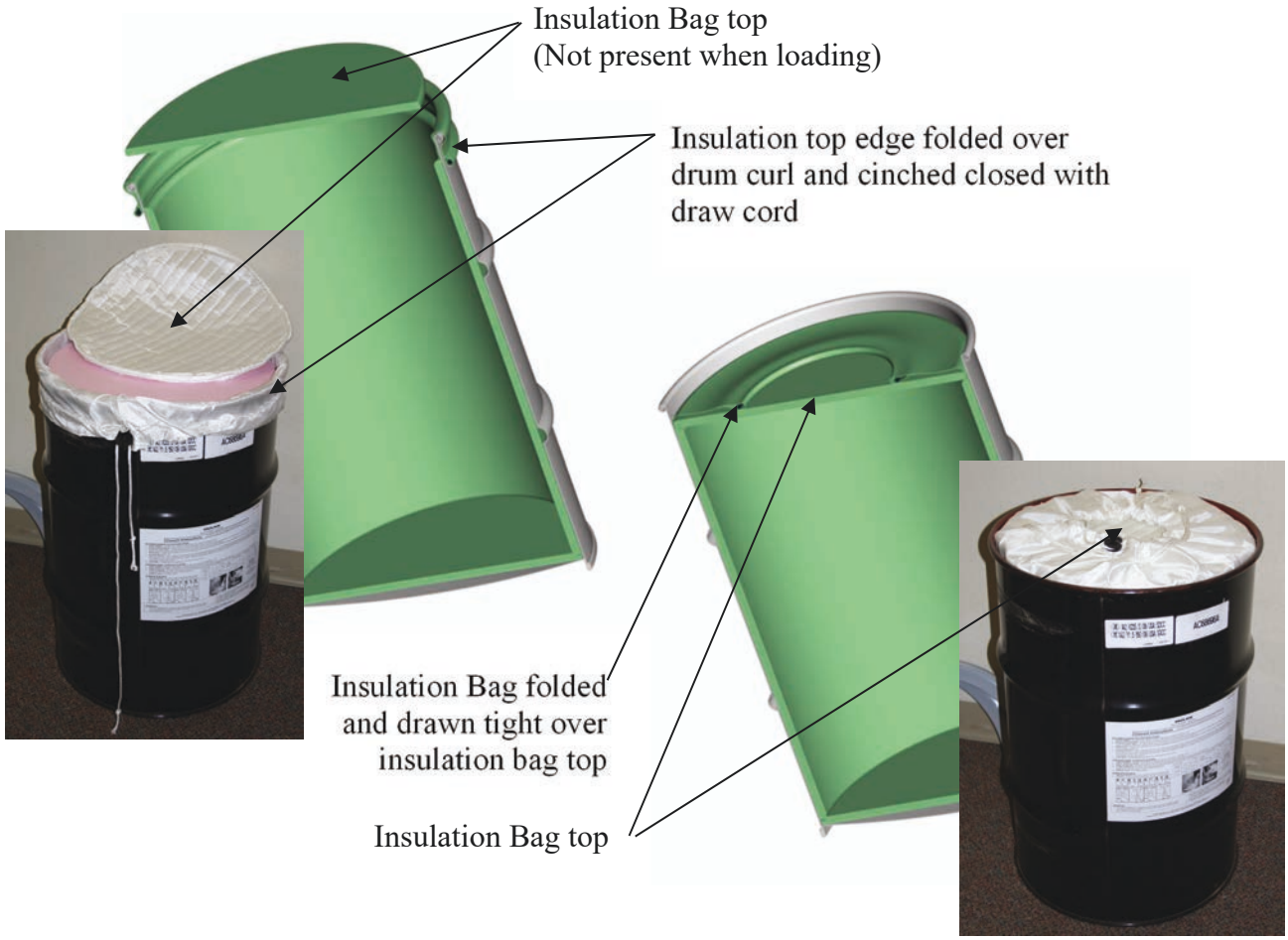

Figure 1.12 - Insulation Bag

1.3 APPENDIX

1.1 9979 Engineering Drawings
1.2 Vogan Plutonium Special Form Drawings
1.3 Plutonium Oxide Pod (POP) Special Form Drawings

1.4 REFERENCES

1. Shippers General Requirements for Shipments and Packagings, Code of Federal Regulations, Title 49, Part 173, Washington, DC (October 2018).
2. Packaging and Transportation of Radioactive Material, Code of Federal Regulations, Title 10, Part 71, Washington, DC (January 2018).
3. Packaging and Transportation Safety, DOE Order 460.1D, U.S. Department of Energy, Washington, DC (December 20, 2016).
4. Standard Format and Content of Part 71 Applications for Approval of Packaging for Radioactive Material, Regulatory Guide 7.9, Revision 2, U. S. Nuclear Regulatory Commission, Washington, DC (March 2005).
5. Establishing Quality Assurance Programs for Packaging Used in the Transport of Radioactive Material, Regulatory Guide 7.10, Revision 2, U.S. Nuclear Regulatory Commission, Washington, DC (March 2005).
6. Safeguards and Security Program, DOE Order 470.4B Chg 2 (MinChg), U.S. Department of Energy, Washington, DC (January 17, 2017).
7. Application for Contents Amendment for Shipping Reactor Fuel Rod Contents in 9979 Packaging, SRNL-L4500-2014-00003, Revision 1, Savannah River National Laboratory, (September 25, 2014)
8. (OUO) Technical Basis for Radiological Properties Low Enriched Uranium (LEU) Fernald Metal, PORT-LP000024, Revision 1, (July 2010).
9. Testing of Vogan Assemblies with Tungsten Capsules (157Y701711-900B) to 49 CFR 173.469 Standards, Southwest Research Institute, (November 21, 2018).
10. 49 CFR 173.469 Certificate of Testing for Special Form Capsules – Vogan Assemblies with Tungsten – 157Y701711-900B, Southwest Research Institute, (November 21, 2018).
11. Testing Los Alamos Plutonium Oxide Pod (POP) Assembly (157Y701720-000) to 49 CFR 173.469 Standards, Southwest Research Institute, (November 21, 2018).
12. 49 CFR 173.469 Certificate of Testing for Special Form Capsules – Plutonium Oxide Pods (POP) Assembly – 157Y701711-000, Southwest Research Institute, (November 21, 2018).
13. Code of Federal Regulations, 49 CFR 173.469, Tests for special form Class 7 (radioactive) materials, Washington, DC (October 2018).
14. Decision Reference No. SUJB/ONRV/21067/2013, Prague State Office for Nuclear Safety (October 10, 2013)
15. Robert W. Watkins to James M. Shuler, Memorandum, *Application for Contents Amendment for Shipping TRISO Fuel in 9979 Packaging*, SRNL-L4500-2018-00004 Rev. 1, (June 20, 2018).

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Safety Analysis Report – 9979 Type AF Packaging

CHAPTER 7

PACKAGE OPERATIONS

Preface

This Chapter identifies the minimum procedural elements needed to ensure that Users operate the Model 9979 package in accordance with its design. Implementation of these elements ensures safe performance of the 9979 package under Normal Conditions of Transport (NCT) and Hypothetical Accident Conditions (HAC). In addition to Safety Analysis Report for Packaging (SARP) requirements, facility-specific operating procedures shall also comply with all requirements provided in the Certificate of Compliance (CoC).

The procedural elements described in this chapter meet the requirements of:

- DOE Order 460.2A,[1]
- DOE Order 460.1D,[2]
- Title 10 CFR 20.1101(b) and 20.1906,[3]
- 10 CFR 71[4] and Subparts G and H, and
- 49 CFR 173[5]

The procedural elements cover fundamental steps required for packaging inspection, loading the radioactive contents, package handling, receipt, and unloading. Also included are requirements for preparation of an empty packaging for shipment and for packaging storage. The procedural elements are presented sequentially in the order in which they should be performed.

The procedural elements of this Section comply with NRC Regulatory Guide 7.9.[6]

TABLE OF CONTENTS

LIST OF FIGURES

7 PACKAGE OPERATIONS

7.0 General Information

All Users of the 9979 packaging shall register with Department of Energy's (DOE) Headquarters Certifying Official (HCO) prior to first use of the package. A written registration form shall be submitted to the Manager of the Packaging Certification Program (PCP) and the User must have received a verification of registration prior to shipping. The protocol for registration of users of EM-approved packagings is located at https://www.rampac.energy.gov.

7.0.1 Planning

Users shall prepare written site-specific operating procedures for inspections, tests, and activities that meet the requirements of this Chapter and comply with their facility's operational requirements. This SARP, the CoC, packaging hardware, engineering drawings, and technical specifications must be used to prepare site-specific Package User procedures.

The exact sequence of operational steps specified in this chapter may be altered to reflect site-specific needs. Implementation of SARP, CoC, and site radiological requirements shall reflect the principles of As Low As Reasonably Achievable (ALARA) as required by the *Standards for Protection Against Radiation* in Title 10 of the Code of Federal Regulations Section 20.1101(b).[3]

7.0.2 Personnel Qualifications

All personnel who perform duties associated with package operations shall be qualified as described in Section 9.2.1.

7.0.3 Equipment

A complete list of equipment (devices, fixtures, tools, hoists, etc.) and materials (with its specification) necessary for packaging operations shall be provided in each site-specific operating procedure. The procedural activities outlined in the major section of this Chapter also list the equipment necessary for the tasks and, where applicable, cite drawings of the special tools. All equipment, gages, instruments, and other measuring and testing devices used in activities affecting package quality shall be properly calibrated and controlled, as specified in the User's Quality Assurance (QA) Program.

If the shipper chooses to attach an ARG-US radio-frequency identification (RFID) tag to the packaging for monitoring during shipment or as a Tamper-Indicating Device Seal, the shipper must be trained and qualified to use the system in accordance with the latest guide[16].

7.0.4 Quality Assurance

Each site-specific procedure shall document the revision numbers of the CoC and SARP that are in effect at the time of that package operation.

The package User shall document compliance with all procedural elements required by this chapter. Each site-specific procedure shall include instructions for the operator to follow in

the event that a requirement cannot be met during implementation of the procedure. At a minimum, the Operator shall stop work, put the operation in a safe condition, document the event, then notify the appropriate level of Supervision and await further instruction.

7.0.5 Nomenclature

Figure 7.1 illustrates an exploded view of the 9979 packaging assembly and call-outs for the nomenclature used in the following procedures.

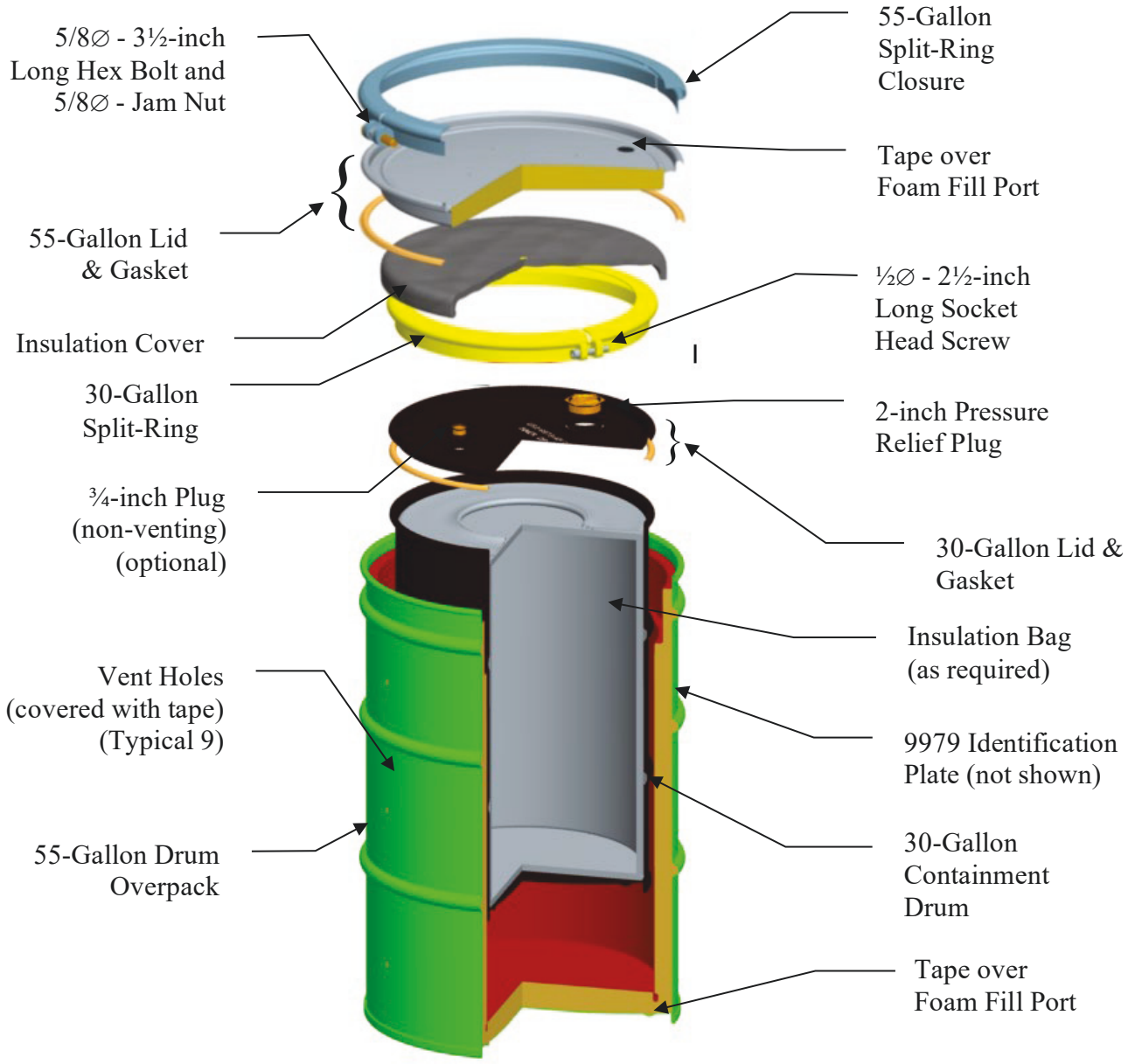

Figure 7.1 – 9979 Packaging -- Exploded 3-Dimensional Sectional View

7.1 PACKAGE LOADING

Packages shall be loaded and closed in accordance with written operating procedures. Detailed operating procedures shall include, at a minimum, the procedural elements of this section and the completion of the Quality Assurance documentation as required in Section 9.17, *Quality Assurance Records*. Implementation of the procedural elements of this section ensures that:

