ENGINEERING DATA TRANSMITTAL

Page 1 of 1

1. EDT 615812

2. To: (Receiving Organization) Packaging Engineering	3. From: (Originating Organization) Packaging Engineering	4. Related EDT No.: 615810
5. Proj./Prog./Dept./Div.: 84100	6. Cog. Engr.: D. K. Clem	7. Purchase Order No.: NA
8. Originator Remarks: The attached document is being submitted for approval and release.		9. Equip./Component No.: NA
		10. System/Bldg./Facility: NA
11. Receiver Remarks:		12. Major Assm. Dwg. No.: NA
		13. Permit/Permit Application No.: NA
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15. DATA TRANSMITTED					(F)	(G)	(H)	(I)
(A) Item No.	(B) Document/Drawing No.	(C) Sheet No.	(D) Rev. No.	(E) Title or Description of Data Transmitted	Approval Designator	Reason for Transmittal	Originator Disposition	Receiver Disposition
1	WHC-SD-TP-DAP-008	NA	0	Documentation and Analysis for Packaging for Surface Moisture Measurement System 7A Containers	SQ	1/2	1	

KEY

Approval Designator (F)	Reason for Transmittal (G)	Disposition (H) & (I)
E, S, Q, D or N/A (see WHC-CM-3-5, Sec.12.7)	1. Approval 2. Release 3. Information 4. Review 5. Post-Review 6. Dist. (Receipt Acknow. Required)	1. Approved 2. Approved w/comment 3. Disapproved w/comment 4. Reviewed no/comment 5. Reviewed w/comment 6. Receipt acknowledged

17. SIGNATURE/DISTRIBUTION (See Approval Designator for required signatures)										(G)	(H)
Reason	Disp.	(J) Name	(K) Signature	(L) Date	(M) MSIN	(J) Name	(K) Signature	(L) Date	(M) MSIN	Reason	Disp.
1	1	Cog. Eng. DK Clem	<i>DK Clem</i>	6/13/96	G1-11	SS Shiraga	<i>SS Shiraga</i>	6/13/96	G1-11	1	1
1	1	Cog. Mgr. JG Field	<i>JG Field</i>	6/13/96	G1-11	RJ Smith	<i>RJ Smith</i>	6/17/96	G1-11	1	1
1	1	QA CR Hoover	<i>CR Hoover</i>	6/13/96	G1-11	TI Stokes	<i>TI Stokes</i>	6/13/96	L6-37	1	1
1	1	Safety DW McNally	<i>DW McNally</i>	6/13/96	G1-11	WT Watson	<i>WT Watson</i>	6/14/96	H0-32	1	1
1	1	MD Clements	<i>MD Clements</i>	6/13/96	G1-11						
1	1	JR Green	<i>JR Green</i>	6/13/96	G1-11						
1	1	GA Ritter	<i>GA Ritter</i>	6/14/96	H0-32						

18. DK Clem <i>DK Clem</i> Signature of EDT Originator Date 6-17-96	19. Authorized Representative for Receiving Organization Date	20. JG Field <i>JG Field</i> Cognate Manager Date 6/13/96	21. DOE APPROVAL (if required) Ctrl. No. ☐ Approved ☐ Approved w/comments ☐ Disapproved w/comments
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Documentation and Analysis for Packaging for Surface Moisture Measurement System 7A Containers

D. K. Clem

Westinghouse Hanford Company, Richland, WA 99352
U.S. Department of Energy Contract DE-AC06-87RL10930

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Key Words: 5-gal drum, Am-Be source, Cf source, transport, SMMS,
Frontier Technology

Abstract: This documentation and analysis for packaging documents that
two, procured, carbon steel 5-gal drums meet all applicable
U.S. Department of Transportation-7A requirements. One container will
be used to transport a 0.009 Ci ²⁵²Cf source and the other to transport
a 1.7 Ci Am-Be source to and from various 200 Area tank farms.

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Janis Bishop 6-17-96
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Approved for Public Release

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CONTENTS

1.0	INTRODUCTION	1
1.1	BACKGROUND	1
2.0	PACKAGE DESCRIPTION	2
2.1	PACKAGING	2
2.2	CONTENTS	3
3.0	DESIGN REQUIREMENTS	4
4.0	EVALUATION	4
5.0	OPERATIONS AND MAINTENANCE	4
6.0	REFERENCES	6

APPENDICES

A	FRONTIER TECHNOLOGY CORPORATION TYPE A CONTAINER CERTIFICATION	A-i
B	FRONTIER TECHNOLOGY CORPORATION UNLOADING PROCEDURE FOR MODEL 50240 SHIPPING CONTAINER	B-i
C	FRONTIER TECHNOLOGY CORPORATION PACKING LIST	C-i
D	DRAWING OF SITE-BUILT ADAPTER FOR ²⁵² Cf CONTAINER	D-i
E	FRONTIER TECHNOLOGY CORPORATION TYPE A CONTAINER CERTIFICATION	E-i
F	FRONTIER TECHNOLOGY CORPORATION UNLOADING PROCEDURE FOR MODEL 50240 SHIPPING CONTAINER	F-i
G	SOURCE DOCUMENTATION	G-i

LIST OF TABLES

1	Activity Comparison	3
2	Packaging External Contamination Limits	3

LIST OF TERMS

Am-Be	americium-beryllium
Cf	californium
Ci	curies
DAP	documentation and analysis for packaging
DOT	U.S. Department of Transportation
dpm/cm ²	disintegrations per minute per square centimeter
ft-lb	foot-pound
g	gram
in.	inch
lb	pound
LOW	liquid observation well
LOWMMS	Liquid Observation Well Moisture Measurement System
m	meter
μCi/cm ²	microcuries per square centimeter
mrem/h	millirem per hour
SMMS	Surface Moisture Measurement System
WEP	water-extended polyester
WHC	Westinghouse Hanford Company

DOCUMENTATION AND ANALYSIS FOR PACKAGING FOR SURFACE MOISTURE MEASUREMENT SYSTEM 7A CONTAINERS

1.0 INTRODUCTION

The purpose of this documentation and analysis for packaging (DAP) is to provide documentation demonstrating that two, procured, carbon steel 5-gal drums (UN/1A2/Y36/S) meet all applicable U.S. Department of Transportation (DOT)-7A requirements. The drums were procured from Frontier Technology Corporation to transport two sources, one per container, to and from various 200 Area tank farms. One container will be used to transport a 0.009 Ci ^{252}Cf source and the other to transport a 1.7 Ci $^{241}\text{Am-Be}$ source. The ^{252}Cf container incorporates a Site-fabricated adapter, which positions the source within the container cavity. Both sources will be transported onsite per the requirements of WHC-CM-2-14, *Hazardous Material Packaging and Shipping*, as separate items.

This DAP also provides documentation on the source term for the transportation classification and defines operational controls for loading and transport requirements that shall be met prior to transport. Both of the containers shall meet radiological requirements prior to transport.

1.1 BACKGROUND

Radioactive wastes from defense operations have accumulated in underground waste storage tanks at the Hanford Site since the 1940s. Potential chemical fuels, in the form of ferrocyanide and various organic compounds, may be present in many of these tanks. Safety concerns have risen based on the possibility of condensed-phase chemical reactions propagating into undesirable consequences.

Analyses and experiments indicate that the reaction propagation, and possibly its initiation, may be precluded by the presence of a sufficient concentration of moisture in the waste. If sufficient moisture is present in a fuel-containing waste boundary between an initiated reaction and a dry stoichiometric mixture of fuel and oxidizer, modeling predicts that the water will absorb the energy released from the reaction so that it will not propagate through the waste boundary. The existence of sufficient moisture concentration in the top layers of waste would, under current safety guidelines, provide evidence that the tank waste is in a stable and safe form for continued storage.

The Surface Moisture Measurement System (SMMS) was developed by Westinghouse Hanford Company (WHC), Science Applications International Corporation, ICF Kaiser Hanford Company, and HiLine Engineering and Fabrication, Inc., to determine the moisture concentration in the upper layers of the waste surface. The ^{252}Cf source is lowered into the tank vapor space during this operation, and contamination of the source is likely.

Waste moisture concentration profiles for tanks that contain liquid observation wells (LOW) will be obtained with the Liquid Observation Well

Moisture Measurement System (LOWMMS), which is controlled using the same data acquisition and control system as the SMMS. The LOWMMS moisture measurements of the waste surface immediately surrounding the LOWs will help confirm the surface moisture measurement obtained with the SMMS. The ^{241}Am -Be source is lowered into the LOW during this operation and will probably remain clean.

A decontamination spray system is provided for cleanup of the SMMS as it is withdrawn from the tank. The decontamination system consists of a decontamination spool piece (attached to the riser), a feed pump, and a water tank truck. The decontamination spool piece is an impact force cleaning chamber with four high-pressure spray nozzles.

2.0 PACKAGE DESCRIPTION

2.1 PACKAGING

Both source containers are carbon steel UN1A2 drums, with open heads, which incorporate water-extended polyester (WEP) neutron shielding and a central cavity formed from steel pipe and pipe caps. The basic drums were fabricated by FBF Nuclear Containers, Inc., and tested to meet DOT-7A requirements per 49 CFR 178.350 and applicable sections of 49 CFR 173. The interior cavities and WEP shielding were added to the basic drums by Frontier Technology Corporation, who is the actual supplier to WHC.

The external drums for both containers are the same size and type, nominally 11½ in. inside diameter by 12½ in. high (inside). The interior cavity dimensions differ, depending on the source that will be used with them. The certification limits gross weight of the drums to 100 lb (normal weight is approximately 45 lb). See Appendices B and F for Frontier Technology Corporation drawings of the drums.

The container for the ^{252}Cf source has a basic cavity based on 2-in. schedule 40 pipe. A Hanford Site-fabricated adapter, which positions the source for easy attachment of a source handling tool, is installed in the cavity. The adapter replaces the original pipe cap for the cavity. It also provides a collar to allow connection of a polyethylene sleeve during source transfer between the container and a glovebox during field operations. See drawings in Appendix D. Neutron shielding is provided by cast WEP fill surrounding the pipe. The high density polyethylene of the adapter provides shielding in the axial direction within the 2-in. pipe. Closure of the cavity is provided by a screwed plug in the adapter.

The container for the ^{241}Am -Be source has a basic cavity based on 3-in. schedule 40 pipe and does not contain an adapter. Neutron shielding is provided by WEP fill that surrounds the pipe. Polyvinyl chloride-jacketed, WEP-filled plugs provide shielding in the axial direction within the 3-in. pipe. Closure of the cavity is provided by a pipe cap screwed onto the 3-in. pipe.

Lifting of the drums shall be by hand using the integral bails.

2.2 CONTENTS

Both the 0.009 Ci ^{252}Cf source and the 1.7 Ci $^{241}\text{Am-Be}$ source are certified special form radioactive materials, as provided in 49 CFR 173.403 (see Appendix G for source documentation). Since both sources are special form and their activities are less than the respective A_1 values for their isotopes shown in Table 1, they meet the requirements for shipment in Type A packaging.

Table 1. Activity Comparison.

Source	Isotope	Activity (Ci)	A_1 value (Ci)	A_2 value (Ci)
^{252}Cf	^{252}Cf	0.009*	2.7	0.027
$^{241}\text{Am-Be}$	^{241}Am	1.7	54.1	0.00541

A_1 and A_2 values taken from 49 CFR 173.435, 1996, "Shippers--General Requirements for Shipments and Packagings, Code of Federal Regulations, as amended.

*Activity value of current source as of 8-31-95.

In use, the ^{252}Cf source will be exposed to the atmosphere, and possibly the contents, of the waste tank. The source will be washed during removal from the tank, but may still have a very small amount of residual waste adhering to it that could contaminate the container adapter cavity. Due to the small size and smooth surfaces of the source, the quantity of waste that could remain after washing is extremely small and can reasonably be expected to be well below applicable A_2 limits.

