Security Related Information - Withhold from Public Disclosure Under 10 CFR 2.390

NEXTera ENERGY POINT BEACH

October 5, 2020

NRC 2020-0031
EA-20-081

U. S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, DC 20555-0001

Point Beach Nuclear Plant Units 1 and 2
Docket 50-266 and 50-301
Renewed License No. DPR-24 and DPR-27

NextEra Energy Point Beach, LLC Response to Apparent Violation in NRC Inspection Report 05000266/2020012, 05000301/2020012; EA-20-081

References:

1. NRC Letter, Point Beach Nuclear Plant, Units 1 & 2 - NRC Inspection Report 05000266/2020012, 05000301/2020012; Preliminary White Finding and Apparent Violations dated August 3, 2020 (ML20216A765)
2. NextEra Letter, Response to Inspection Report 05000266/2020012, 05000301/20200012, dated August 12, 2020 (ML20225A252)
3. NextEra Letter, Response to Apparent Violation in NRC Inspection Report 05000266/2020012, 05000301/2020012; EA-20-081 dated September 11, 2020 (ML20255A142)

In Reference 1, the NRC documented a finding and apparent violations involving transportation of radioactive material as Low Specific Activity – II (LSA-II) that exceeded the LSA shipping limits for radiation levels as specified in 49 CFR 173.427.

By letter dated August 12, 2020 (Reference 2), NextEra informed the NRC that a regulatory conference was not requested and that a written response would be provided on the finding. By letter dated September 11, 2020 (Reference 3), NextEra provided that written response.

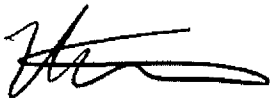
Based on discussion with the NRC that occurred on September 24, 2020, NextEra is supplementing the information provided in Reference 3 with information in the enclosures to this letter. Enclosure 1 contains calculation HP-100-080420 Radwaste Shipment 19-037 Dose Rate Calculation, Enclosure 2 contains calculation RSCS TSD 20-083, Revision 1, Evaluation of Resin Shipment at Point Beach Nuclear Plant, which contains security related information as defined by 10 CFR 2.390(d) and should be withheld from public disclosure, and Enclosure 3 contains calculation RSCS TSD 20-083, Revision 1, Evaluation of Resin Shipment at Point Beach Nuclear Plant Redacted Public Version.

Security Related Information - Withhold Under 10 CFR 2.390.
Enclosure 2 Contains Security Related Information,
Upon Separation of Enclosure 2 this letter is Non-Security Related.

This letter contains no new regulatory commitments or revisions to existing regulatory commitments.

If you have questions regarding this submittal, please contact Mr. Eric Schultz, Licensing Manager, at (920) 755-7854.

Sincerely,



Michael Strope
Site Vice President
NextEra Energy Point Beach, LLC

cc: Administrator, Region III, USNRC
Resident Inspector, Point Beach Nuclear Plant, USNRC
Project Manager, Point Beach Nuclear Plant, USNRC

Enclosures

Security Related Information - Withhold Under 10 CFR 2.390.
Enclosure 2 Contains Security Related Information,
Upon Separation of Enclosure 2 this letter is Non-Security Related.

ENCLOSURE 1

NEXTERA ENERGY POINT BEACH, LLC
POINT BEACH NUCLEAR PLANT, UNITS 1 AND 2

SUPPLEMENTAL INFORMATION
CALCULATION HP-100-080420

(17 pages follow)

Point Beach Nuclear Plant
Technical Basis Document

HP-100-080420 R0	Document Title: Radwaste Shipment 19-037 Dose Rate Calculation

Prepared By: CARL ONESTI 8/18/2020
Name / Date

Reviewed By: Jerri Walters 8/24/2020
Name / Date

Abstract

An assessment was performed of the 3 m radiation survey measurements performed on Radwaste Shipment 19-037 resin liner. This assessment determined that the readings greater than 1,000 mrem/h are not realistic for the 3 m location.

Document Type

	Technical Position		Analysis of Data
	Technical Evaluation		Baseline Documentation
	Question and Answer	X	Calculation
	Interpretation of Regulations		Other:

HP-100-080420 R0	**Document Title: Radwaste Shipment 19-037 Dose Rate Calculation**

Assessment:

Radwaste shipment 19-037 was performed to ship an L 8-120 liner filled with 100 cubic feet of spent resin to a radwaste vendor. Radiation survey measurements were performed on the liner on contact, at 1 meter and at 3 meters from the liner surface at various locations. (See Attachment 1) These measurements are summarized in Table 1, Radiation Survey Measurements for Radwaste Shipment 19-037 Liner. A review of the data shows a disagreement between two groups of 3 m radiation survey readings with one group showing readings greater than one 1,000 mR/h and the other showing readings less than 1,000 mR/h. A radiation shielding calculation was performed to show which readings are indicative of the true dose rate condition at the 3 m location. This calculation showed that the dose rates at distance from the liner surface decrease faster than what the $1/R^2$ general rule of thumb would calculate and that use of this rule will conservatively calculate the dose rate at distance from the liner surface. Calculations were made using this rule and the contact dose rate readings are included in Table 1. It is concluded that the 3 m radiation survey readings with readings greater than 1,000 mR/h are not realistic for the 3 m location. The MicroShield calculations indicate that these survey readings are more indicative of radiation readings at distances of 2.2 to 2.4 meters from the liner surface.

Table 1
Radiation Survey Measurements for Radwaste Shipment 19-037 Liner
(All readings in mR/h)

Location	Contact	1 meter	3 meter	3 meter**
Top of liner	12,200	3,250	863	Note
Bottom of liner	6,000	2,000	600	Note
Side of liner	14,400	3,200	1,200	636
Side of liner	11,600	3,000	1,300	512
Side of liner	9,600	2,000	1,000	424
Side of liner	8,700	2,300	1,200	384
Side of liner	7,500	2,800	1,300	331
Side of liner	8,500	2,200	1,400	375
Side of liner	10,000	3,100	650	441
Side of liner	6,300	4,400	800	278
Side of liner	8,800	1,400	700	388
Side of liner	14,000	No meas. data	No meas. data	618
Side of liner	10,000	No meas. data	No meas. data	441
Side of liner	10,000	No meas. data	No meas. data	441

** Calculated using contact reading and $1/R^2$ general rule of thumb. The applicability of this rule was demonstrated by the shielding calculation and was shown to be a conservative method. Note: Dose rate model only applies to side of liner.