- the condition of the packaging is unimpaired prior to loading,
- contents are authorized, and the package is loaded and closed correctly, and
- the package is properly prepared for transport.

7.1.1 Preparation for Loading

Sections 7.1.1.1 and 7.1.1.2 do not need to be performed sequentially. This provision permits contents/payload preparation operations to be performed separately from the initial packaging preparation.

7.1.1.1 Packaging Preparation

1. Verify that the Example Identification Plate, as shown in Figure 7.2, is attached to the 55-gallon overpack and is legible.

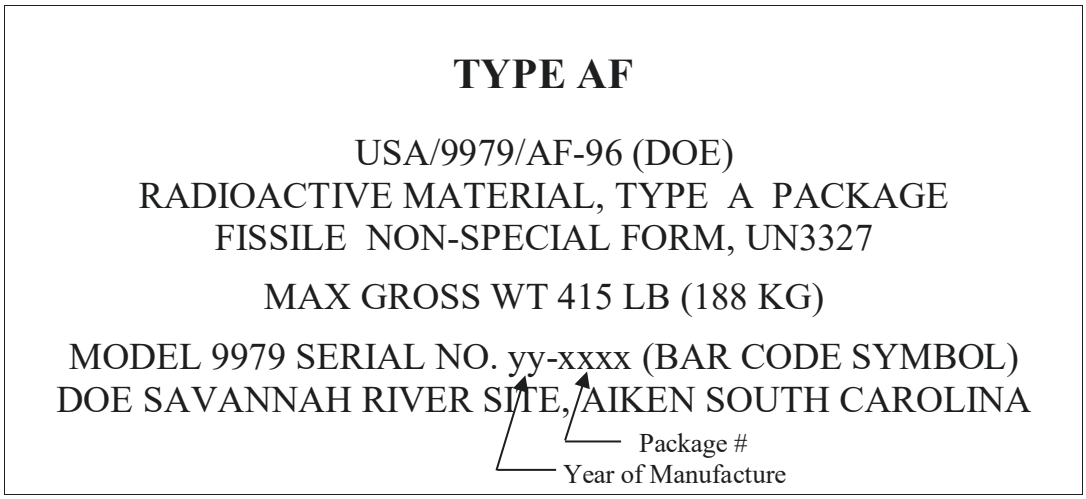

Figure 7.2 – 9979 Packaging Identification Plate

2. Record the packaging model number and the serial number on the Loading Record.
3. Verify that the exterior surfaces of the 55-gallon overpack and the accessible internal components (e.g., accessible surfaces of the overpack body, closure lid, and the accessible surfaces of the 30-gallon drum) do not exceed the applicable radioactive

contamination limits specified in 10 CFR 835, Appendix D and 10 CFR 835.405.[7] Health Protection personnel shall document the results of the survey.

4. Verify that the waterproof tape covers fill and vent holes on the top, bottom and sides of the overpack. If damaged or missing, new tape shall be applied prior to transport.

   NOTE: The installation of a ¾-inch Blind Plug and 'bung-hole' in the 30-gallon drum lid is optional.

5. If present, verify that the ¾-inch Blind Plug is undamaged and securely threaded into the 30-gallon drum 'bung-hole' with its supplied white EPDM gasket to 15 ±1.5 ft-lbs. If the plug or its gasket are visually damaged replace per Section 8.2.

6. Verify the 30-gallon drum is legibly marked; USA/9979/AF-96, Inner Drum.

7. Verify the Rieke 2-inch Pressure Relieving Plug is undamaged and securely threaded into the 30-gallon drum 2-inch 'bung-hole' flange with its supplied white EPDM gasket to 30 ± 3.0 ft-lbs. If the plug or its gasket are visually damaged replace per Section 8.2.

8. Verify that the 30- and 55-gallon split-ring closure devices are undamaged and ensure that the bolts remain with the closure during loading and unloading operations. This ensures that the bolts match those specified on Drawings, R-R1-G-00026 and R-R1-G-00027, respectively.

9. Verify that the overpack drum and 30-gallon drum are not damaged (top, bottom, and side) in any way that would affect packaging or transportation operations. Small surface scratches and dents that would not adversely affect packaging or transportation operations are acceptable.

10. Verify that the 30- and 55-gallon drums are empty and dry.

11. Visually inspect the gaskets of the 30- and 55-gallon closure lids. Verify that the gaskets are securely fixed (glued) to their respective closure lids and free of gouges, nicks, cuts, cracks, scratches, or debris that could affect their sealing performance. The 30-gallon lid gasket is silicone and is rust colored. The 55-gallon gasket is EPDM and is black. If either drum closure gasket is found to be damaged, see Section 8.2.

7.1.1.2 Contents/Payload Preparation

1. Verify that the radioactive contents are in compliance with the current 9979 CoC.

2. Prior to placement inside the 30-gallon drum, verify that the radioactive material handling convenience(s) do not show signs of degradation (e.g., bulging, buckling or corrosion) that could adversely affect the performance of the package.

3. Assemble the contents into a payload configuration described in Section 1.2.2.

4. General operational assembly steps for the content configurations described in Sections 1.2.2.3 through 1.2.2.6 are included below.

a. HEU Content Configuration – Table 1.2

   i. Loading of Contents (e.g., pellets, sand) can be accomplished through the 30-gallon plug(s) if content form allows. Following loading, plug(s) shall be inspected and installed in accordance with Section 7.1.1.1.

   ii. Following content loading operations, the shipper shall verify a minimum of 9% void volume in the 30-gallon drum.

b. LEU Content Configuration – Table 1.3

   i. Install the LEU Cube or Plate(s) (maximum 4 plates) into the 30-gallon drum as shown in Section 1.2.2.5.

c. LEU Content Configuration – Table 1.4

   i. Sharp edged material must be padded if shipped without handling containers.

   ii. Handling containers must be packed upright.

   iii. Following content loading operations, the shipper shall verify a minimum of 5% void volume in the 30-gallon drum.

d. Vogan/POP, Am1.N02, Cs-137, & Th-232 Configuration – Table 1.5

   i. Insert the contents in the 30-gallon drum (maximum quantities listed in Table 1.5). An example loading configuration is shown in Figure 1.10.

   ii. Contents shall not be placed loose in the 30-gallon drum.

7.1.2 Loading of Contents

Facility-specific operating procedures for loading radioactive contents into the 30-gallon drum and for closing the 30-gallon drum shall include, as a minimum, the operational elements listed below. Integration of these procedural elements into facility-specific requirements shall incorporate ALARA principles.

In preparation for loading the 30-gallon drum, all of the steps identified in Sections 7.1.1, 7.1.1.1, and 7.1.1.2 shall have been completed, and all packaging hardware, lifting equipment, and other required apparatus shall be staged and ready.

1. Verify that the weight of the payload (i.e., everything to be placed into the 30-gallon drum) does not exceed 200 lbs and that when combined with the packaging (Figure 7.1) does not exceed the authorized gross weight of the 9979 Package, 415 lbs.

2. Place the contents within the 30-gallon drum via lifting equipment, as required. Acceptable payload configurations are described in Section 1.2.2. Note: All combustible contents shall be loaded into the thermal insulating bag as described in Section 1.2.4.

3. Verify that the closure gasket is in place on the 30-gallon drum closure lid.

4. Install the 30-gallon closure lid and mount the 30-gallon split-ring closure device.

5. Torque the split-ring closure bolts to 40 ±5 ft-lbs in accordance with the closure requirements listed on Drawing R-R1-G-00028, Appendix 1.1.

6. If required per facility operations, both sets of lugs of the split-ring closure include provision for installation of a wire Tamper Indicating Device (TID) as shown (blue lines) in Figure 7.4.

7.1.3 Preparation for Transport

Package closure shall be performed in accordance with a written procedure that includes the following elements:

1. Health Protection personnel shall survey the outer surfaces of the loaded 30-gallon drum and shall provide verification that the contamination limits specified in 10 CFR 835, Appendix D are not exceeded. Health Protection personnel shall document the results of the survey. If the surface contamination measurements exceed the allowable limits, Stop Work and implement the appropriate contamination control procedures.

   WARNING: *A fully loaded 30-gallon drum can weigh as great as 250 lb. Perform lift in accordance with site/facility lifting procedures. An example drum lifting tool is illustrated in Section 1.2.4.*

   NOTE: Verify that the waterproof tape covers the 55-gallon drum fill and vent holes prior to proceeding. Replace if damaged or missing.

2. If required, attach a drum lifting device to the 30-gallon drum split-ring closure device as illustrated in Section 1.2.4.

Figure 7.3 - 9979 30-Gallon Drum Lifting Device Example

3. Lift and lower the 30-gallon drum into the 55-gallon overpack.

4. Place the insulation cover over the 30-gallon drum closure as shown in Figure 7.1.

5. Install the 55-gallon closure lid and mount the 55-gallon split-ring closure device.

6. Torque the split-ring closure bolts to 40 ±5 ft-lbs in accordance with the closure requirements listed on Drawing R-R1-G-00029, Appendix 1.1.

7. Install a wire TID through the 0.13-inch diameter holes in each of the two sets of lugs of the 55-gallon split ring closure assembly as shown (blue lines) in Figure 7.4.

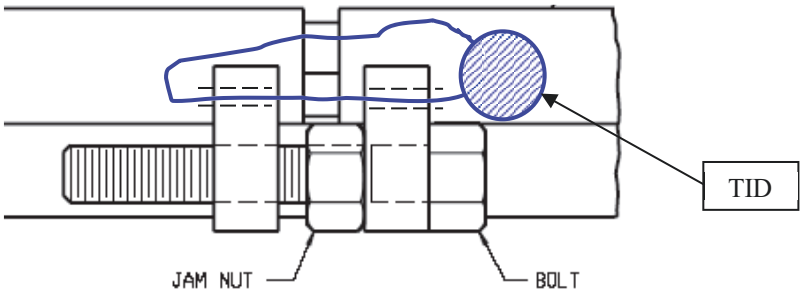

Figure 7.4 – Side View of the Top Portion of the Drum, Showing the TID Installation

8. Health Protection personnel shall survey the outer surfaces of the 55-gallon overpack for surface contamination and shall provide verification that the specified limits of 10 CFR 835, Appendix D are not exceeded. Health Protection personnel shall document the results of the survey.

9. Health Protection personnel shall perform and document a radiological survey of the closed 55-gallon overpack including the following:

   a. Determine the maximum radiation level at 1 meter from the drum top, side, and bottom surfaces, in mrem/hr. This is defined as the Transport Index, per 10 CFR 71.4.

   b. Record the Transport Index on the Transport Record and on the drum's shipping label.

   c. If the Transport Index is greater than 10, the package must be transported by exclusive-use shipment.

10. Verify that the gross package weight is 415 lb or less.

11. Attach radiation tags and labels to the drum, as specified in 49 CFR 172,[8] Subparts D and E.

12. Ensure that any special instructions necessary for safe opening of the package, per 10 CFR 71.89,[4] are provided to the consignee prior to shipment of the package.