The container internals shall be surveyed, and decontaminated if necessary, to 100 times Table 2 limits each time the source is removed. This will prevent buildup of contamination inside the container. The adapter (without the source) can be removed for decontamination.

For shipment of empty containers, internal contamination shall also be limited to 100 times the Table 2 limits. (49 CFR 173.428)

For shipment of full or empty containers, external contamination shall not exceed Table 2 limits. The dose rate limits shall be per 49 CFR 173: 200 mrem/h on contact, 10 mrem/h at 1 m and 2 mrem/h in the occupied space of the transport vehicle.

Table 2. Packaging External Contamination Limits.

Contaminant	Maximum permissible limits	
	$\mu\text{Ci}/\text{cm}^2$	dpm/cm^2
Beta-gamma emitting radionuclides; all radionuclides with half-lives less than ten days; natural uranium; natural thorium; uranium-235; uranium-238; thorium-232; thorium-228 and thorium-230 when contained in ores or physical concentrates	10^{-5}	22
All other alpha emitting radionuclides	10^{-6}	2.2

Source: 49 CFR 173.443(a), 1996, "Shippers--General Requirements for Shipments and Packagings," Code of Federal Regulations, as amended.

3.0 DESIGN REQUIREMENTS

The source drums meet the requirements of 49 CFR 178.350, Specification 7A, Type A, for a container suitable for shipment of Type A quantities of radioactive material.

The drums are reusable with the closure accomplished by a gasket, lid, and bolted lock ring. The lock ring bolt is drilled for installation of a tamper-indicating seal wire.

4.0 EVALUATION

This DAP serves as the document to certify that the source drums were designed, fabricated, and procured to meet all DOT-7A, Type A container requirements. Supplier documentation can be found in Appendices A, B, C, E, and F. Evaluation of the contents is provided to demonstrate that the special form sources, when loaded within the drums, meet all DOT requirements for onsite and offsite transportation.

The Frontier Technology Corporation certification (Appendices A, E, and H) documents that the drums comply with the applicable regulations and requirements. As described, no adverse effects to the WEP occur during the drop scenario. Several Type A and Type B packages use WEP material; therefore, the temperature requirements are met.

5.0 OPERATIONS AND MAINTENANCE

The user must develop procedures for loading, tiedown, transport and unloading, as necessary, to facilitate use of these containers at Hanford. Any necessary Quality Assurance or Quality Control hold points or verification should be incorporated into the procedures per WHC-CM-4-2, *Quality Assurance Manual*.

All operations shall follow the Hanford Site "Master Safety Rules" referenced in WHC-CM-1-10, *Safety Manual*, and applicable Occupational Safety and Health Administration standards per 29 CFR 1910.

The following are guidelines to develop maintenance and operating procedures for the source containers.

1. Stage the empty container on a flat surface and remove the lid.
2. Visually inspect the container and ensure the following:
 - No dents, damage, or rusting of the container, lid, lock ring, or bolt that would adversely affect sealing or closure
 - No gasket damage, age hardening, or cracking that would affect sealing

- No excessive rust that would affect the structural integrity of the container. Paint scratches and small inconsequential rusted areas should be cleaned and touch-up painted at least annually (sooner if metal damage is judged to be significant).
3. Place the ^{241}Am -Be source or the ^{252}Cf source in their respective containers. Apply appropriate radiological controls.
 4. Place shielding plug in the container cavity and install the cavity cap.
 5. Place the lid (with gasket) and the bolted lock ring on the drum.
 6. Tighten the bolt, while tapping the ring at several locations with a hammer, until the lugs begin to bend inward or come together.
 7. Install a jam nut next to the closure nut. Tighten.
 8. Place a seal wire through the hole in the bolt and crimp the seal. A tamper-indicating tape seal is an acceptable alternate. (49 CFR 173.412b)
 9. Prepare the drums for shipment as Type A radioactive material. Have an individual who has been trained in DOT regulations prepare shipping papers and authorize shipment. (See Section 2.2, paragraph 5, for external contamination and dose rate limits).
 10. Block and brace the drum to the transport vehicle and use tiedowns, as required by 49 CFR 393, Subpart I.
 11. To unload the package: stage it on a flat surface, remove the lid and remove the source. Apply appropriate radiological controls.
 12. Survey the container cavity for residual contamination and decontaminate as necessary. (See Section 2.2, paragraph 3.)

If the container is to be shipped empty, survey and decontaminate as necessary, to meet the limits of 49 CFR 173.428. (See Section 2.2, paragraphs 4 and 5.)
 13. Reinstall the container lid.

The Frontier Technology Corporation container handling and maintenance recommendations contained in Appendices B and F are to be used for general guidance, only where applicable, since they do not address the exact procedures needed at Hanford. The general safety precautions contained in these Frontier documents should be reviewed and incorporated into the Hanford procedures, as appropriate.

6.0 REFERENCES

- 29 CFR 1910, 1994, Occupational Safety and Health Standards," *Code of Federal Regulations*, as amended.
- 49 CFR 173, 1996, "Shippers--General Requirements for Shipments and Packagings," *Code of Federal Regulations*, as amended.
- 49 CFR 178, 1996, "Specifications for Packagings," *Code of Federal Regulations*, as amended.
- 49 CFR 393, 1996, "Parts and Accessories for Safe Operation," *Code of Federal Regulations*, as amended.
- RL, 1993, *Hanford Site Hoisting and Rigging Manual*, DOE-RL-92-36, U.S. Department of Energy, Richland Operations Office, Richland, Washington.
- WHC-CM-1-10, *Safety Manual*, Westinghouse Hanford Company, Richland, Washington.
- WHC-CM-2-14, *Hazardous Material Packaging and Shipping*, Westinghouse Hanford Company, Richland, Washington.
- WHC-CM-4-2, *Quality Assurance Manual*, Westinghouse Hanford Company, Richland, Washington.

APPENDIX A

**FRONTIER TECHNOLOGY CORPORATION TYPE A CONTAINER CERTIFICATION
(Container for ^{252}Cf source)**

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TYPE A CONTAINER CERTIFICATION: MODEL 50240
August 24, 1995

Rev. 01

FRONTIER TECHNOLOGY CORPORATION N.R.C. LICENSE S.N.M. 1957

We hereby certify that shipping container, Model No. 50240, meets U.S.D.O.T. specifications 7A as defined in 49CFR178.350 for radioactive material in the form of Special Form Sealed Sources, gross weight up to 100 pounds, and is therefore suitable for common carrier shipment of Type "A" quantities of radioactive material in the form of Special Form Sealed Sources subject to prescribed limits of external radiation, gross weight, and additional specifications and restrictions specified below:

The Model 50240 Shipping Container is a 5 gallon steel drum meeting either DOT specification 17C* for drums manufactured prior to October 1994 or specification UN/1A2/Y36/S for drums manufactured after October 1994, containing shielding and other internals. The specification 17C* or UN/1A2/Y36/S drum is certified by its supplier, FBF Nuclear Containers, as being suitable for a Type A package component based on tests made by Monsanto Research Corporation, Mound Laboratory, Miamisburg Ohio as reported in Report No. MLM3245 by Don Edling and others and certified to be suitable for a Type A package component. The Mound tests, results, and conditions are reported in Report No. WHC-EP-0558 along with additional test results. Copies of the applicable FBF certification and applicable parts of WHC-EP-0558 are attached to and become a part of this certification.

The WHC-EP-0558 Report certifies the 17C drum as DOT 7A Type A for gross weight up to 100 pounds for radioactive material in the form of solids-large particle size only (Form 2) and in the form of objects with no significant dispersible or removable contamination (Form 3). The cover gasket must be positioned on the body curl so that an uninterrupted seal is assured completely around the cover. The ring closure must be properly seated in the cover and the outer edge of the body curl, and the bolt must be tightened until the lugs begin to bend inward or come together, with tapping of the ring during tightening. A jam nut must be used to prevent unintentional loosening during shipment. The jam nut is to be tightened against the ring-clamping nut after tightening of the ring has been completed.

Restriction of the authorized contents to Special Form Sealed Sources results in compliance with the form requirements described above as Form 2 and Form 3.

This certification is issued pursuant to the requirement of 49CFR173.415(a). It does not relieve the shipper from the requirement to comply with all applicable requirements of the DOT regulations.

Authorized Signature
Edward F. Ganzow, President

*In effect in December 1990 (i.e., prior to DOT Estimating HH-181).

FBF Nuclear Containers

Middlebrook Industrial Park - 1201 Hixon Road
Knoxville, Tennessee 37921

Nuclear Containers and Casks for
Fuels in Radiative Isotopes
Research Fuel Elements
Waste Materials
Radioisotopes
Radioactive Sources

Compliance and Control
Overpacks
Subsiding & Repair
Drums
S-A Tanks
Cask Fiberglass Insulation
Explosion Insulation
Aerosol Insulation
Vapor/Air Insulation
Pressure Insulation
DOT & HSC Certification

Lead Products
Lead Pans
Lead Shields
Lead S-A Tanks
Lead Walls
Lead Boxes
Lead Containers

Polystyrene Containers for
Beta Lines (Night)
Low Level Waste
Leaking Metal Drums
Polystyrene Drums

TYPE A AND TYPE B CONTAINERS
LEA AND WASTE CONTAINERS

FBF, INC.
815/554-1868

FBI CERTIFICATE OF COMPLIANCE

TYPE A CONTAINER COMPONENT

CUSTOMER: Frontier Technology Corporation

PURCHASE ORDER NUMBER: 95224

DRAWING NUMBER(S): N/A

SPECIFICATION: UN/1A2/Y36/S (DOT 17C)

QUANTITY: 10 SIZE: 5 gal TYPE UNIT: Type A

SERIAL NUMBER(S): N/A

This FBI Certificate of Compliance, as applied to applicable DOT specifications, is a component only of a Type A package for Type A quantities of radioactive material and subject to the shipper's compliance with CFR 49 and applicable portions of Part 173, and DOT 7A Type A Part 178.330.

This is to certify that the container described above is suitable as a component of a Type A package based on tests made by Monsanto Research Corporation, Mound Laboratory, Miamisburg, Ohio as shown in report number MLM 3243, and certified to be suitable for a Type A package component. The applicable copy of WEC - IF - 0558 report is attached and becomes a part of this certification.

The shipper must establish and maintain his file to show that material offered for shipment and other requirements of DOT regulations are met.

This certification does not relieve the shipper of his requirement to comply with all applicable requirement of DOT regulations.

Don Wayne
Don Wayne

For FBI QA MANAGER

1-10-95

DATE

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SERVING THE NUCLEAR INDUSTRY FOR OVER 35 YEARS
SEND US YOUR PRINTS FOR QUOTATION

NRC FORM 271 5-69		U. S. NUCLEAR REGULATORY COMMISSION		1. APPROVAL NUMBER 0185	
QUALITY ASSURANCE PROGRAM APPROVAL FOR RADIOACTIVE MATERIAL PACKAGES					
<p>Pursuant to the Atomic Energy Act of 1954, as amended, the Energy Reorganization Act of 1974, as amended, and Title 10, Code of Federal Regulations, Chapter 1, Part 71, and in reliance on statements and representations made in Item 5 by the person named in Item 2, the Quality Assurance Program described in Item 3 is hereby approved. This approval is issued so that the requirements of Section 71.104 of 10 CFR Part 71. This approval is subject to all applicable rules, regulations, and orders of the Nuclear Regulatory Commission now or hereafter in effect and to any conditions specified below.</p>					
2. NAME FBF Incorporated			3. EXPIRATION DATE August 31, 1985		
STREET ADDRESS 1201 Milton Road			4. POWER REACTOR 71-0185		
CITY Knoxville	STATE TN	ZIP CODE 37821			
5. QUALITY ASSURANCE PROGRAM APPLICATION DATES August 28, 1983, August 30, 1983 and June 15, 1984					
6. CONDITIONS Activities conducted under applicable criteria of Subpart H of 10 CFR Part 71 to be executed with regard to transportation packages.