HP-100-080420 R0	**Document Title: Radwaste Shipment 19-037 Dose Rate Calculation**

Calculation:

The calculation was performed using MicroShield, a widely used software application for performing shielding calculations. (Reference 1) The liner was modelled using a right circular cylinder geometry with a homogenized source term.

Radwaste shipment 19-037 was an L 8-120 liner filled with 100 cubic feet of spent resin. Activity content used as listed in the radwaste shipment record for the source activity. Waste density is 0.72 g/cc (modeled as polystyrene). Contact readings are assumed to be taken with a TelePole.

Model

- Height of cylinder = 64.912 in. (5 ft 4.912 in) [Data 5]
- Cylinder radius = 30.5 in. (2 ft 6.500 in) [Data 5]
- Cylinder wall thickness = 0.1196 in (material = iron) [Data 4]
- Contact dose rate point distance = 1.5 cm (0.59 in) [Data 1]
- Distance from liner centerline to contact dose rate point w/clad= 2 ft 7.211 in
- Distance from liner centerline to 1 m dose rate point w/clad= 5 ft 9.990 in
- Distance from liner centerline to 3 m dose rate point w/clad= 12 ft 4.730 in
- Distance from liner centerline to 2.2 m dose rate point w/clad= 9 ft 9.234 in
- Distance from liner centerline to 2.3 m dose rate point w/clad= 10 ft 1.171 in
- Distance from liner centerline to 2.4 m dose rate point w/clad= 10 ft 5.108 in

The MicroShield calculation record is attached as Attachment 2. The calculation results are shown in Table 2, Calculated Dose Rates for Radwaste Shipment 19-037 Liner. Also included in Table 2 is the liner contact reading measured by EnergySolutions showing agreement with the calculation. A review of the calculation results shows a reduction in dose rates greater than $1/R^2$ when progressing from the contact location to the other locations farther away from the liner. The use of the $1/R^2$ rule of thumb will conservatively calculate dose rates at distance from the liner. For example, using the $1/R^2$ rule to calculate the resin liner 3 m dose rate using the contact dose rate of 21.67 R/h, the liner centerline to contact distance of 31.21 in. and liner centerline to 3 m distance of 148.73 in., a conservatively calculated dose rate at 3 m is

$$21.67\ \mathrm{R/h} \times (31.21"^2/148.79"^2) = 953\ \mathrm{mR/h}$$

This is a conservative value and the true value is less than this.

Table 2 Calculated Dose Rates for Radwaste Shipment 19-037 Liner (All readings in mR/h)			
Location	Contact (1.5 cm)	1 meter	3 meters
Side of liner with wall clad	21,670	4,064	841
Side of liner with wall clad**	20,000		776***
Location****	2.2 meters	2.3 meters	2.4 meters
Side of liner with wall clad	1,382	1,289	1,206

** EnergySolutions radiation survey data

*** The 3 meter dose rate value of 776 mR/h was calculated using the EnergySolutions contact dose rate and the rate of change values described by the MicroShield calculation, i.e., 20,000 x (841 / 21,670)

**** The calculations performed for the 2.2, 2.3, and 2.4 meters locations is to show the distance from the liner surface where dose rates are in the range of 1,200 to 1,400 mR/h. This information is used to buttress the argument that the survey readings at 3 meters that exceeded 1,000 mR/h are not representative of the true dose rate at the 3 meters distance.

Data:

1. The outside diameter of the detector section of the TelePole containing the detectors is 3 centimeters. (Physical measurement) The centerline of the detectors is located on the instrument's long axis; i.e. pole, centerline. (Reference 2)
2. The activity content of the resin liner is listed in Table 3, Liner Activity Content. (Reference 3)

Table 3, Liner Activity Content					
Nuclide	Activity (mCi)	Nuclide	Activity (mCi)	Nuclide	Activity (mCi)
H-3	1.25E+02	C-14	4.46E+01	Mn-54	1.25E+03
Fe-55	5.70E+03	Co-57	6.39E+02	Co-58	9.05E+03
Co-60	1.82E+04	Ni-59	1.03E+03	Ni-63	7.6E+04
Zn-65	8.75E+01	Sr-89	1.24E+01	Sr-90	4.75E+01
Tc-99	5.90E-01	Sn-113	4.56E+01	Sb-124	1.36E+02
Sb-125	2.14E+03	I-129 <LLD>	1.66E-01	Cs-137	3.26E+03
Ce-144	1.04E+00	Pu-238	7.14E-01	Pu-239	4.75E-01
Pu-241	1.02E+02	Am-241	1.31E+00	Cm-242	7.83E-02
Cm-243	4.59E-01				

3. The waste volume is 100 cubic feet and waste weight is 4,500 pounds. (Reference 3) This gives a density of 0.72 g/cc.
4. The max internal volume of an L 8-120 liner is 120 cubic feet and the wall thickness is 0.1196 inches of steel. (Reference 4)
5. The internal height and radius of an L 8-120 is taken as 64.912 inches and 30.5 inches, respectively. (Reference 3, WMG 1R @ 3 meters calculation summary for 638712-1)

HP-100-080420 R0	Document Title: Radwaste Shipment 19-037 Dose Rate Calculation

Attachments:

1. PBPROD-M-20190529-10, "Outgoing Liner"
2. MicroShield calculation report for resin liner with wall clad
3. 2019-TRAN-BCO-2077, EnergySolutions Vehicle Survey Record for Manifest #19-037

References:

1. MicroShield V12.06, Grove Software
2. Mirion Technologies Document 15-00008, "TelePole Wide Range Operating and Maintenance Manual," Revision 7, September 2013
3. Radwaste shipment 19-037, "Package Characterization Report," 5/29/2019
4. CS-NS-GL-001, "Disposal Container Guideline Data"

ATTACHMENT 1

VSDS Standard Map Survey Report

Survey PBPROD-M-20190529-10

General Information

Title: Primary Resin Liner 638712-1

Survey Date/Time: 6/20/2019 16:48 — Lead Surveyor: Meyer James

Survey Type: Shipping — Work Order/Task #: 4

Counted By: — SLID: WE6437

RWP: 19-0010

Rx % Pwr:

Status: Approved by: LeClair Gene, 6/20/2019 06:17:02 — SLID: WE6020

Ready for Review by: Meyer James, 6/30/2019 09:38:35 — SLID: WE6437

Dose Rate (DR) Object Prefixes/Suffixes

Dose Rates with Prefixes:	Dose Rates with No Prefixes:	Default Prefixes:	Default Suffixes:
* = Contact	Gen Area	HS = Hot Spot	"n" = Neutron
+ = 30cm			"b" = Beta
			"c" = Corrected

Postings Legend

There are no postings in this survey.