7.2 PACKAGE UNLOADING

Implementation of the following procedures shall incorporate ALARA principles. Package receipt shall be performed in accordance with written procedures that include the following elements.

7.2.1 Receipt of Package from Carrier

1. Make arrangements to receive the package in accordance with 10 CFR 20.1906.

2. Health Protection personnel shall survey the conveyance surfaces and package exterior surfaces for radiation levels in accordance with 10 CFR 71.47 and survey the package conveyance and package surfaces for surface contamination in accordance with 49 CFR 173.443 and/or 10 CFR 835.405 and 10 CFR 835, Appendix D as applicable. Health Protection personnel shall document the results of the survey.

   If the surface contamination measurements exceed the allowable limits, Stop Work and notify Health Protection personnel to implement the appropriate contamination control procedures. Contact supervision to evaluate the situation for occurrence reporting requirements per the DOE Order 231.1B, Environmental, Safety, and Health Reporting.[9]

3. Verify that the TID is unbroken on receipt. (On the shipping trailer doors for enclosed trailer shipments or to each package if not enclosed in a trailer.)

   NOTE: If the TID is missing or broken, Stop Work, isolate the package, and notify Nuclear Material Control personnel to implement the appropriate material accountability procedures. Contact supervision to evaluate the situation for occurrence reporting requirements per the Title 49 CFR 171.15, Immediate Notice of Certain Hazardous Materials Incidents.

4. Verify that the package has not sustained any damage that may significantly reduce the packaging performance; if it does, segregate the package, notify Supervision, and report to the Certifying Authority in accordance with 10 CFR 71.95, *Reports*.

7.2.2 Removal of Contents

In many instances, loaded 9979 packages will be disposed directly as waste without removing the payload, hence, unloading procedures are not applicable. However, unloading procedures apply to reusable 9979 packagings and shall include the following elements:

1. Document the removal of the TID per the receiving site procedures.

2. Open the 55-gallon drum overpack by loosening or removing the two split-ring closure bolts.

3. Remove the split-ring closure device and the overpack closure lid.

4. Survey the bottom surface of the overpack closure lid for contamination.

5. Remove the insulation cover from atop the 30-gallon drum.

6. Survey the insulation cover and the top surface of the 30-gallon drum closure lid for contamination.

7. Remove the 30-gallon drum using a drum lifting device. A typical lifting device is illustrated in Figure 7.3.

   NOTE: The 30-gallon drum could be pressurized. Using appropriate facility precautions the ¾-inch (if present) or 2-inch plug may be backed out to relieve any internal pressure.

8. Open the 30-gallon drum by removing or loosening the two split-ring closure bolts, and remove its closure lid.

9. Survey the bottom the 30-gallon closure lid surface for contamination.

10. Remove any packing/dunnage and contents from the 30-gallon drum.

11. Compare the package contents and configuration with the shipping papers and the Certificate of Compliance and note any discrepancies. These discrepancies shall be reported to the Certifying Authority in accordance with 10 CFR 71.95.

12. Survey the interior surface of the 30-gallon drum for contamination to verify that it does not exceed radioactive contamination limits specified in 10 CFR 835, Appendix D.

7.3 PREPARATION OF EMPTY PACKAGE FOR TRANSPORT

An empty 9979 packaging shall be shipped per 49 CFR 173.428,[10] *Empty Class 7 (radioactive) Materials Packaging*. A non-empty packaging is a package that is internally contaminated as specified in 49 CFR 173.421,[11] *Limited Quantities of Radioactive Materials*, and shall be prepared for transport as specified in 49 CFR 173.421. The level of non-fixed contamination on the external surfaces of the package must be kept as low as reasonably achievable and may not exceed the limits set forth in 49 CFR 173.443, *Contamination Control,*[12] or 10 CFR 835, Appendix D, as applicable.

Packaging shall be prepared for transport per written procedures that include the following elements:

7.3.1 Shipping an Empty Packaging

1. Verify the package is undamaged.

2. Verify internal contamination does not exceed limits prescribed in 49 CFR 173.428(d).

3. Verify radiation levels and non-fixed contamination do not exceed limits prescribed in 49 CFR 173.421(b) and (c), respectively.

4. Close the packaging as directed by Section 7.1.3.

5. Affix an “EMPTY” label over the Packaging Identification Plate. Any other labels previously affixed to the drum for shipping shall be removed or covered.

7.3.2 Shipping a Non-Empty Package

1. Non-Empty Package is any empty packaging that cannot qualify as an "EMPTY" per Section 7.3.1.
2. Prepare the packaging for shipment per Section 7.1.1.1, *Packaging Preparation*.
3. Close the packaging per Section 7.1.3, *Preparation for Transport*.

7.4 OTHER OPERATIONS

There are no special operational controls or restrictions for shipping the 9979.

7.4.1 Packaging Storage

Stored the packaging a facility that provides protection from:

- the effects of temperature extremes and humidity (to prevent condensation),
- chemical vapors,
- accelerating forces,
- physical damage and airborne contamination (e.g., rain, snow, dust accumulation, dirt, salt spray and fumes).

Drum assemblies are to be stored with the vent and fill holes covered with waterproof tape, the closure lid in place, and the split-ring closure device installed.

7.4.2 Records and Reporting

The Package Loading Record shall be prepared in accordance with the requirements of 10 CFR 71.91, maintained in accordance with Section 9.17, and shall include as a minimum:

- identification of the packaging by model number and serial number;
- verification that there are no significant defects in the packaging, as shipped;
- type and quantity of licensed material in each package and the total quantity of each shipment;
- date of the shipment;
- any special controls exercised;
- name and address of the transferee;
- address to which the shipment was made; and
- results of the determinations required by 10 CFR 71.87 and by the conditions of the package approval.

Records are valid only if stamped, initialed or signed, and dated by authorized personnel or otherwise authenticated.

7.4.3 30-Gallon Drum Purging & Hydrogen Diffusion

In circumstances where the one year shipping period has been exceeded prior to shipment, the 30-gallon drum may be purged to reduce the hydrogen content and to reset the shipping period. Purging shall be performed with nitrogen gas at a flow rate of 2scfm or less and shall be performed using a wand inserted in the ¾" bung opening with the 2" bung opened. In addition, the opened 2" bung may be covered with a 0.092" thick or less 100µm filter at the discretion of Health Protection personnel[13]. Users shall purge the drum with at least 10 void volumes of nitrogen[14]. Purge time shall be calculated using the equation below:

$$t = \frac{v_{void} N}{Q}$$

Where:

t = time
V_{void} = void volume in drum
N = required number of volumes, and
Q = purge flow rate

Alternatively, users may remove both the 2" and ¾" bung fittings for at least 15 hours to allow hydrogen gas to diffuse from the 30-gallon drum[14].

At the conclusion of purging or diffusion operations, users shall complete Section 7.1.1.1 Steps 6 and 8 and shall survey the package in accordance with Section 7.1.3, Step 1.

7.4.4 Hydrogen Gas Measurement and Sampling

In lieu of venting or purging, users may perform gas sampling to extend the shipping period of the 9979 drum. The intent of this sampling procedure is to provide justification for extending the shipping window under circumstances where hydrogen gas generation is experimentally determined to be negligible[15].

Sampling must be performed using either quantitative measurements or go/ no-go testing using detection probes (e.g. HY-ALERTA 500 or similar) or gas chromatography. Packages with samples that test less than or equal to 0.25% hydrogen are authorized for a shipping extension. Otherwise, the hydrogen concentration must be reduced using one of the methods in Section 7.4.3. The 0.25% hydrogen limit was determined to be consistent with the results of M-CLC-A-00654[14] after 15 hours of venting the 9979 30-gallon drum.

Users shall perform gas samples of the 9979 30-gallon drum headspace in accordance with the steps below to determine compliance with this Section.

1. Open the drum in accordance with Section 7.2.2 Steps 1-5.
2. Remove either the 2” or ¾” bung from the 30-gallon drum lid.
3. Insert sampling device into the 30-gallon drum bung and take reading. Alternatively, take a gas sample with a gas tight syringe for a conformational measurement using gas chromatography.
4. Compare reading with the 0.25% hydrogen concentration limit.
    a. If the hydrogen concentration reading is less than or equal to 0.25%, a shipping extension is authorized with duration below.
        i. Table 1.2 - 180 days
        ii. Table 1.4 - 360 days

        Proceed to Step 5. OR
    b. If the hydrogen concentration reading is greater than 0.25%, the hydrogen concentration must be reduced using one of the methods in Section 7.4.3.
5. Inspect the bung plugs in accordance with Section 7.1.1, Steps 6 or 8 for the ¾-inch and 2-inch fittings respectively. Torque the ¾-inch fitting to 15 ft-lbs ± 1.5 ft-lbs or the 2-inch fitting to 30 ft-lbs ± 3.0 ft-lbs.
6. Complete Section 7.1.3 Steps 4-12 for preparation for transport.

7.5 APPENDIX

None.

7.6 REFERENCES

1. *Departmental Materials Transportation and Packaging Management*, DOE Order 460.2A, U.S. Department of Energy, Washington, DC (December 22, 2004).
2. *Packaging and Transportation Safety*, DOE Order 460.1D, Department of Energy, Washington, DC (December 20, 2016).
3. *Standards for Protection Against Radiation*, Code of Federal Regulations, Title 10 Part 20, Washington, DC (January 2018).
4. *Packaging and Transportation of Radioactive Material*, Code of Federal Regulations, Title 10, Part 71, Washington, DC (January 2018).
5. *Shippers General Requirements for Shipments and Packagings*, Code of Federal Regulations, Title 49, Part 173, Washington, DC (October 2018).
6. Standard Format and Content of Part 71 Applications for Approval of Packaging for Radioactive Material, Regulatory Guide 7.9, Revision 2, U. S. Nuclear Regulatory Commission, Washington, DC (March 2005).
7. *Occupational Radiation Protection*, Code of Federal Regulations, Title 10, Part 835, Washington, DC (January 2018).
8. Hazardous Materials Table, Special Provisions, Hazardous Materials Communications, Emergency Response Information, Training Requirements, and Security Plans, Code of Federal Regulations, Title 49, Part 172, Washington, DC (October 2018).
9. *Environmental, Safety, and Health Reporting*, DOE Order 231.1B, Admin Change 1, Department of Energy, Washington, DC (November 28, 2012).
10. *Empty Class 7 (radioactive) Materials Packaging*, Code of Federal Regulations, Title 49, Section 173.428, Washington, DC (October 2018).
11. *Limited Quantities of Radioactive Materials*, Code of Federal Regulations, Title 49, Section 173.421, Washington, DC (October 2018).
12. *Contamination Control*, Code of Federal Regulations, Title 49, Section 173.443, Washington, DC (October 2018).
13. J. P. Flach, Model 9979 Type AF Shipping Package: 30-Gallon Drum Purging Test Report, M-TRT-G-00020, Revision 0, (December 2018).
14. N. M. Askew & M. R. Kesterson, *Hydrogen Concentration Reduction in a 30 Gallon Drum,* M-CLC-A-00654, Revision 0, (December 2018).
15. S. B. French, Hydrogen Gas Concentration in Model 9979 Type AF Containers at Los Alamos National Laboratory, LA-CP-18-20604, Revision 0, (September 2018).
16. Guide to the RFID Monitoring System (Models 9975, 9977, and 9978 Packages), Argonne National Laboratory, ANL/DIS-09-5, December 3, 2009 and its Supplements.

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Safety Analysis Report – 9979 Type AF Packaging

CHAPTER 8

ACCEPTANCE TESTS AND MAINTENANCE PROGRAM

Preface

The acceptance tests and the maintenance program for the 9979 packaging described in this chapter ensure compliance with the requirements of Subpart G of Title 10 of the Code of Federal Regulations (CFR), Part 71.[1] The acceptance tests and the maintenance program shall be conducted in accordance with the quality assurance requirements described in Chapter 9 of this SARP. The information presented is in the format specified in U.S. Nuclear Regulatory Commission Regulatory Guide RG 7.9.[2]

TABLE OF CONTENTS

8.0 ACCEPTANCE TESTS AND MAINTENANCE PROGRAM

Roles and responsibilities for organizations involved in acceptance and maintenance activities of the 9979 packaging described in this Chapter are defined as follows:

Cognizant Technical Function (CTF)	The person or group within the Purchasing Organization responsible for the technical requirements of procured items and services. For items and services procured by SRNL, the CTF is in the PT&TE group.
Design Authority	SRNL's PT&TE group is the Design Authority for the 9979 design, responsible for all design specifications and acceptance criteria. Deviations from the specified design shall be reviewed and approved by SRNL/PT&TE.
Owner	SRNS, the SRS Management Contractor serving DOE-Savannah River, is designated the 9979 Packaging design Owner. All QA and fabrication documentation records for 9979 are maintained by SRNS QA.
Purchasing Organization	The organization responsible for all procurement activities. For items and services procured by SRNL, the Purchasing Organization is the SRNL/PT&TE group.