BEST AVAILABLE COPY					
FOR THE U. S. NUCLEAR REGULATORY COMMISSION
CHARLES E. MACGARRATH			JUL 26 1984 DATE		
CHIEF, TRANSPORTATION BRANCH DIVISION OF SAFEGUARDS AND TRANSPORTATION OFFICE OF NUCLEAR MATERIAL SAFETY AND EMERGENCIES					

GRACEContainer and Chemical Specialist
Dewey and Almy Chemical DivisionW. E. Grace & Co., Conn.
55 Hayden Avenue
LaSington, Mass. 02173

The cover and seaming compounds manufactured by Grace for Cleveland Steel are made of blends of Styrene-Butadiene Rubbers (SBR) which, based on the supplier of these materials, typically operate (maintain elastic properties) over the following temperature ranges based on the principal rubber polymers utilized.

Upper Limit	SBR
	150 F
Lower Limit	-40 F

Testing to determine outer temperature operating limits has never been done on each compound by Grace. We have based this information on the physical characteristics of the principle rubber system, SBR.

Gasket performance is a function of the total container system. Long term performance is determined by the container design, assembly and the storage environment. Grace has no control or knowledge of all these factors. Characterization of rubber specification in temperature extremes is not a warranty or representation, expressed or implied, of Grace's cover and seaming compound performance.

Sincerely,

B. E. Wagner
General Sales Manager

BEW:kpf

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ref. WHC-EP-0558

Figure 2-2. DOT-17C 5-Gallon Steel Drum, 49 CFR 178.118.

**DOT 7A Type A
49 CFR 178.350** **BEST AVAILABLE COPY**

ref WHC-EP-0558

2.2 DOT-17C 5-GALLON STEEL DRUM (DOCKETS: MLM)

2.2.1 Package Description

Dimensions

5-gallon drum	Height (in.)	Diameter (in.)
Interior	12.5	11.25
Exterior (with ring)	13.0	12.00

Materials/Method of Construction

5 gallon	
Body and head sheet	24 gauge
Ring	16 gauge
Bolt	0.25 in.
Gasket required	

2.2.2 Authorized Contents

The shipper must determine that the actual contents are closely simulated by the test contents. If they are not, testing or analysis must be conducted and documented to demonstrate DOT-7A compliance with the actual contents.

2.2.2.1 Physical Form

2.2.2.1.1 Solids Only. Three forms are authorized. Each shipper must determine the most appropriate form for his particular contents and comply with any special requirements (e.g., RTV, etc.).

- Material Form No. 1: Solids--any particle size.
- Material Form No. 2: Solids--large particle size only (e.g., sand, concrete, debris, soil, etc.)
- Material Form No. 3: Solids--objects with no significant dispersible or removable contamination. (For definition, see 49 CFR 173.443, Contamination control.)

2.2.2.1.2 Maximum Gross Weight. Form No. 1, No. 2 and No. 3:

- 100 lb.

WHC-EP-0558

2.2.2.2 Chemical Form. The shipper must evaluate and ensure chemical compatibility of the material to be shipped with the materials of the packaging in contact with the payload.

2.2.2.3 Radiological. The 4-ft drop test caused deformation of the package resulting in a decrease in the distance from the exterior to the center of the package at the bottom edge of 0.8 in. (approximate). The shipper must ensure that the radiation level at any surface would not increase by more than 20% (relative to the radiation level of the undamaged configuration) if such a deformation would occur.

2.2.3 Restrictions/Specifications

For Form No. 1 Contents--RTV sealant (or equivalent) must be applied to the surface of the gasket in contact with the drum body.

For Form No. 2 and No. 3 Contents--No packaging component requirements other than as specified in Section 2.2.1.

Bolt closure tightened, with tapping, until the lugs begin to band inward or come together--typically less than 40 ft-lb. A jam nut shall also be used to prevent unintentional loosening during transport.

The gasket material must have an operating range of -40 °F to +158 °F.

For heavy, bulky materials (e.g., concrete chunks, motors, pumps, etc.), equipment or materials with sharp corners or protrusions, or material/containment geometries that could result in highly localized forces, the shipper must ensure that the contents are securely fastened/positioned within the package.

BEST AVAILABLE COPY

ref WHC-EP-0558

2.2.4 49 CFR 178.350 Regulatory Requirements

Regulatory Compliance Assessment

Regulatory requirements	Testing/analysis results
49 CFR 173.24, Standard requirements for all packages	Meets applicable requirements. See Appendix A, Table A-1.
49 CFR 173.411, General design requirements	Meets applicable requirements. See Appendix B, Table B-1.
49 CFR 173.412, Additional requirements for Type A packages	Meets applicable requirements. See Appendix C, Table C-1.
49 CFR 173.465, Type A packaging tests	Meets applicable requirements.
Water spray	<u>Pass</u> . Tests were conducted on all three styles of drums and demonstrated no leakage of water. Further, the water spray test preceded each of the remaining Type A tests. In no case was there any effect on the ability of the packagings to meet the required tests. See Appendix D, Table D-1.
Free drop	<u>Pass</u> . Sixty-nine separate drop tests were conducted (22 on Styles 1A and B, 26 on Style 2, and 21 on Style 3). Drops were conducted on edges, top corners, bottom corners, and the ends. In all cases, there was no loss of contents or major distortion of the packagings. See Appendix D, Table D-10.
Corner drop	Not required.
Compression	<u>Pass</u> . The test was conducted on all three styles at greater than five times the gross weight for greater than 24 hr. There was no visible distortion of the packagings or loss of contents. See Appendix D, Table D-23.
Penetration	<u>Pass</u> . The test was conducted at several points on all three styles of the packagings with no significant effect. The tests on the bungs left no discernable mark. The impact on the centers of the covers resulted in a maximum dent of 0.25 in. The tests on the closure rings left no visible effect. See Appendix D, Table D-30.

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WHC-EP-0558

2.2.5 Quality Control

Packaging/Acceptance/Use Criteria

Critical	Major	Acceptance/pre-use/ inspection criteria
Lid/body interface sealing surface	Vendor qualifications and experience	Functional: <ul style="list-style-type: none"> • Ease of lid/closure ring application • Bolt closure ring--bolt size • Gasket, adhesive, as specified • Geometry, as specified Acceptable Conditions: <ul style="list-style-type: none"> • Lack of dents, no deformation of sealing surfaces • Dimensions, as specified • Continuous welds, no sharp edges
Gasket		
Weld areas		
Body and chime	Metal thickness	Lot tests by shipper, as appropriate.
Air leak tests	Bolt size	Vendor Data and/or Certifications: <ul style="list-style-type: none"> • Marking • Test data • Type A document provided as appropriate • Air leak tests
	Protective coating application	Visual: <ul style="list-style-type: none"> • Surface/coating as specified • Lack of imperfections in application • Lack of rust, dents, nicks

*These criteria apply to first-time use and to reuse as a DOT-7A Type A packaging.

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NOV. 07 '95 04:59PM FBI NUCLEAR CONTAINER NRC FORM 511 1043		U. S. NUCLEAR REGULATORY COMMISSION QUALITY ASSURANCE PROGRAM APPROVAL FOR RADIOACTIVE MATERIAL PACKAGES		1. OFFICIAL FORM LA CLASS REVISION NUMBER 4
<p>PURSUANT TO THE Atomic Energy Act of 1954, as amended, the Energy Reorganization Act of 1974, as amended, and Title 10, Code of Federal Regulations, Chapter I, Part 71, and in reliance on standards and requirements hereunder found in Part 8 of the process carried to Part 2, the Quality Assurance Program identified in Item 3 is hereby approved. This approval is based on the requirements of Section 71.101 of 10 CFR Part 71. This approval is subject to all applicable rules, regulations, and orders of the Nuclear Regulatory Commission then in effect and to any amendments specified below.</p>				
2. NAME FBI, BROOKFIELD			3. EXPIRATION DATE August 31, 2000	
STREET ADDRESS 1201 Milton Road			4. IDENTIFICATION NUMBER 71-0185	
CITY Brookfield	STATE IN	ZIP CODE 47821		
5. QUALITY ASSURANCE PROGRAM APPLICATION DATES August 28, 1988, August 30, 1989 and July 10, 1993				
6. COMMENTS <p>Activities conducted under applicable criteria of Subpart H of 10 CFR Part 71 to be executed with regard to transportation packaging.</p>

BEST AVAILABLE COPY				
FOR THE U.S. NUCLEAR REGULATORY COMMISSION <i>David C. Harkovitch</i> David C. Harkovitch, ESQ. NUCLEAR REGULATORY COMMISSION			8/16/95 DATE	
DIVISION OF INDUSTRIAL AND MEDICAL NUCLEAR SAFETY OFFICE OF NUCLEAR MATERIAL SAFETY AND ENVIRONMENT				

APPENDIX B

**FRONTIER TECHNOLOGY CORPORATION UNLOADING PROCEDURE
FOR MODEL 50240 SHIPPING CONTAINER
(With a 2-in. center pipe and supplied
with a 0.009 Ci ²⁵²Cf source)**

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UNLOADING PROCEDURE
FOR
FRONTIER TECHNOLOGY CORPORATION
MODEL 50240 SHIPPING PACKAGE
WITH
WEP PLUG SOURCE HOLDER

Revision 1

November 1988

Frontier Technology Corporation
1641 Burnett Drive
P.O. Box 486
Xenia, Ohio 45385

DISCLAIMER

These procedures are provided to supply information concerning the mechanical construction of the shipping package and the mechanical steps associated with unloading and loading the package. They are not designed or intended, and cannot be, used to replace proper radiological health procedures to be followed when handling radioactive materials. The package should be unloaded or loaded only in the presence of a Radiation Safety Officer and only by persons trained and authorized to handle radioactive materials.

I. GENERAL

A. Container Description

The Frontier Technology Corporation Model 50240 shipping package is a type A package meeting DOT Specification 7A. The package is designed to transport Special Form Californium-252 neutron sources up to approximately 12 micrograms but it may also be used to transport type A quantities of other radioactive materials in Special Form provided that pertinent regulations are complied with.

The Model 50240 container is constructed per Frontier Technology Corporation (FTC) drawing number ASD240-AA00, Rev. 0. Basically, it is a 5-gallon USDOT Specification 17C steel drum filled with water-extended-polyester (WEP) shielding material. The radioactive source is located in a central cavity between (WEP) plugs all of which are located within a 2" schedule 40 steel pipe.

Weight of the container is approximately 45 pounds.

11. ACTIONS TO BE TAKEN UPON
RECEIPT OF LOADED PACKAGE

CAUTION: These steps should be performed under supervision of your Radiation Safety Officer by persons trained and authorized to handle radioactive materials.

A. Monitor Radiation:

Survey total Gamma and Neutron radiation fields. Verify Transport Index stated on package.

B. Monitor Radioactive Contamination:

Perform smear test of package surfaces for removable radioactive contamination.

C. Check Security Seal:

A security seal should be present. The seal is in the form of a wire through the body of the bolt holding the bolt ring onto the package, with the ends of the seal wire embedded into a lead seal having raised letters "FTC". Verify the presence of the seal and that the lead seal disk has the Frontier Technology Corporation "FTC".

D. Immediately notify Frontier Technology Corporation of any improper conditions.

III. ACTIONS TO BE TAKEN PRIOR TO OPENING THE PACKAGE

A. Examine Drawings and Unloading Procedure:

Examine drawing of the shipping package and this procedure.
Read this procedure completely through. If any steps are
unclear or if you have any questions, call Frontier
Technology Corporation, telephone number (513) 376-5671.