Map Location

File Name	Image Description	Location Code	Bldg/Area Name	Location Description
Ship-Out-Liner	Outgoing Liner	Rad-Waste-Shipments	Outgoing Shipment	Outgoing Liner

Instruments Used

#	Instrument Model	Instrument Serial #
1	ISOLO	472033
2	ISOLO	472030
3	ISOLO	472937
4	ISOLO	472922
5	TELEPOLE	330489

ATTACHMENT 1

VSDS Standard Map Survey Report

Outgoing Liner	Survey #: PBPROD-M-20190620-10	Date/Time: 6/20/2019 10:40

Outgoing Liner

Highest 1 Meter Dose rate	4400
3 Meter Dose rate	1400
Avg. 1 Meter dose Rate	178.33

Liner Type:	L8120 BTFR
Liner Serial #	6287121
Liner Size:	8 -120
Type processing performed:	gross Dewatered

Top

3 Meter Dose rate	863
1 Meter Dose rate	3260
Contact Dose Rate	*12200

LINER	Date	RP Int
Package Inspected prior to use	6 20 19	jm
Liner Filled	6 11 19	jm
Liner Processed	6 20 19	jm
Lid Gasket installed & in good condition	6 20 19	DS
Lid Installed	6 20 19	DS
Liner Weight in lbs.	6760 Lbs	jm
Liner marked for shipment	6 20 19	jm
Markings applied	na	na

Side

Contact Dose Rate	*14400	*1100	*8200
1 Meter Dose rate	3200	2000	2000
3 Meter Dose rate	1200	1300	1000

Side

Contact Dose Rate	*8700	*7600	*6500
1 Meter Dose rate	2800	2800	2200
3 Meter Dose rate	1200	1300	1400

Bottom

Contact Dose Rate	*6000
1 Meter Dose Rate	2000
3 Meter Dose Rate	600

side

	contact	1 meter	3 meters
top	*10000	3100	650
middle	*6300	4400	800
bottom	*8800	1400	700

side

	contact
	*14000
	*10000
	*10000

Package Inspected: jm

Ship-Out-Liner

Comments: beta mda 171.3 dpm
alpha mda 19.6 dpm

Summary of Highest Readings
(All available values may not be listed)

Smears	Air Samples & Wipes
6) <MDA DPM/100 cm2 β/γ	
6) <MDA DPM/100 cm2 α	

Type: Shipping

Symbol Legend (for example only)

Dose Rate
*100 Contact Reading
+75 30 cm Reading
20 General Area
HS-60 Hot Spot
RCA Posting
Drip Bag
15 Smear
15 Air Sample
RM
15 Wipe

RWP #: 19-0010
Short Name: outgoing resin liner primary

Unless otherwise noted, dose rates in mrem/hr.

Lead Surveyor: Meyer James	Status: Approved by: LeClair Gene, 6/20/2019 06:17:02
Location Code: Rad-Waste-Shipments	Bldg/Area Name: Outgoing Shipment
Location Description: Outgoing Liner	

Alpha (Y/N): n
Survey #: PBPROD-M-20190620-10 - PDF Generated On: 6/20/2019 06:17

Image File: Ship-Out-Liner

ATTACHMENT 1

VSDS Standard Map Survey Report

Data Point Details

Survey #: PBPROD-M-20190529-10

Map: Ship-Out-Liner

#	Type	Inst.	Value	Units	Location	Notes
DR	γ	N/A	4400	mrem/hr		
DR	γ	N/A	176.33	mrem/hr		
DR	γ	N/A	3260	mrem/hr		
DR	γ	N/A	* 12200	mrem/hr		
DR	γ	N/A	3200	mrem/hr	Top	
DR	γ	N/A	* 14400	mrem/hr	top	
DR	γ	N/A	2300	mrem/hr	Top	
DR	γ	N/A	* 8700	mrem/hr	Top	
DR	γ	N/A	* 11600	mrem/hr	Middle	
DR	γ	N/A	* 9600	mrem/hr	Bottom	
DR	γ	N/A	3000	mrem/hr	Middle	
DR	γ	N/A	2000	mrem/hr	Bottom	
DR	γ	N/A	* 7500	mrem/hr	Middle	
DR	γ	N/A	* 8500	mrem/hr	Bottom	
DR	γ	N/A	2600	mrem/hr	Middle	
DR	γ	N/A	2200	mrem/hr	Bottom	
DR	γ	N/A	* 6000	mrem/hr		
DR	γ	N/A	2000	mrem/hr		
DR	γ	N/A	863	mrem/hr		
DR	γ	N/A	600	mrem/hr		
DR	γ	N/A	* 10000	mrem/hr		
DR	γ	N/A	* 6300	mrem/hr		
DR	γ	N/A	* 8600	mrem/hr		
DR	γ	N/A	* 14000	mrem/hr		
DR	γ	N/A	* 10000	mrem/hr		
DR	γ	N/A	* 10000	mrem/hr		
DR	γ	N/A	1400	mrem/hr	bottom	
DR	γ	N/A	4400	mrem/hr	middle	
DR	γ	N/A	3100	mrem/hr	top	
DR	γ	N/A	1200	mrem/hr	top	
DR	γ	N/A	1300	mrem/hr	middle	
DR	γ	N/A	1000	mrem/hr	bottom	
DR	γ	N/A	1200	mrem/hr	top	
DR	γ	N/A	1300	mrem/hr	middle	
DR	γ	N/A	1400	mrem/hr	bottom	
DR	γ	N/A	700	mrem/hr	bottom	
DR	γ	N/A	800	mrem/hr	middle	
DR	γ	N/A	650	mrem/hr	top	
DR	γ	N/A	1400	mrem/hr		
1	Smear	N/A	β/γ <MDA	DPM/100 cm2	liner top	
		N/A	α <MDA	DPM/100 cm2		
2	Smear	N/A	β/γ <MDA	DPM/100 cm2	liner top	
		N/A	α <MDA	DPM/100 cm2		
3	Smear	N/A	β/γ <MDA	DPM/100 cm2	liner top	
		N/A	α <MDA	DPM/100 cm2		
4	Smear	N/A	β/γ <MDA	DPM/100 cm2	liner top	
		N/A	α <MDA	DPM/100 cm2		
5	Smear	N/A	β/γ <MDA	DPM/100 cm2	liner top	
		N/A	α <MDA	DPM/100 cm2		
6	Smear	N/A	β/γ <MDA	DPM/100 cm2		
		N/A	α <MDA	DPM/100 cm2		