8.1 ACCEPTANCE TESTS

To ensure compliance with Subpart G of 10 CFR 71, prior to the first use of each 9979 packaging, the Purchasing Organization shall verify conformance to all design and quality assurance requirements defined in this Section, in Chapter 9, and as specified in the Engineering Drawings (Chapter 1, Appendix 1.1). The Purchasing Organization shall require the Supplier to satisfy the fabrication, assembly, inspection and testing requirements in accordance with the Procurement Contract and Procurement Specification (or equivalent). The Owner shall verify that all fabrication and QA records submitted by the Supplier to the Purchasing Organization are complete and traceable for each 9979 packaging (i.e. by serial number).

Inspections described in this section provide the Owner with verification that the packaging meets the Inspection Criteria and that the Supplier has fabricated the packaging in accordance with the engineering drawings referenced in the Certificate of Compliance.

As needed, the Owner shall prepare and issue a Nonconformance Report (NCR) per the requirements of Chapter 9, Section 9.15, when prescribed acceptance criteria are not met. The Design Authority shall approve disposition of the NCR (see Section 9.1.2).

8.1.1 Inspections and Measurements

Throughout the fabrication process, visual inspections, dimensional measurements and tests are performed to assess and verify compliance with all requirements (e.g., component materials and component dimensions) given in the drawings. The inspections, tests and documentation detailed in the drawings, Appendix 1.1, and the foam insulation detailed in Appendix 8.1, *Acceptance Tests for Dow BETAFOAM 87100/87124 in the 9979 Packaging*, ensure that newly fabricated packagings are complete and operable upon receipt. Destructive and nondestructive methods validate the foam filling procedures and the methodology described in Appendix 8.1 ensures complete filling of the drum and lid. Other nondestructive processes, such as thermal imaging, ultrasonic evaluation, and radiography, may be used if approved by SRNL.

8.1.2 Weld Examinations

Weld examinations shall be performed by qualified inspectors of all welds. Inspector qualification shall be in accordance to the employer's written practice and as required in the American Welding Society (AWS) D1.1 Structural Welding Code – Steel [2015], Clause 6, Section 6.1.4. Visual weld inspections shall meet acceptance criteria of American Welding Society (AWS) codes (e.g., AWS D1.3[3] and AWS C1.4[4]) for the weld specified on the Engineering Drawings.

Materials, workmanship, welding procedure specification, welder performance qualification, weld acceptance criteria, and weld documentation shall meet the requirements of the current edition of the AWS D1.3, Structural Welding Code -Sheet Metal.

Personnel performing nondestructive testing (NDT) shall be qualified in conformance with the current addition of the American Society for Nondestructive Testing Recommended Practice No. SNT-TC-1A.[5] and shall be certified as a minimum Level II in the methods used.

8.1.3 Structural and Pressure Tests

Structural and pressure tests are conducted by the drum fabricator in accordance with commercial standards for the specified drums; unique requirements are specified on the Engineering Drawings and in the subsections below.

8.1.3.1 Pressure Tests

The drum fabricator performs hydrostatic pressure tests per 49 CFR 178.605 for the 30-gallon drum used in the 9979 design. The drum fabricator tests a minimum of three samples from each drum lot at 150 kPa (22.5 psig) for five minutes. Closure-lid vents are sealed during the tests. Acceptance is no visible water leakage from the package.

Typically the hydrostatic pressure test is only specified for packaging design types intended to contain liquids, and the 9979 prohibits liquid contents. The hydrostatic test requirement ensures additional integrity and robustness of the 30-gallon drum.

8.1.3.2 Structural Tests

The 30-gallon and 55-gallon drums requires structural batch lot testing as Packing Group I (PG I) for solids and Packing Group II for liquids per 49 CFR 173.465(b), (c), (d) and (e), 173.401(f) and 173.24a(a)(5).

8.1.4 Leakage Tests

The 30-gallon and 55-gallon drums and the 55-gallon drum liner are subjected to a leakproofness test in accordance 49CFR178.604 and 49CFR178 Appendix B, Method 3. The test requires the items to be pressurized with a gas medium to at least 30 kPa (4 psig) and show no leakage of air from the package. Acceptance is verified by 100% inspection of the longitudinal drum seam and bottom chime using a bubble test.

8.1.5 Component and Material Tests

The 9979 packaging design incorporates a pressure relieving plug within the 30-gallon closure lid. The device is designed to release pressure between 12-15 psig and to reseal by 3 psig. The manufacturer shall verify by test the minimum following critical characteristics for the plug: relieving and resealing pressure. The test frequency shall be in accordance with sampling as specified by ANSI/ASQ Z1.4-2008, "Sampling Procedures and Tables for Inspection by Attributes" for an Acceptance Quality Limit (AQL) not greater than 2.5, as defined in Table II-A and Table II-B for single sampling plans; reduced inspection not permitted. [6]

The 9979 incorporates a DOW Chemical rigid polyurethane foam as an energy impact absorber and thermal barrier. The material tests prescribed in Appendix 8.1 shall be performed and documented on each batch of foam used in the construction of the 9979.

8.1.6 Shielding Tests

The 9979 packaging design does not include any shielding features. Therefore, acceptance of newly-fabricated packagings does not require testing of shielding integrity.

8.1.7 Thermal Tests

The 9979 packaging design does not incorporate active heat transfer features. Passive heat transfer mechanisms are not significantly sensitive to normal variations in the materials of construction or fabrication methods. Therefore, acceptance of newly fabricated packagings does not require testing of thermal integrity.

8.1.8 Miscellaneous Tests

Acceptance of newly fabricated 9979 packagings does not require additional acceptance testing.

8.2 MAINTENANCE PROGRAM

The 9979 packaging design does not require annual maintenance. The inspections required in Chapter 7 for normal use are sufficient to ensure performance of the packaging has not been degraded.

The User's Procurement Organization shall verify by direct inspection, or confirm via QA records, that acceptance testing and inspections were satisfied prior to releasing the 9979 packaging for package for shipment, see Section 9.7.

Packaging subassemblies may be repaired, refurbished, or replaced using procedures prepared and approved in accordance with the QA requirements given in Section 9.15. All such

repairs shall be documented in accordance with the requirements of Section 9.6. For serial numbers 0100-0599, see Appendix 8.2.

8.2.1 Structural and Pressure Tests

The 9979 packaging design does not require periodic structural or pressure tests.

8.2.2 Leakage Tests

The 9979 packaging design does not require periodic or pre-shipment leakage tests. However, the 9979 includes gasketed closures that provide weatherproof seals necessary for continued package performance. If during routine visual inspections described in Section 7.1.1 these gasket materials are found to be faulty, e.g., are cut, gouged, cracked, etc., that would otherwise be considered to change their performance they shall be replaced. Installation may be performed by the user with the same item as specified by the applicable drawing given in Appendix 1.1 or returned to the SRNL for repair. A cleaning and installation procedure is required and shall be approved by the SRNL Design Agency prior to any material retrofit.

8.2.3 Component and Material Tests

The 9979 packaging design does not include materials or components that require routine annual maintenance. Prior to shipment, pre-loading inspection requirements described in Section 7.1.1 will segregate out units that need repair.

8.2.4 Thermal Tests

The 9979 packaging design does not require annual thermal performance testing.

8.2.5 Miscellaneous Tests

A currently certified welding inspector must visually inspect all welds in accordance with the American Welding Society (AWS) D1.3.

8.3 APPENDICES

The appendices listed below by title are located at the end of the chapter.

8.1 Acceptance Tests for Dow BETAFOAM 87100/87124 in the 9979 Packaging

8.2 Procedure for Repair for Serial Numbers 11-0100 thru 11-0599

8.4 REFERENCES

1. *Packaging and Transportation of Radioactive Material*, Code of Federal Regulations, Title 10, Part 71, Washington, DC (January 2018).
2. Standard Format and Content of Part 71 Applications for Approval of Packaging for Radioactive Material, Regulatory Guide 7.9, Revision 2, U. S. Nuclear Regulatory Commission, Washington, DC (March 2005).
3. American Welding Society, D1.3, Structural Welding Code - Sheet Steel - 5th Edition, (November 2008).
4. American Welding Society, C1.4, Structural Welding Code – Specification for Resistance Welding of Carbon and Low-Alloy Steels, 2nd Edition, (2009).
5. Recommend Practice Number SNT-TC-1A – Non-Destructive Testing, American Society of Non-Destructive Testing, ASNT SNT-TC-1A (2011).
6. American National Standard, *Sampling Procedures and Tables for Inspection by Attributes*, ANSI/ASQ Z1.4-2008.

Safety Analysis Report - 9979 Packaging

CHAPTER 9

QUALITY ASSURANCE REQUIREMENTS

Preface

The Quality Assurance (QA) requirements for ensuring the safety of the package, as applied by Savannah River Nuclear Solutions (SRNS) at the Savannah River Site (SRS) are provided in this chapter. Requirements provided include the QA methodology and applicable areas of package design, purchasing, fabrication, handling, shipping, storage, cleaning, assembly, inspection, testing, operation, maintenance, repair, and component modification.

This chapter meets the requirements of, and is organized in accordance with the 18 criteria of Subpart H of 10 CFR 71[1], as presented in Sections 9.1 through 9.18. Non-SRNS users of the package are responsible for setting up comparable QA programs.

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TABLE OF CONTENTS

LIST OF TABLES

Page

LIST OF FIGURES

Page

9.0 QUALITY ASSURANCE

Quality Assurance (QA) comprises those planned and systematic actions necessary to provide adequate confidence that a system or component will perform satisfactorily in service.

Purpose

Chapter 9.0 establishes Quality Assurance (QA) requirements applying to all activities related to the 9979 packaging that are important to safety. All personnel whose activities affect the quality of any aspect of the packaging are subject to the requirements of this chapter in accordance with their degree of involvement.

Scope

Chapter 9.0 establishes QA requirements that apply to the design, procurement, fabrication, handling, shipping, storage, cleaning, assembly, use, periodic inspection, acceptance testing, maintenance, repair, and modification of the packages in accordance with the requirements specified in the regulations of the U.S. Department of Energy (DOE) and the U.S. Department of Transportation (DOT). The chapter also describes the QA Program necessary to meet the requirements of Title 10 of the Code of Federal Regulations (CFR), Part 71, Subpart H and is presented in the format of the Nuclear Regulatory Commission Regulatory Guide 7.10[2] and ASME-NQA-1.[3]

9.1 QUALITY ASSURANCE ORGANIZATION

This section introduces the package Owner, Design Authority, Design Agency, package User, and QA organizations. Figure 9.1 shows a SRNS organizational chart depicting the three responsible QA groups: SRNS Design Agency, User organization, and Procurement Management. The QA organization is within each of these main organizations and will be referred throughout this chapter are:

- Design Agency QA
- User QA
- Procurement Agency QA
- Supplier QA

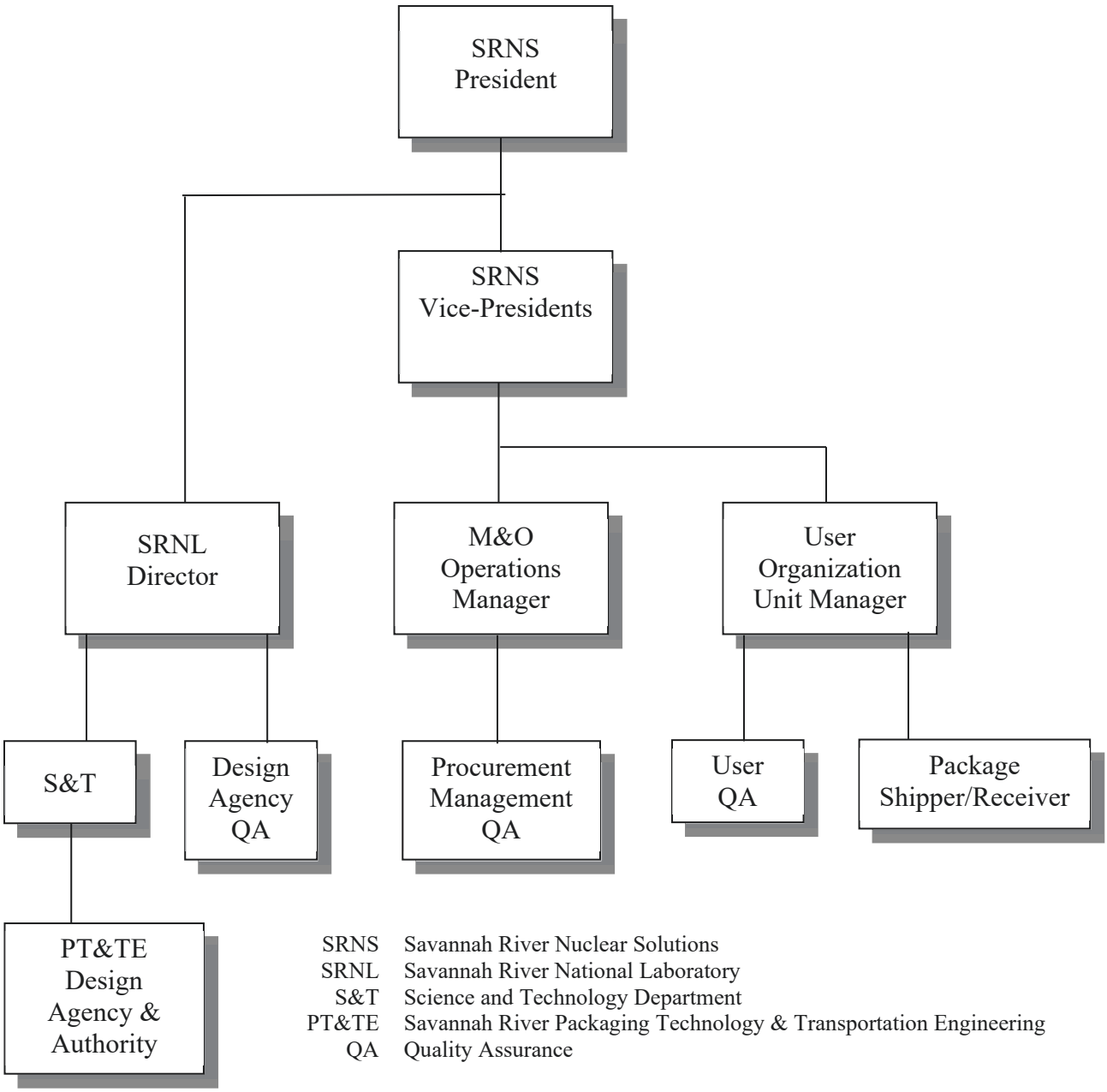

Figure 9.1 - SRS Quality Assurance Functional Organization Chart

9.1.1 *Package Owner – Savannah River Nuclear Solutions*

SRNS is the Savannah River Site (SRS) Management Contractor acting for the DOE, and as such has accepted the responsibilities of Owner for DOE 9979 packagings, until otherwise directed by the DOE. SRNS conducts its business consistent with the requirements of its DOE-approved QA Program as presented in the SRNS *Quality Assurance Manual*.[4] In those instances where DOE designates another organization as the owner, that organization shall have comparable QA controls. All organizational elements of SRNS are required to implement the applicable QA program elements consistent with the appropriate sections of American Society of Mechanical Engineers (ASME), Nuclear Quality Assurance NQA-1 and Subpart H of 10 CFR 71. A comparison of the SRNS QA Program to the 10 CFR 71, Subpart H program elements is provided in Table 9.1.

9.1.2 *Design Authority and Design Agency -- Savannah River Packaging Technology*

The Packaging Technology and Transportation Engineering (PT&TE) organization of the Savannah River National Laboratory (SRNL) is the designated Design Authority and is responsible for the changes to, and final acceptance of, the design of the package. PT&TE is the SRNS-designated Design Agency for the 9979 packaging.

9.1.3 *Package User – SRNS and Others*

A package User ships and receives materials in that specific package. SRS and DOE Complex-Wide shippers are responsible for the QA controls necessary to ensure that the certified packages and their use, maintenance, and testing meet the requirements of this Safety Analysis Report for Packaging (SARP) and the Certificate of Compliance (CoC).

SRNS is a package User. Any organization outside of SRNS that intends to maintain, ship, or receive loaded or empty 9979 packages is a non-SRNS User. The SRNS User is responsible for preparation and implementation of facility-specific, detailed compliance procedures. All users of the 9979 package shall have in place a QA program that is compliant with Subpart H of 10 CFR 71.

9.1.4 *Quality Assurance*

Several organizational elements provide SRS QA support for the package. The SRNL QA Department is the SRNS Design Agency QA and responsible for performing QA audits and carrying out surveillance and inspection functions for the activities performed by the SRNS Design Agency. The SRNS Design Agency QA is also responsible for reviewing and approving the procurement documents for prototype and/or production units. The Procurement QA Department is the SRNS Design Agency QA and responsible for performing QA audits and carrying out surveillance and inspection functions for the activities performed by the SRNS Design Agency.

The SRNS Users QA organization monitors the activities by performing QA audits, surveillance, and inspections. In addition, these organizations are responsible for reviewing and approving procedures and procurement documents for certified packagings.

The SRNS QA Program contains provisions for maintenance of the 1Q Quality Assurance Manual as well as for providing training and certification of QA personnel at the SRS. In addition, the QA Program contains provisions for supplier evaluations, surveillance, and receiving inspection.

The duties and responsibilities of the SRNS Users QA organization include, but are not limited to, the following:

- Reviewing and approving the administrative procedures of their respective organizations that implement the requirements of the SRNS User's QA program
- Reviewing and approving selected operating procedures prepared within the performing organization for quality-related activities
- Assisting the line organization in problem identification and problem solving
- Reviewing nonconformance documentation
- Performing and documenting independent inspections and tests where applicable
- Evaluating selected QA data and reporting results to appropriate levels of management
- Identifying and documenting, through inspection planning and/or procedure review, necessary witness and hold points
- Issuing Stop-Work Orders when conditions adverse to quality require immediate corrective action
- Assessing the adequacy of the SRNS User organization's QA Program.

The SRNS User QA organization shall monitor the activities of its SRNS Users by performing QA audits, surveillance and inspections. In addition, the SRNS User QA organization is responsible for reviewing and approving procedures that implement the requirements of this SARP.

Table 9.1 - SRNS Quality Assurance Program and Corresponding Regulatory Criteria

10 CFR 71 Subpart H Criterion	10 CFR 71 Subpart H Title	SRNS Manual 1Q Section	Manual 1Q Section Title	Description
1 (71.103)	QA Organization	1.0	Organization	Establishes and describes the responsibilities and requirements for SRNS organizations that provide for the achievement and verification of quality in the items produced and activities performed under the direction of SRNS. Additionally, it establishes the responsibilities and defines the requirements for the initiation and resolution of formal Stop Work Orders issued to SRNS organizations.
2 (71.105)	QA Program	2.0	QA Program	Provides requirements for the SRNS QA Program. This documented QA Program includes policy, plans, manuals and implementing procedures or instructions required to define and control activities affecting quality.
3 (71.107)	Package Design Control	3.0 20.0	Design Control Software QA	The SRNS QA Manual uses two sections to describe the responsibilities and requirements necessary to meet Regulatory Element 3. Section 3 defines the responsibilities and requirements for SRNS's design control activities. Section 20, "Software Quality Assurance," is an extension of Design Control.
4 (71.109)	Procurement Document Control	4.0	Procurement Document Control	Defines responsibilities and requirements for processing and controlling documents associated with the SRNS procurement cycle.
5 (71.111)	Instructions, Procedures, and Drawings	5.0	Instructions, Procedures, and Drawings	Establishes the SRNS responsibilities and requirements for the systematic control of written management direction in the form of instructions, procedures and drawings.
6 (71.113)	Document Control	6.0	Document Control	Describes the requirements to ensure that information is controlled and provided to the user as needed to perform quality-related activities
7 (71.115)	Control of Purchased Material, Equipment, and Services	7.0	Control of Purchased Items and Services	Defines the requirements and responsibilities for establishing procurement levels at SRNS, the QA controls associated with those levels and the control of purchased items and services.
		7.3	Commercial Grade Item Dedication	Establishes the minimum requirements for the dedication of commercial grade items for use in Category A and B "Q" Item applications.
8 (71.117)	Identification and Control of Materials, Parts, and Components	8.0	Identification and Control of Items	Defines the requirements and responsibilities for the identification and control of items.

Table 9.1 (continued)

10 CFR 71 Subpart H Criterion	10 CFR 71 Subpart H Title	SRNS 1Q Manual Section	1Q Section Title	Description
9 (71.119)	Control of Special Processes	9.0	Control of Processes	Defines the responsibilities and requirements for performing processes for product acceptance or continued service. Special processes such as welding, heat treating, brazing, chemical cleaning, soldering, bonding, and nondestructive examination (NDE) are included within this section.
10 (71.121)	Internal Inspection	10.0	Inspection	Establishes the requirements and responsibilities for specifying, planning, performing and documenting independent inspection and peer verification.
11 (71.123)	Test Control	11.0	Test Control	Provides the requirements and responsibilities for planning, performing and documenting tests.
12 (71.125)	Control of Measuring and Test Equipment	12.0	Control of Measuring and Test Equipment	Defines the requirements and responsibilities for the control of Standards and Measuring and Test Equipment.
13 (71.127)	Handling, Storage, and Shipping Control	13.0	Packaging, Handling, Shipping, and Storage	Defines the requirements and specifies the responsibilities for the handling, shipping, packaging and storage of items to prevent damage, deterioration or loss.
14 (71.129)	Inspection, Test, and Operating Status	14.0	Inspection, Test, and Operating Status	Establishes the methods and requirements associated with status indicators used to prevent inadvertent use or installation of unacceptable or unqualified items.
15 (71.131)	Non-conforming Materials, Parts, or Components	15.0 19.0	Control of Non-conforming Items Quality Improvement	Describes a system for identifying and resolving nonconforming items. SRNS Quality Assurance Manual 1Q, Section 19, "Quality Improvement," is an extension of Control of Non-conforming Items.
16 (71.133)	Corrective Action	(See Note)		Establishes responsibilities and requirements for the SRNS corrective action system to assure that Significant Conditions Adverse to Quality are identified, reported and corrected to preclude recurrence.
17 (71.135)	Quality Assurance Records	17.0	Quality Assurance Records	Establishes requirements for the preparation, indexing, validation, receipt, storage and correction of documents designated as QA records.
18 (71.137)	Audits	18.0	Audits	Defines the SRNS QA requirements for the Audit Program.

Note: The requirements of 10 CFR 71.133 are met in SRNS Manual 22Q, Procedure CAP-1, "Corrective Action Program".

9.2 QUALITY ASSURANCE PROGRAM

9.2.1 *General*

The SRNS Management and Operations (M&O) Quality Assurance Program Document (QAPD)[5] is the governing document for the SRNS Packaging and Transportation Program. The SRNS Quality Assurance Manual describes the procedures to be followed in implementing the QAPD. The SRNS Quality Assurance Manual QA Program complies with DOE Order 460.1D[6] and 10 CFR 830, Subpart A.[7] The QA program contains supplemental controls that maintain compliance with Subpart H of 10 CFR 71 and with NQA-1. The interrelationship among the SRNS QA Program documents, including implementing procedures, is depicted in Figure 9.2.