B. Place the Container:

Move the container to the location where it is to be
unloaded. This location should be in a restricted area
covered by your radioactive materials license.

C. Obtain Tools Necessary to Unload the Package:

Tools Required:
Wire Cutters
7/16-inch wrench
Pliers
Screwdriver (flat blade)

IV. UNLOADING PROCEDURE

- CAUTION: THE LOADED PACKAGE CONTAINS RADIOACTIVE MATERIAL WHICH EMITS SIGNIFICANT AMOUNTS OF NEUTRON AND GAMMA RADIATION.
- CAUTION: UNLOADING SHOULD BE PERFORMED UNDER SUPERVISION OF YOUR RADIATION SAFETY OFFICER BY PERSONS TRAINED AND AUTHORIZED TO HANDLE RADIOACTIVE MATERIAL.
- CAUTION: PRIOR TO AND DURING THE PERFORMANCE OF EACH STEP OF THIS PROCEDURE, MONITOR THE AREA WHERE YOU WILL BE WORKING FOR NEUTRON AND GAMMA RADIATION. PERFORM SMEAR TESTS FOR REMOVABLE RADIOACTIVE MATERIAL ON THE OUTSIDE OF THE PACKAGE PRIOR TO STARTING UNLOADING, AND ON EACH INTERNAL SURFACE AS IT IS EXPOSED DURING UNLOADING.
- A. Cut the seal wire securing the bolt in the bolt ring. Remove the seal wire from the bolt.
 - B. Remove the bolt ring and the drum cover.
 - C. Just inside the drum is a 2-inch steel pipe cap. Remove the cap by turning it counter-clockwise.
 - D. The top of a water-extended polyester (WEP) shield plug is now visible inside the 2-inch steel pipe. A cavity in the top of the shield plug contains an identification tag for each source in the container. Two strings are attached to each tag, and extend downward into the pipe alongside the shield plug, and are attached either to an open-top "bucket" inside of which the source is located, or to an eyelet adapter threaded onto a stud on the source. Remove the tags from the cavity and place them outside the pipe so that the strings are out of the way of the shield plug. Lift the plug by grasping the wire lifting loop and pulling upward until the plug is entirely out of the pipe.
 - E. The source "buckets" or source eyelet adapters are now visible in cavities inside the pipe. Remove the buckets (with source) or the source adapter assemblies one at a time from the container by pulling the attached strings vertically upward. A source may be removed from a "bucket" by turning the "bucket" upside down.
- CAUTION: THIS WILL EXPOSE THE UNSHIELDED SOURCE. THE NEUTRON AND GAMMA RADIATION LEVELS IN AIR AT ONE METER FROM AN UNSHIELDED 77 MICROGRAM/MILLIGRAM CF-252 SOURCE ARE APPROXIMATELY 37 mREM/HR AND 2.7 mR/HR, RESPECTIVELY. CAREFULLY MONITOR NEUTRON AND GAMMA RADIATION LEVELS. USE DISTANCE AND/OR SHIELDING TO REDUCE EXPOSURE TO PERSONNEL.
- F. Unloading is now complete. If the empty package is to be returned to Frontier, prepare it for shipment as outlined below.
 - G. Perform a swipe test for removable contamination on the internal surfaces of the package and the surfaces of internal components. Removable contamination averaged over each 300 sq cm of surface must not exceed 10 (exp. -4) μ Ci/sq cm (220 dpm/sq cm) alpha and 10 (exp. -3) μ Ci/sq cm (2200 dpm/sq cm) beta-gamma (49CFR 173.427(c) and 173.443(a)).
 - H. Replace the 2-inch pipe cap by screwing it clockwise onto the pipe.
 - I. Inspect the gasket on the inside of the drum cover. If not in good condition, replace it. Gasket material must have an operating range of -40 degrees F. to +158 degrees F.
 - J. Replace the drum cover onto the drum.
 - K. Replace the bolt ring and tighten the bolt tapping the ring until the lugs begin to bend inward, or come together.
 - L. Place a seal wire through the hole in the bolt and seal.

- M. Remove the Radioactive Materials labels from the container and place two DOT "EMPTY" labels on the container, one on each side. (Required by 49CFR173.427. Label specification is 49CFR172.450).
- N. Survey the package for neutron and gamma radiation. Total level at any point on the external surface of the package must not exceed 0.5 mRem/hr. (49CFR173.427(a) and 49CFR173.421(b)).
- O. Survey the external surfaces of the package for removable contamination using the swipe test method. Maximum permissible levels over any 300 square centimeter swipe area are 10(exp.-5)uCi/sq cm (2.2 dpm/sq cm) alpha and 10(exp.-5) uCi/sq cm (22 dpm/sq cm) beta-gamma, (49CFR173.427(a), 173.421(c), and 173.443(a)).
- P. Remove or cover the statements "Radioactive Material, Special Form Nos" and "UN2974" from each side of the package and replace with: "Radioactive Material, Empty Package" and "UN2908", also on each side of the package. Marking must be in a color which contrasts with the color of the package where the marking is put, the letters must be at least 1/2 inch high, and the marking material must be durable.
- Q. Mark package with the name and address of consignee and the name and address of consignor, making clear which is which.
- R. Examine package for damage and completeness. The package must be in unimpaired condition and securely closed so that there will be no leakage of radioactive material under conditions normally incident to transportation.
- S. The package is now ready to ship. It must be shipped as a hazardous material with appropriate shipping paper and shipper's declaration.

UN/1A2/Y36/S OR
USDOT SPFC 17C DRUM. WITH FULL OPENING HEAD
AND BOLT RING CLOSURE. CLAMP BOLT DRILLED
FOR SEAL WIRE. GASKET MAT'L TO HAVE MIN.
OPERATING RANGE OF -40°F. TO +158°F.

PAINT ALL INSIDE SURFACES.

USDOT 7A MARKING ON HEAD OR SIDE.

DIMENSIONS ARE IN INCHES □ MILLIMETERS

UNLESS OTHERWISE SPECIFIED
TOLERANCES:

DECIMALS FRACTIONS
.XX = ±
.XXX = ±
.XXXX BASIC
ALL SURFACES ✓

MATERIAL

MS

QA

MFG

DE

DRAWN

SIGNATURE

APPROVAL

DATE

FRONTIER TECHNOLOGY CORPORATION
XENIA, OHIO

5-GALLON CONTAINER

DWG. NO.
A50240-AA00

REV.
02

SCALE

WT. CALC
ACT.

CODE IDENT. NO.

SHEET 1 OF 1

REVISIONS

DE MFG QA MS

SYM.

DESCRIPTION

DATE

APPROVAL

01

CHANGE GASKET SPECIFICATION
ADD UN number

11/29/88

02/28/95

APPROVAL

APPROVAL

APPENDIX C**FRONTIER TECHNOLOGY CORPORATION PACKING LIST
(For 0.009 Ci ²⁵²Cf source and container)**

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WESTINGHOUSE HANFORD
DECEMBER 4, 1995

-PACKING LIST-
FRONTIER TECHNOLOGY CORPORATION
1641 Burnett Drive, Xenia Ohio 45385 * tel: 513/376-5691

SOLD TO	SHIP TO:
WESTINGHOUSE HANFORD COMPANY	THE DEPARTMENT OF ENERGY
ATT: ACCOUNTS PAYABLE(MSIN G1-80)	C/O WESTINGHOUSE HANFORD COMPANY
P.O. BOX 1970	CENTRAL RECEIVING
RICHLAND, WA 99352	2355 STEVENS DRIVE
	RICHLAND, WA 99352

P.O.# WGS-XDV-428737 WRM-5513
Shipped via FEDEX COLLECT Date shipped: 12/4/95

SOURCE DATA: as of 8/31/95
Serial No. Model Content Output(n/s) Contamination/100 cm²
FTC-CF-690 10S 16.8 ug. 9.0 mCi. 3.9 x 10⁷ (per source)
alpha<9 x 10⁻⁶uCi
beta/gamma<45 x 10⁻⁶uCi

RADIATION SURVEY IN AIR(mRem/hr)	GAMMA	NEUTRON
AT ONE FOOT FROM SOURCE	30	240
AT ONE METER FROM SOURCE	4	35

SHIPPING CONTAINER: US-DOT 7A Type A
Model #50240 Serial #229 Weight 45 lbs. Seal #FTC

Radiation level (mrem/hr);	surface	at one meter
gamma	48	1.2
neutron	120	6.0
TOTAL	168	7.2 (II)

Survey Instruments Used: Gamma RO2 287 Neutron PNR4 2236
Contamination level: alpha<9 x 10⁻⁶uCi/100cm²
beta/gamma<45 x 10⁻⁶uCi/100cm²

NOTICE: A radiation safety specialist should be present when this container is opened.

CERTIFICATIONS

SPECIAL FORM: At the time of shipment the source in this shipment met the requirements for special form.

LEAK TEST: The source in this shipment has passed the helium bubble pressure leak test.

CERTIFICATE OF ORIGIN: The Cf-252 neutron source, FTC-CF-690 and the Type A shipping container, Model 50240 serial number 229, are the product of the United States of America.

CERTIFICATE OF CONFORMANCE: The products covered by this document are certified to meet the requirements of the contract.

SHIPMENT APPROVALS:

QC *Edward L. Jumper* Date: DECEMBER 4, 1995
Health Physics *Edward L. Jumper* Date: DECEMBER 4, 1995

SHIP 50240 s/n 229

WESTINGHOUSE HANFORD WRM-5513
DECEMBER 4, 1995

FRONTIER TECHNOLOGY CORPORATION
RADIOACTIVE SOURCE SHIPMENT SURVEY RECORD

A. Source Data

1. Type of source: Cf-252
2. Quantity of sources: 1
3. Type of radiation emitted: neutron, gamma
4. Source identification: FTC-CF-690

Shipping Package Data

1. Type A
2. Model No. 50240
3. Serial No. 229
4. Approximate weight 45 lbs.

C. Radiological Control

1. Container Survey - contamination, microcuries/100 cm²
Outer Surface: alpha $< 9 \times 10^{-6}$
beta/gamma $< 45 \times 10^{-6}$
2. Container Survey - radiation, mrem/hr

	Surface	1 meter from surface
Gamma	48	1.2
Neutron	120	6.0
Total	168	7.2 *

*=transport index when rounded to next higher tenth, 49CFR173.389(1)
Survey instruments used: Gamma: RO2 287 Neutron: PNR4 2236

D. Name and address of shipper: FRONTIER TECHNOLOGY CORPORATION
1641 Burnett Drive
Xenia, Ohio 45385 U.S.A.
tel: 513/376-5691

E. Name and title of person generating form: Treva L. Janzow
Projects Manager

SHIP 50240 s/n 229

APPENDIX D

DRAWING OF SITE-BUILT ADAPTER FOR ^{252}Cf CONTAINER

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APPENDIX E

**FRONTIER TECHNOLOGY CORPORATION TYPE A CONTAINER CERTIFICATION
(Container for ^{241}Am -Be source)**

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TYPE A CONTAINER CERTIFICATION: MODEL 50240
August 24, 1995

Rev. 01

FRONTIER TECHNOLOGY CORPORATION N.R.C. LICENSE S.N.M. 1957

We hereby certify that shipping container, Model No. 50240, meets U.S.D.O.T. specifications 7A as defined in 49CFR178.350 for radioactive material in the form of Special Form Sealed Sources, gross weight up to 100 pounds, and is therefore suitable for common carrier shipment of Type "A" quantities of radioactive material in the form of Special Form Sealed Sources subject to prescribed limits of external radiation, gross weight, and additional specifications and restrictions specified below:

The Model 50240 Shipping Container is a 5 gallon steel drum meeting either DOT specification 17C* for drums manufactured prior to October 1994 or specification UN/1A2/Y36/S for drums manufactured after October 1994, containing shielding and other internals. The specification 17C* or UN/1A2/Y36/S drum is certified by its supplier, FBF Nuclear Containers, as being suitable for a Type A package component based on tests made by Monsanto Research Corporation, Mound Laboratory, Miamisburg Ohio as reported in Report No. MLM3245 by Don Edling and others and certified to be suitable for a Type A package component. The Mound tests, results, and conditions are reported in Report No. WHC-EP-0558 along with additional test results. Copies of the applicable FBF certification and applicable parts of WHC-EP-0558 are attached to and become a part of this certification.