ATTACHMENT 1

VSDS Standard Map Survey Report

Data Point Details

Survey #: PBPROD-M-20190529-10

Map: Ship-Out-Liner

#	Type	Inst.	Value	Units	Location	Notes
	Text		L8120 BTFR			
	Text		636712-1			
	Text		8 -120			
	Text		gross Dewatered			
	Text		8/29/17			
	Text		2/11/19			
	Text		5/23/19			
	Text		5/23/19			
	Text		5/23/19			
	Text		6750 Lbs			
	Text		5/30/19			
	Text		na			
	Text		jm			
	Text		jm			
	Text		jm			
	Text		ds			
	Text		DS			
	Text		jm			
	Text		jm			
	Text		na			
	Text		jm			
	Text		Side			
	Text		Bottom			
	Text		1 Meter Dose Rate			
	Text		3 Meter Dose Rate			
	Text		top			
	Text		middle			
	Text		bottom			
	Text		side			
	Text		side			
	Text		1 meter			
	Text		3 meters			
	Text		contact			
	Text		contact			
	Text		Contact Dose Rate			

ATTACHMENT 2

MicroShield 12.06
Nextera Energy Employee

Date	Preparer	Reviewer
8/18/2020	EARL ONESTI	Jenn Walters

File Name	Run Date	Run Time	Duration
C:\Users\np4102\OneDrive - NEE\Documents\DA EP Calc\L8-120 Dose Rate Calc with wall clad - polystyrene.msd	August 18, 2020	9:17:16 AM	00:00:10

Project Info

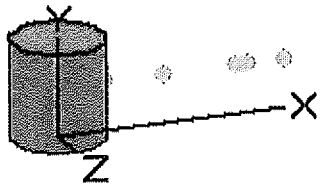
Case Title	L8-120 Liner
Description	Dose Rates at contact, 1 and 3 Meters with Wall Clad
Geometry	7 - Cylinder Volume - Side Shields

Source Dimensions

Height	164.876 cm (5 ft 4.912 in)
Radius	77.47 cm (2 ft 6.500 in)

Dose Points

No.	X	Y	Z
#1	79.277 cm (2 ft 7.211 in)	82.438 cm (2 ft 8.456 in)	0.0 cm (0 in)
#2	177.774 cm (5 ft 9.990 in)	82.448 cm (2 ft 8.460 in)	0.0 cm (0 in)
#3	377.774 cm (12 ft 4.730 in)	82.438 cm (2 ft 8.456 in)	0.0 cm (0 in)
#4	297.774 cm (9 ft 9.234 in)	82.438 cm (2 ft 8.456 in)	0.0 cm (0 in)
#5	307.774 cm (10 ft 1.171 in)	82.44 cm (2 ft 8.457 in)	0.0 cm (0 in)
#6	317.774 cm (10 ft 5.108 in)	82.44 cm (2 ft 8.457 in)	0.0 cm (0 in)



Shields

Shield N	Dimension	Material	Density (g/cm³)
Source	3.11e+06 cm³	Polystyrene	0.72
Transition		Air	0.00122
Air Gap		Air	0.00122
Wall Clad	0.304 cm	Iron	7.86

Source Input: Grouping Method - Standard Indices
Number of Groups: 25
Lower Energy Cutoff: 0.015
Photons< 0.015: Excluded
Library: Grove

Nuclide	Ci	Bq	μCi/cm³	Bq/cm³
Am-241	1.3100e-003	4.8470e+007	4.2140e-004	1.5592e+001

ATTACHMENT 2

Ba-137m	3.0840e+000	1.1411e+011	9.9205e-001	3.6706e+004
C-14	4.4600e-002	1.6502e+009	1.4347e-002	5.3084e+002
Ce-144	1.0400e-003	3.8480e+007	3.3455e-004	1.2378e+001
Cm-242	7.8300e-005	2.8971e+006	2.5188e-005	9.3194e-001
Cm-243	4.5900e-004	1.6983e+007	1.4765e-004	5.4631e+000
Co-57	6.3900e-001	2.3643e+010	2.0555e-001	7.6055e+003
Co-58	9.0500e+000	3.3485e+011	2.9112e+000	1.0771e+005
Co-60	1.8200e+001	6.7340e+011	5.8546e+000	2.1662e+005
Cs-137	3.2600e+000	1.2062e+011	1.0487e+000	3.8801e+004
Fe-55	5.7000e+000	2.1090e+011	1.8336e+000	6.7842e+004
H-3	1.2500e-001	4.6250e+009	4.0210e-002	1.4878e+003
I-129	1.6800e-004	6.2160e+006	5.4042e-005	1.9996e+000
In-113m	4.5600e-002	1.6872e+009	1.4669e-002	5.4274e+002
Mn-54	1.2500e+000	4.6250e+010	4.0210e-001	1.4878e+004
Ni-59	1.0300e+000	3.8110e+010	3.3133e-001	1.2259e+004
Ni-63	7.6000e+001	2.8120e+012	2.4448e+001	9.0456e+005
Pr-144	1.0251e-003	3.7930e+007	3.2976e-004	1.2201e+001
Pu-238	7.1400e-004	2.6418e+007	2.2968e-004	8.4981e+000
Pu-239	4.7500e-004	1.7575e+007	1.5280e-004	5.6535e+000
Pu-241	1.0200e-001	3.7740e+009	3.2811e-002	1.2140e+003
Sb-124	1.3500e-001	4.9950e+009	4.3427e-002	1.6068e+003
Sb-125	2.1400e+000	7.9180e+010	6.8840e-001	2.5471e+004
Sn-113	4.5600e-002	1.6872e+009	1.4669e-002	5.4274e+002
Sr-89	1.2400e-002	4.5880e+008	3.9888e-003	1.4759e+002
Sr-90	4.7500e-002	1.7575e+009	1.5280e-002	5.6535e+002
Tc-99	5.9000e-004	2.1830e+007	1.8979e-004	7.0223e+000
Y-90	4.7500e-002	1.7575e+009	1.5280e-002	5.6535e+002
Zn-65	8.7500e-002	3.2375e+009	2.8147e-002	1.0414e+003