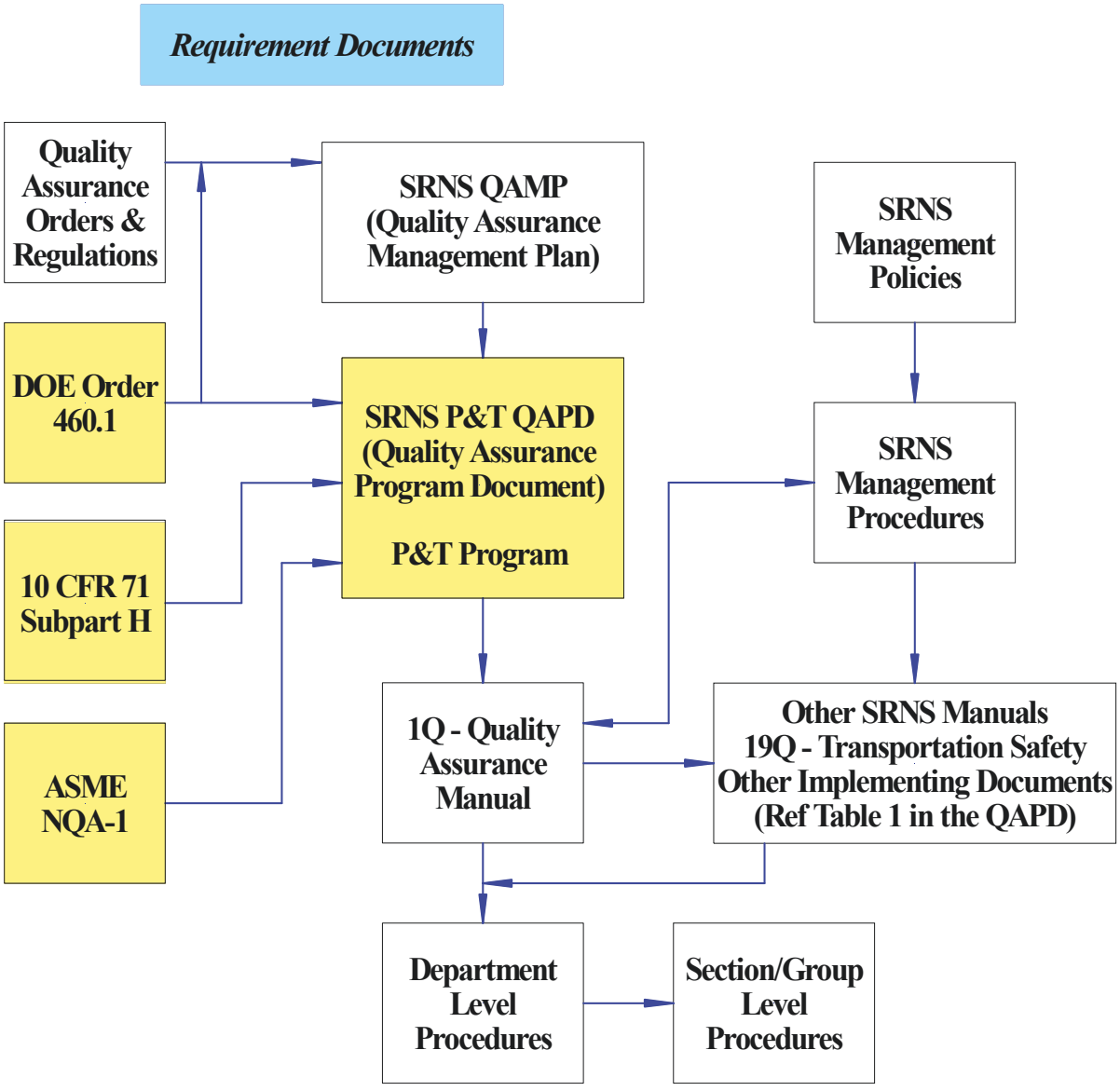

Figure 9.2 - SRNS Quality Assurance Program Description Documents

At the SRS, the SRNS Design Agency, in combination with the QA organizations, the SRNS Users, and Procurement organizations, controls activities related to the design, procurement, fabrication, handling, shipping, storage, cleaning, assembly, periodic inspection, acceptance testing, maintenance, repair and modification of the packages. Control of fabrication, examination and inspection is ensured by including appropriate sections of NQA-1 requirements in the procurement specifications. The performing organization and the respective QA organizations implement the requirements of the SRNS QA Program by using the QA procedures contained in the SRNS *Quality Assurance Manual* or through the use of implementing procedures and instructions provided in derivative procedures (see Figure 9.2 for depiction of the SRNS QA Program document relationships). Activities important to safety are performed using specified equipment and under suitable environmental conditions.

All SRNS employees are responsible for implementing the requirements of the SRNS *Quality Assurance Manual* within the limits of their job assignments. SRNS management assesses the proper implementation, adequacy and effectiveness of the QA Program at least annually. Documentary evidence and independent verification, where appropriate, are used to demonstrate that specific objectives are achieved.

Personnel who perform inspections, tests and examinations are qualified in accordance with applicable requirements, including specific provisions for education and/or experience. Qualification programs include documentation of capability, through either written testing or physical demonstrations of skill, as well as evidence of maintenance of proficiency based on retraining or continued satisfactory performance. Certificates of qualification, or other similar documentation, specify activities for which the individual is qualified and the basis for their certification.

The initial and continuing employee indoctrination program consists of:

- General employee indoctrination managed by Training Integration.
- Area/division indoctrination as established by the Business Units.
- Radiation Worker Training managed by the Environmental, Safety and Health Department.

General QA program indoctrination shall be a part of employee indoctrination and provide familiarization with the QA Program administered at SRNS. The SRNS Design Agency QA shall develop and implement the QA indoctrination program and the training for the applicable site QA Program elements as defined in the SRNS *Quality Assurance Manual*.

At a minimum, indoctrination shall include familiarization with requirements associated with the applicable aspects of the following as related to the job function:

- General criteria including codes and standards and their technical objectives
- Administrative and implementing procedures
- Applicable QA Program elements
- Job responsibilities and authorities

9.2.2 *Package Program*

The 9979 package was designed and tested as described in Chapters 1 through 8 of this document. QA requirements are invoked in the design, procurement, fabrication, assembly, testing, maintenance, and use of the package to ensure that established standards are maintained. Items and activities to be controlled and documented are described in this chapter.

At SRS, the requirements of the SRNS *Quality Assurance Manual*, in conjunction with procedures written to address specific shipping activities, are implemented by the appropriate SRNS User.

Training in the use of the package is documented and maintained in the Operators' training files. Personnel from the SRNS User QA shall monitor and review operations at least annually and report to management independent of the operation being monitored.

9.2.3 *Safety-Related Items*

Safety-related or "Q" items have been determined for the packages on the basis of the following definitions:

- **"Q" item** — Safety-related item, judged to have a significant impact on nuclear criticality control, off-site contamination release, or operations personnel exposure. "Q" items require a formal QA program.
- **Non-"Q" item** — Not related to safety and requires no formal QA program.

The SRNS Design Agency subcategorized "Q" items as A, B, or C according to Nuclear Regulatory Commission Regulatory Guide (RG) 7.10 and NUREG/CR-6407 [8] . Category A items are critical to safe operation; Category B items have a major impact on safety; Category C items have a minor impact on safety; and Non-Q items are not important to safety. In accordance with NUREG/CR-6407, a Commercial Grade Dedication program may be used for Category A and B "Q" Items.

Table 9.2 presents the correlation between the RG 7.10 categories and the SRNS program safety designations.

Table 9.2 - Comparison of RG 7.10 and SRS Safety Designations

RG 7.10 Safety Designation	SRNS Safety Designation
A	Safety Class
B	Safety Significant
C	Production Support
Non-Q	General Services

QA Categories and functions of the package components are listed in Table 9.3. The level of QA effort for each QA category is indicated in Table 9.4. This graded QA effort is implemented by the SRNS *Quality Assurance Manual* 1Q.

The package has undergone an assessment to determine which components are significant to safety (the A, B, or C "Q" items) and what steps or procedures are required to verify their adequacy. Table 9.3 presents the assessment to determine the category of safety associated with each packaging component.

Table 9.3 - Safety Assessment of Packaging Features

Feature	Q Category	Function	Component Name	Drawing Number
30- Gallon Drum Assembly				
Drum Body	A	Contain Payload	1A2 30-Gallon Drum Body	R-R2-G-00058
Drum Closure Lid	A	Contain Payload	1A2 30-Gallon Closure Lid	R-R2-G-00060
Split-Ring Closure including Screws	A	Contain Payload	30-Gallon Split-Ring Closure	R-R1-G-00026
Closure Gasket	A	Contain Payload	Silicone Gasket	R-R4-G-00062
Pressure Relieving Plug (2-inch)	B	Limit pressures in 30-gallon drum	2-inch Pressure Relieving Plug	R-R1-G-00028
*Steel Plug (3/4-inch)	B	Provides containment at drum pressures	¾-inch Steel Plug	R-R1-G-00028
Drum Ceramic Insulation	B	Additional Insulation for Heat-Sensitive Payloads Only	Thermal Insulation Bag	R-R4-G-00064
55 - Gallon Drum Assembly				
Overpack Body	B	Confine and Protect 30-gallon drum	55-Gallon Overpack Body	R-R2-G-00057
Overpack Closure Lid	B	Confine and Protect 30-gallon drum	55-Gallon Overpack Closure Lid	R-R1-G-00059
Split-Ring Closure including Bolts	B	Confine and Protect 30-gallon drum	55-Gallon Split-Ring Closure	R-R1-G-00027
Overpack Closure Gasket	B	Confine and Protect 30-gallon Drum	EPDM Gasket	R-R1-G-00029
Polyurethane Foam Insulation	B	Insulate 30-Gallon Drum from Impact and Fire under HAC	Dow BETAFOAM™	R-R2-G-00057
Package Identification Plate	C	Identify the Packaging	Identification Plate	R-R2-G-00057
Tape	C	Weather Protection	Tape, waterproof	R-R2-G-00057 R-R2-G-00059

Table 9.3 - Safety Assessment of Packaging Features (Continued)

Feature	Q Category	Function	Component Name	Drawing Number
Other Packaging Components				
Insulation Blanket	B	Insulate 30-gallon Drum from HAC fire	Superwool Blanket	R-R4-G-00065

*3/4" Bung hole feature optional; Plug and gasket required if hole is present

Critical items that require independent QA verification to ensure the safe operation of 9979 packaging are listed below.

1. Confirmation that the cavity within the 55-gallon drum assembly, R-R1-G-00029, will accept a 30-gallon drum assembly, R-R-G-00028 without binding.

2. Verification that the 30 and 55-gallon split-ring closures can be tightened to 40-ft lbs on the drum assemblies, (R-R1-G-00029 and R-R-G-00028), without the ends touching.

3. Verification that the polyurethane foam specified on Drawing R-R2-G-00057 and R-R2-G-00059 is installed in accordance with Chapter 8, Section 8.1.1 and Appendix 8.1.

4. Verify that all documentation required by the procurement contract is complete.

Table 9.4 - Level of Quality Assurance Effort for Q Categories

QA Element	Level of Effort	Q Category		
		A	B	C
1	Quality Assurance Organization			
	• Structure and authority	X	X	X
	• Responsibilities defined	X	X	X
	• Reporting levels established	X	X	X
	• Management endorsement	X	X	X
2	Quality Assurance Program			
	• Procedures written	X	X	X
	• Trained personnel	X	X	X
	• Activities controlled	X	X	X
3	Package Design Control			
	• Most Stringent Codes and Standards	X		
	• Codes and Standards	X	X	
	• Control of design verification (prototype tests/ analysis)	X	X	
	• Formal Design Review	X	X	
	• Control of design process (Peer Review)	X	X	
	• Control of design input	X	X	
	• Commercial item (off-the-shelf)			X
	• Conditions of Approval Controlled	X	X	X
	• Software Control	X	X	X
4	Procurement Document Control			
	• Complete traceability	X	X	
	• Qualified suppliers list	X		
	• Off-the-shelf item			X
5	Instructions, Procedures and Drawings			
	• Must be written and controlled	X	X	
	• Qualitative or quantitative acceptance criteria	X	X	
	• Changes to conditions of approval listed in Certificate controlled	X	X	X
	• Standard work practices are acceptable		X	X
6	Document Control			
	• Issue must be controlled	X	X	
	• All changes must be controlled	X	X	
	• Procurement documents	X	X	X
7	Control of Purchased Material , Equipment, and Services			
	• Source evaluation and selection plans	X		
	• Evidence of QA at supplier	X	X	
	• Inspections, audits or surveillance at supplier	X		
	• Formal receiving inspection	X	X	X
	• Objective proof that all specifications are met	X	X	X
	• Commercial Grade dedicated Items acceptable	X	X	

(Continued)

Table 9.4 (continued)

QA Element	Level of Effort	Q Category		
		A	B	C
8	Identification and Control of Material, Parts, and Components			
	• Positive identification and traceability of each item	X		
	• Identification and traceable to heats, lots or other groupings	X	X	
	• Identification to end use drawings, etc.	X	X	X
9	Control of Special Processes			
	• All welding, heat treating, and nondestructive testing done by qualified personnel	X	X	
	• Qualification records and training of personnel	X	X	
	• No special processes			X
10	Internal Inspection			
	• Documented inspection of all specifications required	X		
	• Examination, measurement, or test of material or processed product to assure quality	X	X	
	• Process monitoring if quality requires it	X		
	• Inspectors must be independent of those performing operations	X	X	
	• Qualified inspectors only	X	X	
	• Receiving inspection	X	X	X
11	Test Control			
	• Written test program	X	X	
	• Written test procedures for all requirements in the package approval	X	X	
	• Documentation of all testing and evaluation	X	X	
	• Buyer's representative observes all supplier acceptance tests	X		
	• No physical tests required			X
12	Control of Measuring and Test Equipment			
	• Tools, gauges, and instruments must be in a formal calibration program	X	X	
	• Only qualified inspectors	X	X	
	• No test required			X
13	Handling, Storage, and Shipping Control			
	• Written plans and procedures required	X	X	
	• Routine handling			X
14	Inspection, Test, and Operating Status			
	• Individual items identified as to status or condition	X	X	
	• Stamps, tags, labels , etc., must clearly show status	X	X	
	• Visual examination only			X

(Continued)

Table 9.4 (continued)