The WHC-EP-0558 Report certifies the 17C drum as DOT 7A Type A for gross weight up to 100 pounds for radioactive material in the form of solids-large particle size only (Form 2) and in the form of objects with no significant dispersible or removable contamination (Form 3). The cover gasket must be positioned on the body curl so that an uninterrupted seal is assured completely around the cover. The ring closure must be properly seated in the cover and the outer edge of the body curl, and the bolt must be tightened until the lugs begin to bend inward or come together, with tapping of the ring during tightening. A jam nut must be used to prevent unintentional loosening during shipment. The jam nut is to be tightened against the ring-clamping nut after tightening of the ring has been completed.

Restriction of the authorized contents to Special Form Sealed Sources results in compliance with the form requirements described above as Form 2 and Form 3.

This certification is issued pursuant to the requirement of 49CFR173.415(a). It does not relieve the shipper from the requirement to comply with all applicable requirements of the DOT regulations.

Authorized Signature Edward F. Jancow
Edward F. Jancow, President

"in effect in December 1990 (i.e., prior to DOT Rulemaking RM-161)."

FBF Nuclear Containers

Middlebrook Industrial Park • 1201 Hilton Road
Knoxville, Tennessee 37921

Nuclear Containers and Casks for:
Fissile & Radioactive Material
Reactor Fuel Elements
Waste Material
Radioisotopes
Radioactive Sources

Containers and Casks:
Overpacks
Refurbishing & Repair
Drums
2-R Tubes
Cane Fiberboard Insulation
Semtex Insulation
Auratonite Insulation
Vermiculite Insulation
Phywood Insulation
DOT & NRC Specification

Lead Products:
Lead Pits
Lead Shields
Lead 2-R Liners
Lead Brick
Lead Boxes
Lead Containers

Polyethylene Containers for:
Drum Liners (Rigid)
Low Level Waste
Leaking Metal Drums
Polyethylene Drums

TYPE A AND TYPE B CONTAINERS
LSA AND WASTE CONTAINERS

FBF, INC.
615/584-1868

FBF CERTIFICATE OF COMPLIANCE

TYPE A CONTAINER COMPONENT

CUSTOMER: Frontier Technology Corp
PURCHASE ORDER NUMBER: 96238
DRAWING NUMBER(S): N/A
SPECIFICATION: UN1A2/Y36/S (Old DOT 17C) 5 Gal.
QUANTITY: 4 SIZE: 5 Gal TYPE UNIT: Component of a Type A Package
SERIAL NUMBER(S): N/A

This FBF Certificate of Compliance, as applied to applicable DOT specifications, is a component only of a Type A package for Type A quantities of radioactive material and subject to the shipper's compliance with CFR 49 and applicable portions of Part 173, and DOT 7A Type A Part 178.350.

This is to certify that the container described above is suitable as a component of a Type A package based on tests made by Monsanto Research Corporation, Mound Laboratory, Miamisburg, Ohio as shown in report number MLM 3245, and certified to be suitable for a Type A package component. The applicable copy of WHC - EP - 0558 report is attached and becomes a part of this certification.

The shipper must establish and maintain his file to show that material offered for shipment and other requirements of DOT regulations are met.

This certification does not relieve the shipper of his requirement to comply with all applicable requirement of DOT regulations.

FBF QA MANAGER

3/12/96

DATE

SERVING THE NUCLEAR INDUSTRY FOR OVER 38 YEARS
SEND US YOUR PRINTS FOR QUOTATION

NRC FORM 311 - p.49		U. S. NUCLEAR REGULATORY COMMISSION		1. APPROVAL NUMBER 0185	
QUALITY ASSURANCE PROGRAM APPROVAL FOR RADIOACTIVE MATERIAL PACKAGES				REVISION NUMBER 4	
<p>Pursuant to the Atomic Energy Act of 1954, as amended, the Energy Reorganization Act of 1974, as amended, and Title 10, Code of Federal Regulations, Chapter 1, Part 71, and in reliance on statements and representations heretofore made in Item 5 by the person named in Item 2, the Quality Assurance Program identified in Item 5 is hereby approved. This approval is issued to satisfy the requirements of Section 71.101 of 10 CFR Part 71. This approval is subject to all applicable rules, regulations, and orders of the Nuclear Regulatory Commission now or hereafter in effect and to any conditions specified below.</p>					
2. NAME FBF, Incorporated			3. EXPIRATION DATE August 31, 2000		
STREET ADDRESS 1201 Hilton Road			4. JACKET NUMBER 71-0185		
CITY Knoxville	STATE TN	ZIP CODE 37921			
5. QUALITY ASSURANCE PROGRAM APPLICATION DATE(S) August 28, 1989, August 30, 1989 and July 18, 1995					
6. CONDITIONS Activities conducted under applicable criteria of Subpart H of 10 CFR Part 71 to be executed with regard to transportation packagings.

<p>FOR THE U.S. NUCLEAR REGULATORY COMMISSION</p> <p><i>John P. Jankovich</i> John P. Jankovich Ph.D.</p> <p>8/16/95 DATE</p>					
<p>XXXXXXXXXXXXXXXXXXXX DIVISION OF INDUSTRIAL AND MEDICAL NUCLEAR SAFETY OFFICE OF NUCLEAR MATERIAL SAFETY AND SAFEGUARDS</p>					

FBF NUCLEAR CONTAINER
SHOP TRAVELER

Traveler: 1454 Date: 3/12/96 Customer: Frontier Technology Corp.
Purchase Order: 96238 Product Description: UNIA2 5gal
Serial No. on Drum: NA Inner Container: NA
Serial No. Sequence: — to — UN Specification No.: UNIA2/436/S
Drum Size: 5 gal Quantity: 4 Other: NA
Customer Drawing No.: NA
Customer Design Specification No.: NA
Customer Paint Specification No.: NA
Special Customer Requirements: Ship UPS

DRUM LABELS

Labeling Stock: Material: _____ Size/Guage: _____
Label Content: _____

Label Method: Painting: _____ Etching: _____ Die-Stamp: _____ Size of Alpha/Numeric: _____
Method of Attaching Label: _____

APPLICABLE FBF PROCEDURES

☒ 10.1 Rev. 2 Inprocess and Final Inspection A1-1, P1 to P1, SMAW
10.2 Rev. _____ Visual Weld Inspection T1-1, P1 to P1, GTAW
☒ 13.1 Rev. 4 Handling, Storage and Shipping TMSP 1-1, P1 to P1, GTAW/GMAW
14.1 Rev. _____ Inspection, Testing, and Operating Status
☒ 15.1 Rev. 2 Nonconformance Reporting T8-8, P8 to P8, GTAW
Other: _____

Traveler Completed by:

FBF Plant Manager

Approved by:

FBF CEO/QA Manager

ref WHC-EP-0558

Figure 2-2. DOT-17C 5-Gallon Steel Drum, 49 CFR 178.115.

**DOT 7A Type A
49 CFR 178.350** **BEST AVAILABLE COPY**

ref. WHC-EP-0558

2.2 DOT-17C 5-GALLON STEEL DRUM (DOCKETS: MLM)**2.2.1 Package Description**

Dimensions

5-gallon drum	Height (in.)	Diameter (in.)
Interior	12.5	11.25
Exterior (with ring)	13.0	12.00

Materials/Method of Construction

5 gallon	
Body and head sheet	24 gauge
Ring	16 gauge
Bolt	0.25 in.
Gasket required	

2.2.2 Authorized Contents

The shipper must determine that the actual contents are closely simulated by the test contents. If they are not, testing or analysis must be conducted and documented to demonstrate DOT-7A compliance with the actual contents.

2.2.2.1 Physical Form

2.2.2.1.1 Solids Only. Three forms are authorized. Each shipper must determine the most appropriate form for his particular contents and comply with any special requirements (e.g., RTV, etc.).

- Material Form No. 1: Solids--any particle size.
- Material Form No. 2: Solids--large particle size only (e.g., sand, concrete, debris, soil, etc.)
- Material Form No. 3: Solids--objects with no significant dispersible or removable contamination. (For definition, see 49 CFR 173.443, Contamination control.)

2.2.2.1.2 Maximum Gross Weight. Form No. 1, No. 2 and No. 3:

- 100 lb.

ref WHC-EP-0558

2.2.2.2 Chemical Form. The shipper must evaluate and ensure chemical compatibility of the material to be shipped with the materials of the packaging in contact with the payload.

2.2.2.3 Radiological. The 4-ft drop test caused deformation of the package resulting in a decrease in the distance from the exterior to the center of the package at the bottom edge of 0.5 in. (approximate). The shipper must ensure that the radiation level at any surface would not increase by more than 20% (relative to the radiation level of the undamaged configuration) if such a deformation would occur.

2.2.3 Restrictions/Specifications

For Form No. 1 Contents--RTV sealant (or equivalent) must be applied to the surface of the gasket in contact with the drum body.

For Form No. 2 and No. 3 Contents--No packaging component requirements other than as specified in Section 2.2.1.

Bolt closure tightened, with tapping, until the lugs begin to bend inward or come together--typically less than 40 ft-lb. A jam nut shall also be used to prevent unintentional loosening during transport.

The gasket material must have an operating range of -40 °F to +158 °F.

For heavy, bulky materials (e.g., concrete chunks, motors, pumps, etc.), equipment or materials with sharp corners or protrusions, or material/containment geometries that could result in highly localized forces, the shipper must ensure that the contents are securely fastened/positioned within the package.

BEST AVAILABLE COPY

ref. WHC-EP-0558

2.2.4 49 CFR 178.350 Regulatory Requirements

Regulatory Compliance Assessment

Regulatory requirements	Testing/analysis results
49 CFR 173.24, Standard requirements for all packages	Meets applicable requirements. See Appendix A, Table A-1.
49 CFR 173.411, General design requirements	Meets applicable requirements. See Appendix B, Table B-1.
49 CFR 173.412, Additional requirements for Type A packages	Meets applicable requirements. See Appendix C, Table C-1.
49 CFR 173.465, Type A packaging tests	Meets applicable requirements.
Water spray	<u>Pass</u> . Tests were conducted on all three styles of drums and demonstrated no leakage of water. Further, the water spray test preceded each of the remaining Type A tests. In no case was there any effect on the ability of the packagings to meet the required tests. See Appendix D, Table D-1.
Free drop	<u>Pass</u> . Sixty-nine separate drop tests were conducted (22 on Styles 1A and B, 26 on Style 2, and 21 on Style 3). Drops were conducted on edges, top corners, bottom corners, and the ends. In all cases, there was no loss of contents or major distortion of the packagings. See Appendix D, Table D-10.
Corner drop	Not required.
Compression	<u>Pass</u> . The test was conducted on all three styles at greater than five times the gross weight for greater than 24 hr. There was no visible distortion of the packagings or loss of contents. See Appendix D, Table D-23.
Penetration	<u>Pass</u> . The test was conducted at several points on all three styles of the packagings with no significant effect. The tests on the bungs left no discernable mark. The impact on the centers of the covers resulted in a maximum dent of 0.25 in. The tests on the closure rings left no visible effect. See Appendix D, Table D-30.