Buildup

Buildup: The material reference is Source.

Integration Parameters

Radial	20
Circumferential	20

ATTACHMENT 2

Y Direction (axial)	20

Results With Buildup: Dose Point No. 1 - (X = 79.277, Y = 82.43824, Z = 0) cm

Energy (MeV)	Activity (Photons/sec)	Energy Flux (MeV/cm²/sec)	Photon Flux (Photons/cm²/sec)	Exposure Rate (mR/hr)	Absorbed Dose Rate (mrad/hr)	Absorbed Dose Rate (mGy/hr)
2.000e-02	1.339e+09	1.513e-22	7.567e-21	5.243e-24	4.577e-24	4.577e-26
3.000e-02	4.261e+10	6.128e-05	2.043e-03	6.073e-07	5.302e-07	5.302e-09
4.000e-02	4.888e+09	1.567e+00	3.917e+01	6.929e-03	6.049e-03	6.049e-05
6.000e-02	1.760e+07	2.718e+00	4.531e+01	5.400e-03	4.714e-03	4.714e-05
8.000e-02	6.152e+05	3.706e-01	4.632e+00	5.864e-04	5.120e-04	5.120e-06
1.000e-01	2.043e+10	2.017e+04	2.017e+05	3.086e+01	2.694e+01	2.694e-01
1.500e-01	2.710e+09	3.921e+03	2.614e+04	6.456e+00	5.636e+00	5.636e-02
2.000e-01	6.012e+09	9.463e+03	4.732e+04	1.670e+01	1.458e+01	1.458e-01
3.000e-01	3.654e+08	7.238e+02	2.413e+03	1.373e+00	1.199e+00	1.199e-02
4.000e-01	2.590e+10	6.262e+04	1.566e+05	1.220e+02	1.065e+02	1.065e+00
5.000e-01	1.083e+11	3.114e+05	6.228e+05	6.113e+02	5.336e+02	5.336e+00
6.000e-01	1.365e+11	4.594e+05	7.657e+05	8.967e+02	7.828e+02	7.828e+00
8.000e-01	3.824e+11	1.675e+06	2.094e+06	3.186e+03	2.781e+03	2.781e+01
1.000e+00	6.753e+11	3.725e+06	3.725e+06	6.867e+03	5.995e+03	5.995e+01
1.500e+00	6.780e+11	5.901e+06	3.934e+06	9.929e+03	8.668e+03	8.668e+01
2.000e+00	2.863e+08	3.499e+03	1.749e+03	5.410e+00	4.723e+00	4.723e-02
Total	**2.085e+12**	**1.217e+07**	**1.158e+07**	**2.167e+04**	**1.892e+04**	**1.892e+02**

Results With Buildup: Dose Point No. 2 - (X = 177.7738, Y = 82.4484, Z = 0) cm

Energy (MeV)	Activity (Photons/sec)	Energy Flux (MeV/cm²/sec)	Photon Flux (Photons/cm²/sec)	Exposure Rate (mR/hr)	Absorbed Dose Rate (mrad/hr)	Absorbed Dose Rate (mGy/hr)
2.000e-02	1.339e+09	2.666e-23	1.333e-21	9.235e-25	8.062e-25	8.062e-27
3.000e-02	4.261e+10	2.903e-05	9.678e-04	2.877e-07	2.512e-07	2.512e-09
4.000e-02	4.888e+09	6.059e-01	1.515e+01	2.680e-03	2.339e-03	2.339e-05
6.000e-02	1.760e+07	8.207e-01	1.368e+01	1.630e-03	1.423e-03	1.423e-05
8.000e-02	6.152e+05	9.175e-02	1.147e+00	1.452e-04	1.268e-04	1.268e-06
1.000e-01	2.043e+10	4.478e+03	4.478e+04	6.850e+00	5.980e+00	5.980e-02
1.500e-01	2.710e+09	7.803e+02	5.202e+03	1.285e+00	1.122e+00	1.122e-02
2.000e-01	6.012e+09	1.830e+03	9.151e+03	3.230e+00	2.820e+00	2.820e-02

ATTACHMENT 2

3.000e-01	3.654e+08	1.380e+02	4.601e+02	2.618e-01	2.286e-01	2.286e-03
4.000e-01	2.590e+10	1.191e+04	2.977e+04	2.320e+01	2.025e+01	2.025e-01
5.000e-01	1.083e+11	5.909e+04	1.182e+05	1.160e+02	1.013e+02	1.013e+00
6.000e-01	1.365e+11	8.705e+04	1.451e+05	1.699e+02	1.483e+02	1.483e+00
8.000e-01	3.824e+11	3.157e+05	3.946e+05	6.005e+02	5.242e+02	5.242e+00
1.000e+00	6.753e+11	6.999e+05	6.999e+05	1.290e+03	1.126e+03	1.126e+01
1.500e+00	6.780e+11	1.101e+06	7.338e+05	1.852e+03	1.617e+03	1.617e+01
2.000e+00	2.863e+08	6.490e+02	3.245e+02	1.004e+00	8.762e-01	8.762e-03
Total	**2.085e+12**	**2.282e+06**	**1.376e+07**	**4.064e+03**	**3.548e+03**	**3.548e+01**