QA Element	Level of Effort	Q Category		
		A	B	C
15	Nonconforming Materials, Parts or Components			
	• Written program to prevent inadvertent use	X	X	
	• Nonconformance must be documented and closed	X	X	
	• Disposal without records			X
16	Corrective Action			
	• Written plan to correct all conditions adverse to quality	X	X	X
	• Cause and corrective action documented	X	X	
	• Safety significant events reported	X	X	X
17	Quality Assurance Records			
	• Design and use records	X	X	
	• Results of reviews, inspections, test, audits, surveillance, and materials analysis	X	X	
	• Personnel qualifications	X	X	
	• Records of fabrication retained throughout the life of package plus 3 years	X	X	
	• Records of acceptance testing retained throughout the life of package plus 3 years	X	X	
	• Records of maintenance retained throughout the life of package plus 3 years	X	X	
	• Record of package use kept for 3 years after shipment	X	X	X
	• All records managed by written plans for retention and disposal	X	X	X
	• Procurement records	X	X	X
18	Audits			
	• Written plan of periodic audits	X	X	X
	• Implementation by written procedure	X	X	X
	• All certified auditors	X		
	• Lead auditor certified	X	X	

9.3 PACKAGE DESIGN CONTROL

9.3.1 *Design Control*

The Design Agency shall establish measures for the identification and control of design interfaces and for coordination among participating design organizations. These measures must include the establishment of written procedures, among participating design organizations, for the review, approval, release, distribution, and revision of documents involving design interfaces. The design control measures must provide for verifying or checking the adequacy of design, by methods such as design reviews, alternate or simplified calculational methods, or by a suitable testing program. For the verifying or checking process, the licensee shall designate individuals or groups other than those who were responsible for the original design, but who may be from the same organization. Where a test program is used to verify the adequacy of a specific design feature in lieu of other verifying or checking processes, the licensee shall include suitable qualification testing of a prototype or sample unit under the most adverse design conditions. The licensee shall apply design control measures to items such as the following:

- Criticality physics, radiation shielding, stress, thermal, hydraulic, and accident analyses
- Compatibility of materials
- Accessibility for in-service inspection, maintenance, and repair
- Features to facilitate decontamination
- Delineation of acceptance criteria for inspections and tests

The SRNS Design Agency shall submit all package design changes, including field changes, to design-control measures commensurate with those applied to the original design. Changes in the parameters specified in the CoC require DOE approval.

The SRNS Design Authority shall review and approve all changes to this design. The design includes the physical dimensions for the package, dimensional tolerances and necessary material and testing specifications.

All design changes affecting the safety, configuration and functional design of the package that are not addressed in this SARP must be reviewed and approved by the SRNS Design Agency before requesting approval from the DOE Certifying Authority.

After the package design and the SARP is finalized and approved by DOE Certifying Authority, a CoC is issued. Revisions to the package shall be made in accordance with the following requirements:

- Requests for design modifications shall be routed to the SRNS Design Agency. Modifications include any deviation from the evaluated contents or their configuration within the package or from the specified packaging design and drawings or any revision to the specified design. The SRNS Design Agency shall determine if the modification affects the safety performance of the packaging or the conditions of approval as cited in the CoC.

- The SRNS Design Agency shall perform all design modifications. The SRNS Design Agency and the SRNS Design Authority shall approve all modifications. The DOE Certifying Authority is the final approver.
- The SRNS Design Agency shall submit modifications affecting safety performance or the certification conditions of approval to the certifying official for approval prior to implementation. Modifications that do not affect the safety performance or the certification conditions shall be accumulated and included no later than the next SARP revision and or certificate extension, whichever occurs first.
- Approved SARP revisions shall be distributed on a timely basis to all holders of controlled copies of the SARP.

9.3.2 *Software Control*

The Code of Federal Regulation 10 CFR 71 Subpart H includes the Control of Software in Criterion 3.0. However, SRNS Manual 1Q Section 20.0 defines the QA requirements for software control. Section 20.0 defines design, testing, validation, operation, maintenance, and configuration control requirements for software. Also, defined and specified are requirements for the purchase of software using the procurement process controlled per SRNS Quality Assurance Manual Sections 4.0 and 7.0. Levels A, B, and C software are purchased as SRNS Procurement Levels 1, 2, and 3 respectively. In addition, Section 20.0 specifies that existing or acquired software that was not developed in accordance with Section 20.0 be classified, evaluated, placed under configuration control, and controlled in accordance with the remaining life cycle requirements of the program.

Software is controlled throughout its life cycle, using a graded approach based upon its software classification level. Additive controls are defined at each higher level. The three software classification levels important to the 9979 are Levels A, B, and C that correspond to the A, B, and C Level defined in Table 9.2.

This section applies to software used in the design, procurement, fabrication, handling, shipping, storing, cleaning, assembly, inspection, test, operation, maintenance, repair, modification, and use of the 9979 packaging.

9.4 PROCUREMENT DOCUMENT CONTROL

Purchasers of packages and replacement items shall use a graded QA approach. As noted in Section 9.2.3 and Table 9.3, the "A" items are critical to safe operation and are subject to the most stringent quality controls.

Procurement Agency QA Procurement documentation specifications shall contain the applicable requirements including, as appropriate, standards, specifications, codes, documentation and any other special conditions. Specifications prescribe the necessary inspections, tests and other pertinent QA considerations as well as packaging, shipping and handling requirements.

The initiator of the purchase requisition or order is responsible for including the applicable QA requirements on the requisition and for obtaining proper approval signatures. Suppliers are evaluated to assess the supplier's capability to meet the QA program requirements specified in the procurement documents. Also, where sub-tier suppliers are involved, the QA provisions appropriate to these procurements are specified. The extent of the supplier's or sub-tier supplier's QA program depends on the particular item or service being procured.

The SRNS Design Agency is responsible for package design and shall approve the procurement specifications issued for all new packages. A new package shall be fabricated by a supplier that has been evaluated and approved in accordance with a DOE-approved QA Program. Before fabrication begins, the supplier shall have a QA program in place that includes those elements of NQA-1 that have been specified by the SRNS Design Agency QA, the SRNS User QA, and the Receiver's QA organizations.

At the SRS, changes to the procurement documents must be approved by the organizations that approved the original documents.

9.5 INSTRUCTIONS, PROCEDURES AND DRAWINGS

Activities concerning loading, leak-rate testing and shipping are performed in accordance with operating procedures developed by the package SRNS User. Requirements, including sequential setups, technical constraints, acceptance criteria and references, will be specified in the written operating procedures. Procedures are issued as controlled documents.

Personnel must receive appropriate training in the procedural requirements on the basis of the particular aspects of the procedure in which they are involved. Chapter 7, *Package Operations*, of this SARP provides specific information governing loading and unloading procedures for these packages. Chapter 8, *Acceptance Tests and Maintenance Program*, of this SARP provides specific information governing acceptance tests, inspections and maintenance activities associated with these packages. Changes in the approved procedures require the same level of approval as the initial issue.

The SRNS User organization must prepare written procedures or instructions for repair, rework, modification and maintenance of packages and components and obtain approval of these procedures or instructions prior to their use. Inspection, testing and independent verification, if required, will be included in the procedures.

The SRNS Design Agency is responsible for the preparation of package design drawings and subsequent drawing revisions. The drawings are issued as controlled documents.

9.6 DOCUMENT CONTROL

Each department within SRNS is responsible for the establishment, development, review, approval, distribution, revision and retention of its own documents. A document is a publication that prescribes requirements for items or activities affecting quality. Documents are controlled to ensure that correct versions (e.g., current revision) are being used and to provide assurance that record requirements are met. Documents requiring control, the level of control and personnel responsibilities (including training requirements) are defined in SRNS departmental procedures. Upon completion, many of these documents become QA Records.

Documents to be controlled include the following as a minimum:

- Design documents
- Prototype test plan and procedures
- Procurement documents
- QA and Quality Control manuals
- Maintenance and modification procedures and log
- Inspection and test procedures
- Nonconformance reports
- Design change requests
- Shipment documentation
- Repair procedures
- Certificate of Compliance and the SARP and its amendments
- Loading and unloading procedures
- Packaging for transport procedures
- Fabrication records
- Drawings of packages and components
- Test reports/records (prototype, fabrication, periodic, post-load, and post-maintenance or modification)

Section 9.3 defines controls for modification of design basis documents. Revisions to documents are handled in a manner similar to the original issue via review and approvals from the original departments. Document control measures ensure that only the currently approved version is available for use at the work facility.

9.7 CONTROL OF PURCHASED MATERIAL, EQUIPMENT AND SERVICES

Established procedures ensure that purchased materials, equipment and services conform to procurement document requirements. The procurement process for the package incorporates the graded approach defined in Appendix A of Regulatory Guide 7.10.

The procurement of replacement parts shall be done under a QA program that meets the requirements of 10 CFR 71, Subpart H. Procurement documentation specifications shall contain the applicable requirements including (as appropriate) standards, specifications, codes, documentation, and any other special conditions. Specifications prescribe the necessary inspections, tests and other pertinent QA considerations as well as packaging, shipping, and handling requirements.

Only evaluated and approved manufacturers may supply packages. The suppliers must submit a copy of their administrative procedural controls and a Manufacturing and Inspection Plan (MIP) for the SRNS Design Agency review and approval prior to the start of fabrication. The SRNS Design Agency and the purchaser use the MIP to establish witness and hold points to be observed during the manufacture of the packages. The supplier's QA program must address the requirements of ASME NQA-1, with the exception of Design Control.

The supplier's MIP shall address the following items as required in the procurement specifications:

- Material identification and material certifications including traceability of materials
- Welding procedure specifications and welding procedure qualification records
- Welder qualification records and process qualification
- Types of inspections and tests to be performed and by whom
- NDE procedures
- NDE personnel qualification records
- Weld inspection records
- NDE reports
- Dimensional inspection reports
- Cleaning procedures
- Procedures for controlling nonconformance
- Manufacturing and test procedures
- Qualifications of individuals involved in the QA support for these packagings

Where a commercial grade item or service is designated as Category A or B for safety, Appendix 9.1 presents the dedication process that establishes a minimum set of requirements and activities to ensure the item or service is acceptable for use in the 9979 packaging.

9.8 IDENTIFICATION AND CONTROL OF MATERIALS, PARTS AND COMPONENTS

Items that require protection to ensure their intended use or that have unique characteristics must be identified and controlled throughout fabrication, assembly and storage. Traceability of these controlled items must be ensured. Each SRNS User is responsible for identifying these items and the level of control to be maintained.

Any packaging component not meeting all specifications shall have a Nonconformance Report (NCR) issued against it and shall be tagged and segregated until the disposition of the NCR has been approved and implemented.

Equivalent to the original parts, replacement parts must be identified clearly to ensure correct usage.

9.9 CONTROL OF SPECIAL PROCESSES

During fabrication, the drum seams may be resistance welded in accordance with SRNL-L4410-2011-00025[11] or data sheet M-DS-A-00078[12] and visually examined per AWS C1.4. Alternatively, the longitudinal seam may be a GTAW in accordance with AWS D1.3[9,10]. All arc welding is performed in accordance with AWS D1.3[9] and data sheet M-DS-A-00079[13]. Stud welding, if used, is performed in accordance with data sheet M-DS-A-00077.[14]

The installation of the polyurethane foam into the drum weldment shall be controlled to a procedure prepared by the Supplier and approved by the Design Authority. A controlled procedure assures that the polyurethane foam is installed correctly with no significant voids in the foam.

During fabrication, independent inspectors shall verify foam installation and carry out other inspections as required by the procurement documents.

9.10 INTERNAL INSPECTION

The packaging is required to undergo fabrication inspections by the supplier and independent inspections performed by the purchaser.

Supplier inspections (as defined in the MIP) are designed to ensure that an accepted packaging or item conforms to the tested and certified design criteria. The supplier is required to submit an MIP for approval prior to the start of fabrication. Approvers of the MIP include SRNS Design Agency, and QA (e.g., SRNS User QA). The MIP is a tool for establishing witness and hold points. The MIP details how fabrications and inspections are to be performed and describes the qualifications of the suppliers and inspectors. Inspections shall be documented and the results shall be delivered to the purchaser along with the packaging. The MIP establishes methods, equipment and personnel qualifications. Supplier conformance with the requirements of the MIP is verified and is monitored by the SRS Source Surveillance Representative.

Independent inspections shall be performed by qualified inspectors. The activities shall include verifications of conformance with accept/reject criteria, completion of prerequisites, personnel qualifications and equipment calibrations.

Inspections shall be performed upon receipt of the packaging, prior to first usage (implemented by SRNS User procedures), and annually. Post-loading inspections shall be performed prior to shipment in all cases.

Procedures shall be established by the Supplier and approved by the Purchaser and the SRNS Design Agency to ensure that inspectors are qualified in accordance with applicable codes and standards, as well as with the SRNS User's training program. The procedures require that the inspection personnel certifications are kept current and that inspection personnel are independent from individuals performing the activity being inspected.