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W WHC-EP-0558

2.2.5 Quality Control

Packaging/Acceptance/Use Criteria

Critical	Major	Acceptance/pre-use/ inspection criteria
Lid/body interface sealing surface	Vendor qualifications and experience	Functional: <ul style="list-style-type: none"> • Ease of lid/closure ring application • Bolt closure ring--bolt size • Gasket, adhesive, as specified • Geometry, as specified Acceptable Conditions: <ul style="list-style-type: none"> • Lack of dents, no deformation of sealing surfaces • Dimensions, as specified • Continuous welds, no sharp edges
Gasket		
Weld areas		
Body and chime	Metal thickness	Lot tests by shipper, as appropriate.
Air leak tests	Bolt size	Vendor Data and/or Certification: <ul style="list-style-type: none"> • Marking • Test data • Type A document provided as appropriate • Air leak tests
	Protective coating application	Visual: <ul style="list-style-type: none"> • Surface/coating as specified • Lack of imperfections in application • Lack of rust, dents, nicks

*These criteria apply to first-time use and to reuse as a DOT-7A Type A packaging.

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JMF-WHC-EP-0558

2.2.6 ADDITIONAL INFORMATION

Evaluation and testing of this packaging were performed at MLM and were documented in Edling 1987. Complete evaluation reports are available upon request from one of the DOT-7A Program technical contacts listed in Section 1.1.2.

2.2.6.1 Primary Users

<u>Site/Contact/Phone</u>	<u>Address</u>
Los Alamos National Laboratory N. King COMM/FTS 505-667-4125	Los Alamos National Laboratory P.O. Box 1663 Los Alamos, NM 87545
Battelle Columbus Laboratories T. R. Emsweiler 614-879-5165	Battelle Columbus Laboratories 565 King Avenue Columbus, OH 43201

Supplier: FBF Nuclear Containers, Inc.
1201 Hilton Road
Knoxville, Tn. 37921
Phone (615) 54-1868
Fax (615) 54-4935

BEST AVAILABLE COPY

GRACEContainer and Chemical Specialties
Dowey and Almy Chemical DivisionW.R. Grace & Co., Conn.
55 Hayden Avenue
Lexington, Mass. 02173

The cover and seaming compounds manufactured by Grace for Cleveland Steel are made of blends of Styrene-Butadiene Rubbers (SBR) which, based on the supplier of these materials, typically operate (maintain elastic properties) over the following temperature ranges based on the principal rubber polymers utilized.

	<u>SBR</u>
Upper Limit	158 F
Lower Limit	-40 F

Testing to determine outer temperature operating limits has never been done on each compound by Grace. We have based this information on the physical characteristics of the principal rubber system, SBR.

Gasket performance is a function of the total container system. Long term performance is determined by the container design, assembly and the storage environment. Grace has no control or knowledge of all these factors. Characterization of rubber specification in temperature extremes is not a warranty or representation, expressed or implied, of Grace's cover and seaming compound performance.

Sincerely,

B. E. Wagner
General Sales Manager

BEW:kpf

BEST AVAILABLE COPY

FBF NUCLEAR CONTAINERS
1201 HILTON ROAD
KNOXVILLE, TN. 37921
PH. 615/584-1868
FAX 615/584-4935

TO WHOM IT MAY CONCERN:

THE DRUMS WE SUPPLY DO NOT CONTAIN LEAD, CADMIUM, MERCURY OR
HEXAVALENT CHROMIUM IN EXCESS OF THE 100 PPM REQUIREMENT SET BY
CONEG.

A handwritten signature in black ink, appearing to read "Don Wayne", is positioned above the printed name.

DON WAYNE
GENERAL MANAGER

FBF Nuclear Containers

Middlebrook Industrial Park • 1201 Hilton Road
Knoxville, Tennessee 37921

Nuclear Containers and Casks for:

Radioactive Material
Nuclear Fuel Elements
Waste Material
Radioisotopes
Radioactive Sources

Containers and Casks

Overpacks
Refueling & Repair
Drums
S-H Tubes
Core Plasterboard Insulation
Borehole Insulation
Aerogel Insulation
Vermiculite Insulation
Plywood Insulation
DOT & HAC Specification

Lead Products:

Lead Pans
Lead Shields
Lead S-H Liners
Lead Bricks
Lead Boxes
Lead Containers

Polyethylene Containers for:

Drum Liners (Rigid)
Low Level Waste
Leaking Metal Drums
Polyethylene Drums

TYPE A AND TYPE B CONTAINERS LSA AND WASTE CONTAINERS

FBF, INC.
615/584-1868
FAX 615/584-4835

DRUM CLOSURE INSTRUCTIONS

ON CLOSED HEAD DRUMS THE FITTINGS ARE REQUIRED TO HAVE THE GASKETS PROPERLY SEATED ON THE BUNG AND ON THE BUNG FLANGE. THE BUNG HAS TO BE TORQUED TO 15-20 FT. LBS. TO PROVIDE ADEQUATE SEAL ON THE GASKET.

ON OPEN HEAD DRUMS, IF THEY HAVE FITTINGS, THE SAME REQUIREMENTS APPLY. IF FOR ANY REASON IT BECOMES NECESSARY FOR YOUR PERSONNEL TO REMOVE THE COVER OR RING CLOSURE, THEN THE COVER AND COVER GASKET HAVE TO BE POSITIONED ON THE BODY CURL SO THAT AN UNINTERRUPTED SEAL IS ASSURED COMPLETELY AROUND THE FULL AREA OF THE COVER BY THE COVER GASKET. AFTER THE PROPER SEAL IS ACHIEVED BY THE COVER GASKET, THE RING CLOSURE MUST BE PROPERLY SEATED ON THE COVER AND THE OUTER EDGE OF THE BODY CURL SO THE BOLT CAN BE TORQUED TO THE FULL INTEGRITY OF THE RING CLOSURE, NOT TO EXCEED 40 FT. LBS...THE LOCK NUT MUST BE POSITIONED AGAINST THE NON-THREADED LUG, BETWEEN THE TWO LUGS AND THEN TIGHTENED (IF SC EQUIPPED) AGAINST THE NON-THREADED LUG TO FORM A SECURED LOCK TO PREVENT THE BOLT FROM VIBERATING LOOSE.

THIS INSTRUCTION SHEET MUST BE PROPERLY DISPOSED OF PRIOR TO CLOSING DRUM.

John Gamble
JOHN GAMBLE
QUALITY ASSURANCE MANAGER

SERVING THE NUCLEAR INDUSTRY FOR OVER 38 YEARS
SEND US YOUR PRINTS FOR QUOTATION

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APPENDIX F

**FRONTIER TECHNOLOGY CORPORATION UNLOADING PROCEDURE
FOR MODEL 50240 SHIPPING CONTAINER
(With a 3-in. center pipe)**

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UNLOADING PROCEDURE
FOR
FRONTIER TECHNOLOGY CORPORATION
MODEL 50240 SHIPPING PACKAGE
WITH
WEP PLUG SOURCE HOLDER

3" Center pipe
MARCH 1996

Frontier Technology Corporation
1641 Burnett Drive
P.O. Box 486
Xenia, Ohio 45385

DISCLAIMER

These procedures are provided to supply information concerning the mechanical construction of the shipping package and the mechanical steps associated with unloading and loading the package. They are not designed or intended, and cannot be, used to replace proper radiological health procedures to be followed when handling radioactive materials. The package should be unloaded or loaded only in the presence of a Radiation Safety Officer and only by persons trained and authorized to handle radioactive materials.

I. GENERAL

A. Container Description

The Frontier Technology Corporation Model 50240 shipping package is a Type A package meeting DOT Specification 7A. The package is designed to transport Special Form Californium-252 neutron sources up to approximately 12 micrograms but it may also be used to transport Type A quantities of other radioactive materials in Special Form provided that pertinent regulations are complied with.

The Model 50240 container is constructed per Frontier Technology Corporation (FTC) drawing number A50240-AA00, Rev. 0. Basically, it is a 5-gallon USDOT Specification 17C steel drum filled with water-extended-polyester (WEP) shielding material. The radioactive source is located in a central cavity between (WEP) plugs all of which are located within a 3" schedule 40 steel pipe.

Weight of the container is approximately 45 pounds.

11. ACTIONS TO BE TAKEN UPON
RECEIPT OF LOADED PACKAGE

CAUTION: These steps should be performed under supervision of your Radiation Safety Officer by persons trained and authorized to handle radioactive materials.

A. Monitor Radiation:

Survey total Gamma and Neutron radiation fields. Verify Transport Index stated on package.

B. Monitor Radioactive Contamination:

Perform smear test of package surfaces for removable radioactive contamination.

C. Check Security Seal:

A security seal should be present. The seal is in the form of a wire through the body of the bolt holding the bolt ring onto the package, with the ends of the seal wire embedded into a lead seal having raised letters "FTC". Verify the presence of the seal and that the lead seal disk has the Frontier Technology Corporation "FTC".

D. Immediately notify Frontier Technology Corporation of any improper conditions.

III. ACTIONS TO BE TAKEN PRIOR TO OPENING THE PACKAGE

A. Examine Drawings and Unloading Procedure:

Examine drawing of the shipping package and this procedure.
Read this procedure completely through. If any steps are
unclear or if you have any questions, call Frontier
Technology Corporation, telephone number (513) 376-5671.

B. Place the Container:

Move the container to the location where it is to be
unloaded. This location should be in a restricted area
covered by your radioactive materials license.

C. Obtain Tools Necessary to Unload the Package:

Tools Required:
Wire Cutters
7/16-inch wrench
Pliers
Screwdriver (flat blade)

IV. UNLOADING PROCEDURE

- CAUTION: THE LOADED PACKAGE CONTAINS RADIOACTIVE MATERIAL WHICH EMITS SIGNIFICANT AMOUNTS OF NEUTRON AND GAMMA RADIATION.
- CAUTION: UNLOADING SHOULD BE PERFORMED UNDER SUPERVISION OF YOUR RADIATION SAFETY OFFICER BY PERSONS TRAINED AND AUTHORIZED TO HANDLE RADIOACTIVE MATERIAL.
- CAUTION: PRIOR TO AND DURING THE PERFORMANCE OF EACH STEP OF THIS PROCEDURE, MONITOR THE AREA WHERE YOU WILL BE WORKING FOR NEUTRON AND GAMMA RADIATION. PERFORM SMEAR TESTS FOR REMOVABLE RADIOACTIVE MATERIAL ON THE OUTSIDE OF THE PACKAGE PRIOR TO STARTING UNLOADING, AND ON EACH INTERNAL SURFACE AS IT IS EXPOSED DURING UNLOADING.
- A. Cut the seal wire securing the bolt in the bolt ring. Remove the seal wire from the bolt.
 - B. Remove the bolt ring and the drum cover.
 - C. Just inside the drum is a 3-inch steel pipe cap. Remove the cap by turning it counter-clockwise.
 - D. The top of a water-extended polyester (WEP) shield plug is now visible inside the 3-inch steel pipe. A cavity in the top of the shield plug contains an identification tag for each source in the container. Two strings are attached to each tag, and extend downward into the pipe alongside the shield plug, and are attached either to an open-top "bucket" inside of which the source is located, or to an eyelet adapter threaded onto a stud on the source. Remove the tags from the cavity and place them outside the pipe so that the strings are out of the way of the shield plug. Lift the plug by grasping the wire lifting loop and pulling upward until the plug is entirely out of the pipe.
 - E. The source "buckets" or source eyelet adapters are now visible in cavities inside the pipe. Remove the buckets (with source) or the source-adaptor assemblies one at a time from the container by pulling the attached strings vertically upward. A source may be removed from a "bucket" by turning the "bucket" upside down.
- CAUTION: THIS WILL EXPOSE THE UNSHIELDED SOURCE. THE NEUTRON AND GAMMA RADIATION LEVELS IN AIR AT ONE METER FROM AN UNSHIELDED MICROGRAM/MILLIGRAM CF-252 SOURCE ARE APPROXIMATELY _____ mREM/HR AND _____ mR/HR, RESPECTIVELY. CAREFULLY MONITOR NEUTRON AND GAMMA RADIATION LEVELS. USE DISTANCE AND/OR SHIELDING TO REDUCE EXPOSURE TO PERSONNEL.
- F. Unloading is now complete. If the empty package is to be returned to Frontier, prepare it for shipment as outlined below.
 - G. Perform a swipe test for removable contamination on the internal surfaces of the package and the surfaces of internal components. Removable contamination averaged over each 300 sq cm of surface must not exceed 10 (exp. 4) $\mu\text{Ci}/\text{sq cm}$ (220 dpm/sq cm) alpha and 10 (exp. 3) $\mu\text{Ci}/\text{sq cm}$ (2200 dpm/sq cm) beta-gamma (49CFR 173.427(c) and 173.443(a)).
 - H. Replace the 3-inch pipe cap by screwing it clockwise onto the pipe.
 - I. Inspect the gasket on the inside of the drum cover. If not in good condition, replace it. Gasket material must have an operating range of -40 degrees F. to +158 degrees F.
 - J. Replace the drum cover onto the drum.
 - K. Replace the bolt ring and tighten the bolt, tapping the ring until the lugs begin to bend inward, or come together.
 - L. Place a seal wire through the hole in the bolt and seal.