Results With Buildup: Dose Point No. 3 - (X = 377.774, Y = 82.43824, Z = 0) cm

Energy (MeV)	Activity (Photons/sec)	Energy Flux (MeV/cm^2/sec)	Photon Flux (Photons/cm^2/sec)	Exposure Rate (mR/hr)	Absorbed Dose Rate (mrad/hr)	Absorbed Dose Rate (mGy/hr)
2.000e-02	1.339e+09	5.827e-24	2.914e-22	2.018e-25	1.762e-25	1.762e-27
3.000e-02	4.261e+10	9.691e-06	3.230e-04	9.605e-08	8.385e-08	8.385e-10
4.000e-02	4.888e+09	1.595e-01	3.988e+00	7.056e-04	6.160e-04	6.160e-06
6.000e-02	1.760e+07	1.738e-01	2.897e+00	3.453e-04	3.014e-04	3.014e-06
8.000e-02	6.152e+05	1.872e-02	2.340e-01	2.963e-05	2.586e-05	2.586e-07
1.000e-01	2.043e+10	9.120e+02	9.120e+03	1.395e+00	1.218e+00	1.218e-02
1.500e-01	2.710e+09	1.595e+02	1.063e+03	2.627e-01	2.293e-01	2.293e-03
2.000e-01	6.012e+09	3.749e+02	1.874e+03	6.616e-01	5.776e-01	5.776e-03
3.000e-01	3.654e+08	2.835e+01	9.449e+01	5.377e-02	4.694e-02	4.694e-04
4.000e-01	2.590e+10	2.446e+03	6.115e+03	4.766e+00	4.160e+00	4.160e-02
5.000e-01	1.083e+11	1.215e+04	2.431e+04	2.386e+01	2.083e+01	2.083e-01
6.000e-01	1.365e+11	1.792e+04	2.987e+04	3.498e+01	3.054e+01	3.054e-01
8.000e-01	3.824e+11	6.514e+04	8.142e+04	1.239e+02	1.082e+02	1.082e+00
1.000e+00	6.753e+11	1.447e+05	1.447e+05	2.667e+02	2.329e+02	2.329e+00
1.500e+00	6.780e+11	2.286e+05	1.524e+05	3.846e+02	3.358e+02	3.358e+00
2.000e+00	2.863e+08	1.353e+02	6.766e+01	2.093e-01	1.827e-01	1.827e-03
Total	**2.085e+12**	**4.726e+05**	**1.421e+07**	**8.414e+02**	**7.346e+02**	**7.346e+00**

Results With Buildup: Dose Point No. 4 - (X = 297.7738, Y = 82.43824, Z = 0) cm

Energy (MeV)	Activity (Photons/sec)	Energy Flux (MeV/cm^2/sec)	Photon Flux (Photons/cm^2/sec)	Exposure Rate (mR/hr)	Absorbed Dose Rate (mrad/hr)	Absorbed Dose Rate (mGy/hr)

ATTACHMENT 2

2.000e-02	1.339e+09	9.404e-24	4.702e-22	3.257e-25	2.844e-25	2.844e-27
3.000e-02	4.261e+10	1.473e-05	4.909e-04	1.460e-07	1.274e-07	1.274e-09
4.000e-02	4.888e+09	2.567e-01	6.417e+00	1.135e-03	9.911e-04	9.911e-06
6.000e-02	1.760e+07	2.880e-01	4.799e+00	5.720e-04	4.993e-04	4.993e-06
8.000e-02	6.152e+05	3.097e-02	3.872e-01	4.901e-05	4.279e-05	4.279e-07
1.000e-01	2.043e+10	1.506e+03	1.506e+04	2.304e+00	2.012e+00	2.012e-02
1.500e-01	2.710e+09	2.631e+02	1.754e+03	4.333e-01	3.783e-01	3.783e-03
2.000e-01	6.012e+09	6.176e+02	3.088e+03	1.090e+00	9.516e-01	9.516e-03
3.000e-01	3.654e+08	4.668e+01	1.556e+02	8.855e-02	7.731e-02	7.731e-04
4.000e-01	2.590e+10	4.025e+03	1.006e+04	7.843e+00	6.847e+00	6.847e-02
5.000e-01	1.083e+11	2.000e+04	3.999e+04	3.925e+01	3.426e+01	3.426e-01
6.000e-01	1.365e+11	2.948e+04	4.914e+04	5.755e+01	5.024e+01	5.024e-01
8.000e-01	3.824e+11	1.071e+05	1.338e+05	2.037e+02	1.778e+02	1.778e+00
1.000e+00	6.753e+11	2.377e+05	2.377e+05	4.381e+02	3.825e+02	3.825e+00
1.500e+00	6.780e+11	3.750e+05	2.500e+05	6.309e+02	5.507e+02	5.507e+00
2.000e+00	2.863e+08	2.217e+02	1.108e+02	3.428e-01	2.993e-01	2.993e-03
Total	**2.085e+12**	**7.759e+05**	**1.495e+07**	**1.382e+03**	**1.206e+03**	**1.206e+01**