The inspections to be performed by qualified personnel shall include the inspections or examinations included in Chapter 7, *Package Operations*, and in Chapter 8, *Acceptance Tests and Maintenance Program*. Required inspections and examinations are reported as part of the package documentation record.

9.11 TEST CONTROL

Personnel conducting tests, the test equipment and the test procedures must be qualified with appropriate documentation as listed in the SRNS *Quality Assurance Manual*. The test control procedures shall provide for a written test program supported by approved procedures. The test program shall require documentation of the test objectives, conditions and results. Acceptance tests performed by the supplier shall be observed by the owner or owner representative. The requirements for testing the package and its components are provided in Chapter 8.

Acceptance testing of the package is in accordance with the requirements of Section 8.1 of Chapter 8. Maintenance testing of the accepted package is performed in accordance with the requirements of Section 8.2.

9.12 CONTROL OF MEASURING AND TEST EQUIPMENT

Measuring and Test Equipment (M&TE) is defined as devices or systems used to calibrate, measure, gage, test or inspect, in order to control and validate acquired data and to verify conformance to specified requirements. M&TE used for acceptance and verification is maintained under control systems that identify the status of all M&TE. Calibration procedures, as well as vendor manuals, detail the requirements for M&TE calibration (including frequency and maintenance), the use of appropriate standards and organizational responsibilities for establishing, implementing and ensuring effectiveness of the calibration program. Measuring and test instruments are calibrated with standards traceable to the U.S. National Institute of Standards and Technology.

Procedures are designed to ensure accuracy within established standards and include disposition and/or corrective measures when discrepancies are noted. Damaged or inaccurate M&TE is immediately removed from service until repaired, recalibrated or replaced. If M&TE is found to be out of calibration, the validity of previously performed inspections is determined and documented. If previously performed inspections are determined to be invalid, a nonconformance report shall be completed and dispositioned in accordance with the requirements of this chapter. If any M&TE is consistently out of calibration, it shall be repaired or replaced.

9.13 HANDLING, STORAGE, AND SHIPPING CONTROL

The SRNS User and/or Applicant shall develop written operating procedures from the procedural requirements presented in Chapter 7 to address handling and storage of the package components. These procedures must identify appropriate information regarding environment, temperature, cleaning and preservation as applicable to meet design requirements. Limited-life components must be addressed in these procedures to assure replacement within the required period of time. The procedural controls shall apply to the life cycle of the packaging from initial fabrication through the maintenance and repair aspects. These measures shall apply to complete units as well as spare and replacement parts. Procurement documents shall require that items (spare and replacement parts) be controlled in accordance with supplier developed procedures which adequately address handling, storage and shipping controls.

The SRNS User is responsible for shipment of both loaded packages and empty packagings and is responsible for verifying compliance with the requirements listed in Chapter 7. Upon delivery, all packages shall be visually inspected by the receiving organization for obvious damage.

9.14 INSPECTION, TEST AND OPERATING STATUS

Each SRNS User shall perform maintenance on each package in accordance with a procedure that outlines and records each step in preparation of the package for shipment. Details are provided in Chapter 7. The inspection, test and operating status of any package shall be identified clearly by using status indicators (i.e., tags) or records traceable to the individual units.

9.15 NONCONFORMING MATERIALS, PARTS OR COMPONENTS

9.15.1 *Identification*

Procedures shall be established to identify and document any nonconforming item or activity. If the inspection identifies an out of conformance item or activity, the purchaser/SRNS User documents the nonconformance and recommends one of several disposition options: "repair," "rework," "reject" or "use-as-is." The Purchaser/SRNS User is responsible for obtaining approval of the nonconformance disposition from the SRNS Design Authority and SRNS Design Agency (see Section 9.1.2).

Defects in the packaging or packaging components, or departure from CoC requirements, that significantly reduce the safety performance of the packaging shall be reported to the DOE Certifying Authority within 30 days of the discovery in accordance with 10 CFR 71.95.

9.15.2 *Segregation*

Nonconforming items are marked, tagged, segregated and placed in controlled areas until disposition is complete.

9.15.3 *Disposition*

The evaluation for disposition of the nonconformance may include the following:

- **Rework**: The process by which an item is made to conform to original requirements by completion or correction.

- **Repair**: The process of restoring a nonconforming characteristic to a condition such that the capability of an item to function reliably and safely is unimpaired, even though that item still does not conform to the original requirements (technical justification required).

- **Use-as-is**: A disposition permitted for a nonconforming item when it can be established that the item is satisfactory for its intended use (technical justification required).

- **Reject**: Action taken to eliminate a nonconforming item from its specified use (scrap, return to supplier, etc.). Specific action shall be identified in Disposition Details.

In all cases of action, final disposition of nonconformance must be identified and documented, and the documentation must be maintained as a QA record. Dispositions of non-conformance components shall be reported to the Design Authority.

9.16 CORRECTIVE ACTION

Nonconforming "Q" items shall be promptly identified and the causes of these conditions corrected in accordance with SRNS Manual 22Q, Procedure CAP-1, "Corrective Action Program," to prevent recurrence.

The SRNS Corrective Action Program also addresses significant conditions adverse to quality, identified through:

- Problem Identification and Resolution Process
- Price Anderson Amendments Act Noncompliance
- Occurrence Reporting System to include DOE Occurrences/Events Reportable & Non-Reportable Occurrences/Events within the specified Reporting Groups of the DOE Occurrence Reporting System
- QA Stop Work Orders
- QA Audits/Surveillances
- Management Assessments (that is, Self-Assessment, Performance Analysis)
- Integrated Safety Management Evaluations (that is, Facility Evaluation Board evaluations)
- Vendor Identified Deficiencies
- Operating Experience (lessons learned processes)

9.17 QUALITY ASSURANCE RECORDS

9.17.1 *General*

A record is a completed document that furnishes evidence of the quality of items and/or activities affecting quality. Individual packaging QA records shall be maintained for each package by model number and serial number (i.e., MODEL 9979 SERIAL NO. 010001). The retention periods for various types of QA records are presented in Table 9.5. Record retention periods, at a minimum, shall comply with 10 CFR 71.91 and 10 CFR 71, Subpart H. The procurement specification defines the documents that suppliers are to generate and when the records are to be submitted. Records must be available for inspection and are valid only if stamped, initialed, or signed and dated by authorized personnel.

9.17.2 *Storage, Preservation, and Safekeeping*

To minimize the risk of damage or destruction to the QA records from natural causes, such as extreme temperatures; moisture from rain, snow, or high humidity; insects; mold; or fire, designated records-storage facilities (e.g., a vault with fire protection) are strongly recommended. However, in the event that such facilities are not available, Underwriters Laboratory® listed 1-hour rated fire cabinets are required. Security systems and facility activity classifications shall be established to prevent access to records by unauthorized personnel.

Table 9.5 - Quality Assurance Records

Name of Record	Retention Period (a, b, c)	Produced By
Prototype test plan and procedures	LOP	SRNS Design Authority
Prototype test reports	LOP	SRNS Design Authority
SARP	LOP	SRNS Design Authority
Design drawings	LOP	SRNS Design Authority
Design review records and calculations	LOP	SRNS Design Agency
Package modification records	LOP	SRNS Design Authority
Instrument calibration records	3 years	Supplier
Supplier manufacturing and inspection plan	LOP	Supplier
Material test report or certification required on all material used	LOP	Supplier
Packaging Independent Verification Items	LOP	Supplier
Welding procedure specification	LOP	Supplier
Procedure qualification record	LOP	Supplier
Welder or welding operator qualification tests	LOP	Supplier
Record of qualification of personnel performing radiographic and liquid penetrant inspection	LOP	Supplier
General cleaning procedure	LOP	Supplier
Weld radiographs	LOP	Supplier
Liquid penetrant reports	LOP	Supplier
Structural test (hydrostatic/pneumatic) report as required	LOP	Supplier
Inspection Documentation (Appendix 8.1)	LOP	Supplier/Owner
Package loading procedure	LOP	Owner
Procedures for preparing a package for transport (empty or loaded)	S	Owner
Maintenance procedures	S	Owner
Repair procedures	LOP	Owner
Procurement documentation	LOP	Owner
Audit reports	LOP	Owner
Maintenance log	LOP	Owner
Corrective action reports	LOP	Owner
Shipment records per 10 CFR 71.91(a)	S	Owner
Nonconformance reports	LOP	Owner
Package unloading procedure	S	Receiver

a LOP - Retention by SRNS Design Authority for Lifetime of the Packaging plus 3 years.

b S - Retention by SRNS Design Authority for shipping date plus 3 years (Records for packages to be used as storage containers shall be kept for the lifetime of the package plus 3 years.)

c Copies of all QA Records generated by Supplier are to be retained by the Supplier for a period of 3 years after delivery of packaging and. by the SRNS Design Authority for either LOP or S, as appropriate.

9.18 AUDITS

The SRNS User or SRNS Design Agency QA is responsible for scheduling, planning, and conducting audits at SRS. The schedule may be updated during the year on the basis of reports of surveillance, inspections and audits by outside agencies/customers. The program provides for re-audits, as necessary, to verify corrective action and implementation.

Audits are planned activities performed by qualified personnel, independent of the group or function being audited, using written procedures and/or checklists. A written report documenting the audit results is prepared within 30 days and distributed to appropriate management personnel. When corrective action is required, the report requires the audited organization to reply within a specified time and to identify planned corrective actions and a schedule for implementation.

- Regularly scheduled audits are occasionally supplemented by additional audits of specific subjects when necessary to provide adequate coverage. Supplemental audits are performed under the following circumstances: The quality of an item, product, process, or structure is suspected to not conform with the agreed-upon requirements or commitments.
- A systematic, independent assessment of program effectiveness is considered desirable.
- Implementation of a required corrective action must be verified.

Unscheduled audits are performed under the following circumstances:

- Situations, circumstances, or occurrences dictate the need for current status.
- Information of a critical nature is required.
- The audit is considered necessary by the manager of the SRNS User QA.

In addition to the annual SRNS program audits, the Major Suppliers QA program shall be audited on a triennial basis or earlier as described in the above examples.

The SRNS User or SRNS Design Agency QA is responsible for verifying that corrective action has been implemented and is acceptable. Problems may be escalated to higher levels of management as required.

Audit reports are distributed to appropriate management personnel and retained in accordance with applicable requirements.

Auditors receive training on audit standards and regulatory requirements and practices. Records are maintained by the SRNS User or SRNS Design Agency QA to document auditor qualification in accordance with established procedures.

9.19 APPENDICES

The appendices listed below by title are located at the end of the chapter.

9.1 Commercial Grade Dedication Process for 9979 Packages

9.20 REFERENCES

1. *Packaging and Transportation of Radioactive Materials*, Code of Federal Regulations, Title 10, Part 71, U. S. Nuclear Regulatory Commission, Washington, DC (January 2018).
2. *Establishing Quality Assurance Programs for Packaging Used in the Transport of Radioactive Material*, Regulatory Guide 7.10, Rev. 2, U. S. Nuclear Regulatory Commission, Washington, DC (March 2005).
3. *Quality Assurance Program Requirements for Nuclear Facilities*, ASME NQA-1a-2009, American Society of Mechanical Engineers, New York, NY (2008).
4. *Quality Assurance Manual*, Manual 1Q, Savannah River Nuclear Solutions, Aiken, SC.
5. Management and Operations (M&O) Quality Assurance Program Document (QAPD), SRNS-RP-2014-00880, Rev. 2, Savannah River Nuclear Solutions.
6. *Packaging and Transportation Safety*, DOE Order 460.1D, U. S. Department of Energy, Washington, DC (December 2016).
7. *Quality Assurance Requirements*, Code of Federal Regulations, Title 10, Part 830, Subpart A, "Quality Assurance Requirements", U. S. Department of Energy, Washington, DC (January 2018).
8. *Classification of Transportation Packaging and Dry Spent Fuel Storage System Components According to Importance to Safety*, NUREG/CR-6407, U. S. Nuclear Regulatory Commission, Washington, DC (February 1996).
9. American Welding Society, D1.3, Structural Welding Code - Sheet Steel - 5th Edition, (November 2008).
10. American Welding Society, C1.4:2017, Specification for Resistance Welding of Carbon and Low Alloy Steels, 3rd Edition.
11. Evaluation of Resistance Seam Welded ASTM A1008 Samples from Drums Used for Weld Procedure Qualification by Skolnik Industries, Incorporated, SRNL-L4410-2011-00025, June 2, 2011.
12. 9979 & 9981 Package Resistance Mash Welding Data Sheet, M-DS-A-00078, Revision 0, January 25, 2019.
13. Arc Welding Data Sheet, M-DS-A-00079, Revision 0, January 25, 2019.
14. 9979 & 9981 Package Stud Welding Data Sheet, M-DS-A-00077, Revision 0, January 25, 2019.

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