- M. Remove the Radioactive Materials labels from the container and place two DOT "EMPTY" labels on the container, one on each side. (Required by 49CFR173.427. Label specification is 49CFR172.450).
- N. Survey the package for neutron and gamma radiation. Total level at any point on the external surface of the package must not exceed 0.5 mRem/hr. (49CFR173.427(a) and 49CFR173.421(b)).
- O. Survey the external surfaces of the package for removable contamination using the swipe test method. Maximum permissible levels over any 300 square centimeter swipe area are 10(exp.-6)uCi/sq cm (2.2 dpm/sq cm) alpha and 10(exp.-5) uCi/sq cm (22 dpm/sq cm) beta-gamma, (49CFR173.427(a), 173.421(c), and 173.443(a)).
- P. Remove or cover the statements "Radioactive Material, Special Form Nos" and "UN2974" from each side of the package and replace with: "Radioactive Material, Empty Package" and "UN2974", also on each side of the package. Marking must be in a color which contrasts with the color of the package where the marking is put, the letters must be at least 1/2 inch high, and the marking material must be durable.
- Q. Mark package with the name and address of consignee and the name and address of consignor, making clear which is which.
- R. Examine package for damage and completeness. The package must be in unimpaired condition and securely closed so that there will be no leakage of radioactive material under conditions normally incident to transportation.
- S. The package is now ready to ship. It must be shipped as a hazardous material with appropriate shipping paper and shipper's declaration.

BEST AVAILABLE COPY

UN/1A2/Y36/S OR
 USDOT SPFC 17C DRUM. WITH FULL OPENING HEAD
 AND BOLT RING CLOSURE. CLAMP BOLT DRILLED
 FOR SEAL WIRE. GASKET MAT'L TO HAVE MIN.
 OPERATING RANGE OF -40°F. TO +158°F.

PAINT ALL INSIDE SURFACES.

Plug:
 2 1/2 Sch. 40 PVC.
 "WEP" Filled
 Pinned To Place.

DIMENSIONS ARE IN ☒ INCHES ☐ MILLIMETERS

UNLESS OTHERWISE SPECIFIED

TOLERANCES:

DECIMALS

.XX = ±

.XXX = ±

.XXXX BASIC

ALL SURFACES

✓

MATERIAL

MS	APPROVAL	DATE
QA	<i>[Signature]</i>	4/3/90
MFG	<i>[Signature]</i>	4/3/90
DE	<i>[Signature]</i>	4/3/90
DRAWN	<i>[Signature]</i>	4/3/90
SIGNATURE	DATE	

FRONTIER TECHNOLOGY CORPORATION
 XENIA, OHIO

5-GALLON CONTAINER

DWG. NO.

50240/SN 257

REV.

C2

SCALE

WT. CALC
 ACT.

CODE IDENT NO

SHEET 1 OF 1

REVISIONS

DE MFG QA MS

SYM.	DESCRIPTION	DATE	APPROVAL
01	CHANGE GASKET SPECIFICATION	11/29/88	<i>[Signature]</i>
02	ADD UN number	02/28/89	<i>[Signature]</i>

APPENDIX G

SOURCE DOCUMENTATION

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

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

**IAEA CERTIFICATE OF COMPETENT AUTHORITY
SPECIAL FORM RADIOACTIVE MATERIALS
CERTIFICATE NUMBER USA/0367/S, REVISION 4**

This certifies that the sources described have been demonstrated to meet the regulatory requirements for special form radioactive material as prescribed in the regulations of the International Atomic Energy Agency¹ and the United States of America² for the transport of radioactive materials.

1. Source Identification - Frontier Technology Corporation Model 10 Series and Model 100 Series.
2. Source Description - The Series 10 sources are single encapsulations measuring 5.5 mm (0.217") OD x either 12 mm (0.47") or 25 mm (0.98"). The Series 100 sources are double encapsulations (inner capsule is a Series 10) measuring 9.4 mm (0.37") OD x approximately 25 mm (0.98") or 38 mm (1.48") in length. Both the Series 10 and 100 source capsules are manufactured of 304L stainless steel or zircalloy. Series 100 sources may have a special stud attachment, or may have an extended length with or without an attachment hole as illustrated and described on the attached drawings. These features are identified by prefix and suffix letters in the source model numbers which are also identified on the attached drawings.
3. Radioactive Contents - These sources consist of not more than 0.2 TBq (5.4 Ci) of Californium 252 in the form of Cf-Pd cermet or Cf-Pd alloy.
4. Expiration Date - This certificate expires September 30, 2000.

This certificate is issued in accordance with paragraph 803 of the IAEA Regulations and Section 173.476 of Title 49 of the Code of Federal Regulations, in response to the petition and information dated August 8, 1995 and September 12, 1995 submitted by Frontier Technology Corporation, Xenia, OH, and in consideration of other information on file in this Office.

Certified by:

James K. O'Steen, Director
Office of Hazardous Materials
Technology

OCT 3 1995

(DATE)

Revision 4 - Issued to authorize the use of special attachments on the Series 100 capsule, and to extend the expiration date.

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

2 Title 49, Code of Federal Regulations, Parts 100 - 199, United States of America.

U.S. Department
of Transportation

Research and
Special Programs
Administration

IAEA CERTIFICATE OF COMPETENT AUTHORITY
SPECIAL FORM RADIOACTIVE MATERIALS
CERTIFICATE NUMBER USA/0331/S, REVISION 3

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

This certifies that the source described has been demonstrated to meet the regulatory requirements for special form radioactive material as prescribed in the regulations of the International Atomic Energy Agency¹ and the United States of America² for the transport of radioactive materials.

1. Source Identification - Gammatron Model AN-HP source capsule.
2. Source Description - The source capsule, as shown in Gammatron Drawing Nos. A2002, A2004, A2006, A2008, and A2012 (attached), is a welded, double encapsulation constructed of ARMCO 17-4 (USN N05500) stainless steel with internal dimensions (length x width) 13 mm (0.5") x 13 mm (0.5"), 19 mm (0.75") x 13 mm (0.5"), 16 mm (0.63") x 16 mm (0.63"), 51 mm (2.0") x 19 mm (0.75") or 109 mm (4.3") x 27 mm (1.05").
3. Radioactive Contents - This source consists of not more than 0.74 TBq (20 curies) of either Americium 241 or an Americium-241/Beryllium mixture in the form of americium oxide or 0.0185 TBq (0.5 curies) of Californium 252 as metal pellets or wire.
4. Expiration Date - This certificate expires February 14, 1999.

This certificate is issued in accordance with paragraph 803 of the IAEA Regulations and Section 173.476 of Title 49 of the Code of Federal Regulations, in response to the January 21, 1994 petition by Consol, Inc., Bluefield, VA, and in consideration of other information on file in this Office.

Certified by:

George A. Brown, Chief
Radioactive Materials Branch
Office of Hazardous Materials
Technology

FEB 23 1994

(DATE)

Revision 3 - Issued to extend the expiration date.

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

2 Title 49, Code of Federal Regulations, Parts 100 - 199, United States of America.

APPENDIX H

**FRONTIER TECHNOLOGY CORPORATION MISCELLANEOUS
SUPPORTING DOCUMENTATION**

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FRONTIER TECHNOLOGY

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FRONTIER TECHNOLOGY CORPORATION

1641 Burnett Drive
Xenia, OH 45385

Science Applications International Corporation
Attn: E. J. Cruz
3250 Port of Benton Blvd.
Richland, WA 99352

December 12, 1995
RE: Your faxed letter
dated Nov. 20, 1995

Dear Mr. Cruz:

Frontier Technology Corporation document entitled "Type A Container Certification: Model 50240, Rev. 01, August 24, 1995" certifies the Frontier Model 50240 shipping package as suitable for common carrier shipment of Type A quantities of radioactive material in the form of Special Form Sealed Sources subject to limitations specified in the document.

Shippers of packages containing no more than a Type A quantity of non-fissile radioactive materials (or containing fissile materials meeting exemption standards of 10CFR71.53) are exempted by 10CFR71.10 "Exemption for low level materials" of all other requirements of 10CFR71 "Packaging and Transportation of Radioactive Material" except 10CFR71.5 and 10CFR71.88. Paragraph 10CFR71.5 requires that such shippers comply with 49CFR Parts 170 through 189, and 10CFR71.88 relates solely to the Air Transport of plutonium. Exemptions for Type A shipments include those paragraphs requiring NRC Approvals for specific packages and package designs (10CFR71 Subparts D and E) and requiring an NRC-approved quality assurance program (10CFR71 Subpart H); these items are not applicable to Type A packages or shipments. Paragraph 173.403(cc) of 49CFR specifies that a Type A package does not require "Competent Authority" approval. 49CFR173.415(a) authorizes U.S.D.O.T. Specification 7A packages (as specified in 49CFR178.350) for shipment of radioactive materials in quantities not exceeding applicable Type A limits, and requires that each SHIPPER of a Specification 7A package "maintain on file for at least one year after the latest shipment, and shall provide to DOT on request, a complete documentation of tests and an engineering evaluation or comparative data showing that the construction methods, packaging design, and materials of construction comply with that specification."

The documentation required by 49CFR173.415(a) for the Model 50240 package is contained in the Certification (including attachments) referenced above, as follows:

1. Type A tests were performed on a number of USDOT specification metal drums at Mound Laboratory, with the results of the tests being reported initially in report number MLM-2228 (1975). Changes in 49CFR effective June 30, 1983 resulted in additional testing at Mound Laboratory, the results of which were reported in MLM-3245 (1987). The regulatory changes (summarized

DEC 16 '95 13:34

FRONTIER TECHNOLOGY

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on pages I-32 and I-33 of MLM-3245) had no effect on the acceptability of a steel drum package limited to use with Special Form encapsulated sources, such as the Model 50240. MLM-3245 has been superseded by WHC-EP-0558 (June 1992), which incorporates the test results reported in MLM-3245, adds several new packaging configurations, and discusses the effect of regulatory changes arising from the adoption of HM-181 on Dec. 21, 1990. The metal drums test results contained in all three reports include 5-gallon drums per DOT Specifications* 6C and 17C. In addition, MLM-2228 contains test results on DOT Specification* 17H 5-gallon steel drums with WEP filler.

The drums used as a component of Frontier's Model 50240 packages are certified by their supplier** as "suitable as a component of a Type A package based on tests made by Monsanto Research Corporation, Mound Laboratory" as shown in report number MLM-3245, and reported in WHC-EP-0558. The supplier** of the drums has a quality assurance program approved by the NRC for activities conducted under applicable criteria of Subpart H of 10CFR Part 71 to be executed with regard to transportation packages. Copies of the supplier certification and QA Program Approval document are a part of Frontier's certification for the Model 50240.