Results With Buildup: Dose Point No. 5 - (X = 307.7738, Y = 82.44, Z = 0) cm

Energy (MeV)	Activity (Photons/sec)	Energy Flux (MeV/cm^2/sec)	Photon Flux (Photons/cm^2/sec)	Exposure Rate (mR/hr)	Absorbed Dose Rate (mrad/hr)	Absorbed Dose Rate (mGy/hr)
2.000e-02	1.339e+09	8.799e-24	4.399e-22	3.048e-25	2.661e-25	2.661e-27
3.000e-02	4.261e+10	1.395e-05	4.649e-04	1.382e-07	1.207e-07	1.207e-09
4.000e-02	4.888e+09	2.408e-01	6.019e+00	1.065e-03	9.295e-04	9.295e-06
6.000e-02	1.760e+07	2.686e-01	4.476e+00	5.334e-04	4.657e-04	4.657e-06
8.000e-02	6.152e+05	2.888e-02	3.610e-01	4.570e-05	3.990e-05	3.990e-07
1.000e-01	2.043e+10	1.405e+03	1.405e+04	2.149e+00	1.876e+00	1.876e-02
1.500e-01	2.710e+09	2.454e+02	1.636e+03	4.042e-01	3.529e-01	3.529e-03
2.000e-01	6.012e+09	5.761e+02	2.881e+03	1.017e+00	8.877e-01	8.877e-03
3.000e-01	3.654e+08	4.356e+01	1.452e+02	8.262e-02	7.213e-02	7.213e-04
4.000e-01	2.590e+10	3.756e+03	9.389e+03	7.318e+00	6.389e+00	6.389e-02
5.000e-01	1.083e+11	1.866e+04	3.732e+04	3.662e+01	3.197e+01	3.197e-01
6.000e-01	1.365e+11	2.751e+04	4.585e+04	5.370e+01	4.688e+01	4.688e-01
8.000e-01	3.824e+11	9.992e+04	1.249e+05	1.901e+02	1.659e+02	1.659e+00
1.000e+00	6.753e+11	2.218e+05	2.218e+05	4.089e+02	3.570e+02	3.570e+00

1.500e+00	6.780e+11	3.500e+05	2.333e+05	5.889e+02	5.141e+02	5.141e+00
2.000e+00	2.863e+08	2.070e+02	1.035e+02	3.201e-01	2.794e-01	2.794e-03
Total	**2.085e+12**	**7.242e+05**	**1.564e+07**	**1.289e+03**	**1.126e+03**	**1.126e+01**

Results With Buildup: Dose Point No. 6 - (X = 317.7738, Y = 82.44, Z = 0) cm

Energy (MeV)	Activity (Photons/sec)	Energy Flux (MeV/cm²/sec)	Photon Flux (Photons/cm²/sec)	Exposure Rate (mR/hr)	Absorbed Dose Rate (mrad/hr)	Absorbed Dose Rate (mGy/hr)
2.000e-02	1.339e+09	8.250e-24	4.125e-22	2.858e-25	2.495e-25	2.495e-27
3.000e-02	4.261e+10	1.322e-05	4.406e-04	1.310e-07	1.144e-07	1.144e-09
4.000e-02	4.888e+09	2.261e-01	5.653e+00	1.000e-03	8.730e-04	8.730e-06
6.000e-02	1.760e+07	2.510e-01	4.183e+00	4.985e-04	4.352e-04	4.352e-06
8.000e-02	6.152e+05	2.699e-02	3.374e-01	4.271e-05	3.729e-05	3.729e-07
1.000e-01	2.043e+10	1.313e+03	1.313e+04	2.009e+00	1.754e+00	1.754e-02
1.500e-01	2.710e+09	2.295e+02	1.530e+03	3.779e-01	3.299e-01	3.299e-03
2.000e-01	6.012e+09	5.387e+02	2.694e+03	9.508e-01	8.300e-01	8.300e-03
3.000e-01	3.654e+08	4.073e+01	1.358e+02	7.726e-02	6.745e-02	6.745e-04
4.000e-01	2.590e+10	3.512e+03	8.781e+03	6.843e+00	5.974e+00	5.974e-02
5.000e-01	1.083e+11	1.745e+04	3.490e+04	3.425e+01	2.990e+01	2.990e-01
6.000e-01	1.365e+11	2.573e+04	4.288e+04	5.022e+01	4.384e+01	4.384e-01
8.000e-01	3.824e+11	9.346e+04	1.168e+05	1.778e+02	1.552e+02	1.552e+00
1.000e+00	6.753e+11	2.075e+05	2.075e+05	3.825e+02	3.339e+02	3.339e+00
1.500e+00	6.780e+11	3.275e+05	2.183e+05	5.510e+02	4.810e+02	4.810e+00
2.000e+00	2.863e+08	1.937e+02	9.684e+01	2.995e-01	2.615e-01	2.615e-03
Total	**2.085e+12**	**6.775e+05**	**1.629e+07**	**1.206e+03**	**1.053e+03**	**1.053e+01**

ATTACHMENT 3

Vehicle Survey Form

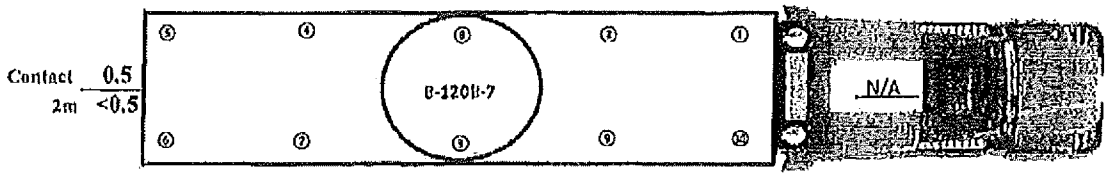
Form CP-SR-PR-201-F2
Rev. 5

SURVEY NUMBER 2019 -TRAN- BCO- 2077

EnergySolutions

Highest Contact Left Side 2m: 4 / 1

Front of Trailer: 0.5



Highest Contact Right Side 2m: 4 / 1

Dose Rate Under Trailer: 2

Dose Rate on Top of Conveyance: N/A

All dose rates in mR/Hr

SMEAR RESULTS (@) dpm/100cm²

LOC	BETA/GAMMA	ALPHA
1	<1000	<100
2	<1000	<100
3	<1000	<100
4	<1000	<100
5	<1000	<100
6	<1000	<100
7	<1000	<100
8	<1000	<100
9	<1000	<100
10	<1000	<100
11		
12		
13		
14		
15		

RWP #: 197000
Date: 5/31/2019 Time: 810
Shipment Number: T191687
Tractor #: 4004 Trailer #: CKB17084
Incoming: Empty ☐ Outgoing: Empty ☐
Incoming: Full ☑ Outgoing: Full ☐
Trucking Company: HTS
Trailer Type: Flat, Rail Frame, Straight Truck, Van, Curtain Van, Tanker, [Cask], Dropdeck