The above documents are adequate to meet the requirements of 49CFR178.350, provided that requirements and restrictions specified in MLM-3245 and WHC-EP-0558 are met and documented.

2. Weight requirements. The Mound tests and results reported in MLM-3245 limit the gross weight of the 17C or equivalent drum to a maximum of 100 pounds. Frontier's certification also imposes a 100 pound gross weight limit. The actual weight of a Model 50240 package as made and delivered by Frontier is 38-43 pounds.

3. Chemical form. Frontier certifies the Model 50240 only for the shipment of radioactive material in the form of Special Form Sealed Sources, which requires that the radioactive material be hermetically sealed inside a non-reactive capsule. The non-radioactive contents consist of WEP, steel or iron, plywood or "masonite" and PVC, all of which are generally accepted as compatible with steel.

4. Radiological considerations. Frontier's Certification for the Model 50240 is stated as subject to prescribed limits of external radiation, by which is meant the limits specified in 49CFR173.441, which sets maximum limits at any point on the package and at specified distances from the package. Radioactive sources shipped in the Model 50240 are approximately centered within the WEP shield radially and axially, as required by the basic drawing, A50240-AA00. The shielding (WEP) distance at the corners of the container is thereby about 1.4 times that at a location radially outward from the source, or about $5.5 \times 1.4 - 5.5 = 2.2$ " greater than the radial shielding thickness. MLM-3245 reports that 4 foot drop tests flat on the top and bottom of the 5-gallon drums were deemed unnecessary because of the "almost total lack of effect" of such drops on other similar drums tested (p. D-20, Addendum 1), and that 4-foot drop tests onto the bottom and top corners were performed and passed (p. D-20, Addendum 1); WHC-EP-0558 indicates that the only damage from such tests significant to radiological considerations is a "decrease in the distance from the exterior to the center of the package at the bottom edge of 0.5 in. (approximate)" (p. 2-11).

* In effect in December 1990.

** Currently, FBF Nuclear Containers, Knoxville, Tennessee.

DEC 16 '95 13:35

FRONTIER TECHNOLOGY

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The damage described cannot reduce the shielding thickness in the damaged region by more than approximately 0.5 inch, leaving this thickness still approx. 1.7 " greater than the thickness radially outward from the source. The radiation levels at the damaged region will thereby remain lower than the as-shipped levels at the radial location, and will continue to be less than the limits prescribed by 49CFR173.441.

5. Bolt closure specification per MLM-3245/WHC-EP-0558. This is incorporated into Frontier's Certification.

6. Gasket material operating range. Covered by the drum supplier's certification.

7. Package content considerations. MLM-3245 (p. A-8) and WHC-EP-0558 (p. 2-10) each contain the statement:

"The shipper must determine that the actual contents are closely simulated by the test contents. If they are not, testing or analysis must be conducted and documented to demonstrate DOT 7A compliance with actual contents."

This statement is amplified in both reports by the additional statement:

"For heavy, bulky materials (e.g., concrete chunks, motors, pumps, etc.), equipment or materials with sharp corners or protrusions, or material/containment geometries that could result in highly localized forces, the shipper must ensure that the contents are securely fastened/positioned within the package."

The contents during the tests are reported in both reports as a quantity of sand and lead (no specified size or geometry for the lead) of a quantity sufficient to result in a gross container weight as-tested in excess of 100 pounds.

Frontier determined that the actual contents of the Model 50240 packages as specified by drawing number A50240-AA00 are adequately functionally simulated by the test contents, as follows.

The second of the above-quoted statements is considered first:

There are no heavy, bulky materials similar to the examples given in the reports, that is, there are no rigid items having gross densities approaching those of concrete or steel, or approaching that of the test material (sand and lead).

There are no items of equipment or materials having sharp corners or sharp protrusions. The only item qualifiable as a "protrusion" is the upper end of the center-pipe cap, which is considered below.

There are no items of material/containment geometries that could result in highly localized forces. The only item capable of resulting in localized forces at all is the upper end of the center-pipe cap, which is considered below.

The contents of the standard Model 50240 are as shown on drawing number A50240-AA00. The plywood or masonite spacers have shapes and holes such that the WEP material will flow around the sides of the spacers and through holes in the spacers, then cure into single solid shield. The spacer below the center-pipe is a nominal 1/2 inch thickness of pre-cured WEP or PVC, configured so as to be encased in WEP during casting. WEP also flows around and below the lower center-pipe cap during casting, such that the cap and attached pipe is constrained from moving axially or vertically relative to the shield once the WEP has cured. The contents of the center-pipe, i.e., source holder and source(s),

DEC 16 '95 13:36

FRONTIER TECHNOLOGY

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are configured so as to position the source(s) essentially in the center of the WEP shield, with little axial or lateral movement permitted; these contents are constrained in place by the two pipe caps. Drops onto the container sides and flat onto the bottom would produce less damage to the drum shell than the Mound tests as reported in MLM-3245, because the shell is fully supported by an elastic solid in these orientations, and the weight of the standard Model 50240 is less than half that of the test drums.

The Mound tests reported in MLM-3245 reported "almost total lack of effect" for drops of 100 pound plus containers flat onto their top or bottom. For drops flat onto the top and with the test contents inside, the bulk of the impact would be against the interior of the lid, then transmitted to the clamp ring via that vertical part of the lid between the more or less flat part and the gasket seat. This portion has a diameter of approximately 11 3/16", and a thickness of at least 0.0209" (min. for 24 gauge). Initial forces for a Model 50240 container dropped flat onto its top will be transmitted through the container side shell wall (also 24 gauge, approx. 11 5/16" dia.) to the gasket, to the lid gasket seat, and thence to the clamp ring, and will be less than one-half the magnitude of the forces in the test units. Thus, no damage to the clamp ring is expected, based on the cited test results. MLM-2228 reports passage of the 4-foot drop test by WEP filled DOT Specification 17H drums. The 17H drums tested were similar to the 17C drums and had the same body wall thickness (24 gauge), the differences between the two drum types being that the 17H head (lid) thickness is 20 gauge (0.0324" minimum) whereas the 17C head thickness is 24 gauge, and that the 17H closure is by a lug type closure and breeze clamp whereas the 17C closure is by a bolted 18 gauge clamp ring. The contents of the test drums were cast WEP containing a polyethylene source holder located in a drilled hole in the WEP shield and held in place by a lock bar screwed to the WEP; i.e., quite similar to the Model 50240 except for the center-pipe in the 50240. Authorized weight of the test drums was 43 pounds, equal to the heaviest measured weight of standard Model 50240 drums. Passage of the drop flat onto top of the 17H test drums as reported in MLM-2228 demonstrates that the unfilled space above the WEP level does not result in damage to the drum body sufficient to cause failure of the test; the demonstration applies to the Model 50240 because the drum body wall thickness and weight is the same as for the units tested. The Model 50240 has a center-pipe which protrudes above the WEP level and is closed by a standard pipe cap. Clearance between the top of the cap and the inside of the drum head (lid) is approximately one inch. If the WEP shield/center-pipe assembly moves relative to the drum body during impact, or if the drum body collapses, the upper end of the pipe cap could contact the inside of the drum head at its center. Total maximum force on the lid would be less than half of the force on the lids of drums tested and reported in MLM-3245 since the weight of contents of the 50240 is less than half that of the drums tested; this demonstrates that the lid will remain in place and sealed at the edges. The top of the standard 2" pipe cap is a flat surface approximately 2.7 inches in diameter with rounded edges of approximately 1/8-inch radii. The initial contact region would be a circle $2.7 - .25 = 2.45$ " in diameter.

DEC 16 '95 13:37

FRONTIER TECHNOLOGY

013 P05

A dent about 2.5 inches in diameter in the center of the lid may be produced, but no other damage is expected as the total forces on the lid are less than one-half those on the test units.

The tests reported in MLM-2228 on the WEP-filled 17H drums indicate the drums tested pass the 4-foot drop test onto the top corner of the drums. The drums tested had 20 gauge heads closed by segmented tabs bent around the curl on the drum bodies and secured from unbending by a light breeze clamp, whereas the Model 50240 has a 24 gauge head secured by an 18 gauge bolt ring and quarter inch bolt. Most of the drum head's resistance to bending and buckling arises from the formed-in gasket seat and the mechanism which clamps the head to the drum body. While the drums tested have thicker heads than the Model 50240 (20 gauge vs. 24 gauge) the clamping mechanism of the test drums is segmented 20 gauge tabs whereas the Model 50240 clamping mechanism is thicker (18 gauge) and continuous except for a short space (0-1/4") in the reinforced region of the clamp ring in the area of the quarter-inch bolt. The Model 50240 configuration has greater resistance to lid bending/buckling than the WEP-filled test drums reported in MLM-2228, and therefore the reported tests demonstrate that damage at the corner of the Model 50240, if it occurs, will not cause failure of the test. The drop onto top corner tests reported in MLM-3245 for 100 pound 17C drums containing sand and lead demonstrate that the Model 50240 lid will remain in place and sealed if the 43 pound maximum WEP shield/center-pipe assembly impacts on the inside of the lid, and the size and geometry of the pipe cap is such that puncture or tearing of the head is not expected. Thus it may be concluded that the contents of the Model 50240 containers are sufficiently closely simulated by the test contents of drums tested and reported by Mound.

We believe the above, along with our Certification for the Model 50240, to be adequate documentation to satisfy the requirements of 49CFR178.350.

Supplemental information: If one postulates that the Model 50240 containers will sustain greater or additional damage from the 4-foot drop tests than occurred to the test packages reported by Mound, the additional damages would be of one or more of the following types:

1. Leakage at the seal between the head and drum body, resulting from localized metal deformation near the point of impact, or
2. Buckling or denting of the container, with localized cracking or tearing of the drum head or body due to local deformation, and resulting leakage, or
3. Damage to the top corner of the WEP shield, potentially increasing radiation levels.

None of the types of postulated additional damage would result in the Model 50240 failing the test. Criteria for passage of the Type A tests are specified in 49CFR173.412(m), and are that when subjected to the tests, the packaging will prevent (1) loss or dispersal of the radioactive contents, and (2) any significant increase in the radiation levels at the external surfaces relative to those present before the tests. Requirement (1) will be met even if joint leakage occurs or cracks or tears in the drum body or head occur because containment of the radioactive

DEC 16 '95 13:37

FRONTIER TECHNOLOGY

013 P06

material authorized for shipment in the Model 50240 is achieved by Special Form encapsulation, assuring that no radioactive material will be lost or dispersed so long as the Special Form capsule(s) remain undamaged and within the center-pipe. Use of Special Form encapsulation as a component of the radioactive material containment system is authorized by 49CFR173.412(f). Requirement (2) will be met because the sources are constrained from moving within the center-pipe, the center-pipe is constrained from moving relative to the WEP shield, and damage to the shield would be limited to the top corner region. The thickness of WEP shielding between the source(s) and the top corner of the shield is about 1.4 times the thickness between the source(s) and the outside of the container as-made, measured on a plane parallel to the top and bottom of the container (called the thickness radially outward from the source(s)), i.e., approximately 5.5 inches. Damage to the corner of the shield would have to exceed approximately 2.2 inches before the radiation levels at the damaged corner would exceed the as-shipped levels of radiation at the surface radially outward from the source. This is more than four times greater than the damage observed for the drop onto the bottom corner of the package with the actual semi-fluid test contents of sand and lead.

The information herein is more than adequate to satisfy regulatory requirements. Therefor any concerns regarding the use of the FTC Model 50240 shipping container should also be satisfactorily alleviated.

Sincerely,

Edward F. Janzow, Ph. D.
Radiation Safety Officer

Treva L. Janzow
Projects Manager

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