DOSE RATE INSTRUMENT
Type: Model 14C w/44-38
Serial Number: 188432
Cal. Due Date: 2/21/2020

CONTAMINATION SURVEY INST. – Beta/Gamma
Type: Model 3 w/44-9
Serial Number: 93088
Cal. Due Date: 11/7/2019

FLOOR MONITOR or DIRECT FRISK (Info Only)
Type: N/A
Serial Number: N/A
Cal. Due Date: N/A

CONTAMINATION SURVEY INST. - Alpha
Type: Model 3 w/43-5
Serial Number: 92147
Cal. Due Date: 5/9/2020

Shipping & Receiving Technician (Initials): JS
Reviewed by: [signature] 5-31-19

ATTACHMENT 3

Incoming Shipment — Package Survey Form

Form CP-SR-PR-201-F3
Rev. 2

Customer: SEMPRA NEXTERA POINT BEACH Manifest # 19-037 Survey Date: 06-05-2019 S MS 6-5-19

No.	Barcode	Max. Contact Dose Rate (mrem/hr)	Max. Dose Rate @ 30 cm (mrem/hr)	Max Smearable Contamination (dpm/100 cm² β-γ and α)	Technician (Print Name)
1	39011597	20,000	7,000	<1000 βγ <100 α	M Smith
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					

Dose Rate Instrument Used: 6112B ~~Mod. 14E w/44-38~~ Serial No.: 150528 Cal. Due Date: 1-7-20 MS 6-5-19

α Survey Instrument Used: Mod. 3 w/43-5 Serial No.: 82869 Cal. Due Date: 10-12-19

β-γ Survey Instrument Used: Mod. 3 ~~w/44-9~~ Serial No.: 192719 Cal. Due Date: 5-31-20

Comments: MS 6-5-19

p. 2 of 2

Security Related Information - Withhold from Public Disclosure Under 10 CFR 2.390

ENCLOSURE 2

NEXTERA ENERGY POINT BEACH, LLC
POINT BEACH NUCLEAR PLANT, UNITS 1 AND 2

SUPPLEMENTAL INFORMATION
CALCULATION RSCS TSD 20-083 REV 1
NOT FOR PUBLIC DISCLOSURE

(226 pages follow)

Security Related Information - Withhold Under 10 CFR 2.390.
Enclosure 2 Contains Security Related Information,
Upon Separation of Enclosure 2 this letter is Non-Security Related.

ENCLOSURE 3

NEXTERA ENERGY POINT BEACH, LLC
POINT BEACH NUCLEAR PLANT, UNITS 1 AND 2

SUPPLEMENTAL INFORMATION
CALCULATION RSCS TSD 20-083 REV 1
REDACTED – PUBLIC VERSION

(226 pages follow)

Evaluation of Resin Shipment at Point Beach Nuclear Plant

RSCS TSD 20-083 Rev01

Performed By: _____
Nasser Rashidifard, CHP, Supervisor of Technical Services

Reviewed by: Ellen P. Anderson
Ellen Anderson, Director of Radiological Services

Approved by: _____
Ron Thurlow, CHP, Sr. Director of Operations

Prepared by:

Radiation Safety & Control Services, Inc

93 Ledge Road,
Seabrook, NH 03874
1-800-525-8339
(603) 778-2871 (Outside USA)
www.radsafely.com

August 26, 2020

1 Introduction

This Technical Support Document (TSD) provides calculations for expected exposure rates of an unshielded vessel of spent primary system resin. This independent calculation is being performed to support Point Beach Nuclear Plant's (PBN) resolution of USNRC letter EA-20-081, provided in Attachment 1, for shipment classification verification on Energy Solution Waste Shipment 19-037, provided in Attachment 2. The dose point of interest is 3 meters from the surface of the resin container.

Rev01 is being issued to provide additional detail on assumptions.

2 Evaluation Methodology

To calculate the expected exposure rates Microshield V8.0 was used to construct the geometry based on a homogenous cylinder inside of a steel container. This scenario represents the unshielded resin container prior to being placed inside its shielded container for shipment. Dose points were placed centered on the side of the cylinder at 50cm increments out to 3m based on the dimensions provided in Table 1 and shown in Attachment 4. The container height is based on an 85% fill of resin corresponding to the 100 ft^3 volume on the waste manifest.

Table 1 Physical Parameters

Parameter	Value	Reference	Attachment #
Resin Composition	Polystyrene	Common Resin	N/A
Resin Density	0.72 g/cc	Waste Manifest	3
Container Material	Carbon Steel	Resin Container Spec Sheet	2
Container Wall Thickness	0.304 cm	Resin Container Spec Sheet	2
Container Inner Diameter	77.788 cm	Resin Container Spec Sheet	2
Container Height	184.15 cm	Resin Container Spec Sheet	2
Nuclide mix/Activity	See Attachment	Waste Manifest	3

An exposure rate was calculated for each nuclide for 1 Ci of activity homogenized in the resin. This provided an mR per hour rate per unit of activity for each nuclide that can be used to determine the effective exposure rate.

3 Results

The results of each activity to exposure rate conversion factor was generated to provide exposure rate per unit activity. The results of the runs are provided in Table 2. This table does not include C-14, H-3, Ni-63, Pu-241, and Sr-90 since they do not contribute to the gamma dose at 3 meters due to the steel outer container. The output files for each nuclide is provided in Attachment 4.

Table 2 Exposure per unit Activity Conversion Factors

	Gamma Constants in mR/hr/Ci					
Distance from Container (meters)	0.5m	1m	1.5m	2m	2.5m	3m
Am-241	7.17E+00	3.83E+00	2.31E+00	1.52E+00	1.07E+00	7.85E-01
Ce-144	8.91E+00	4.66E+00	2.81E+00	1.86E+00	1.31E+00	9.76E-01
Cm-242	9.33E-02	5.50E-02	3.22E-02	1.99E-02	1.31E-02	8.98E-03
Cm-243	2.61E+01	1.37E+01	8.24E+00	5.42E+00	3.82E+00	2.83E+00
Co-57	3.01E+01	1.60E+01	9.56E+00	6.28E+00	4.41E+00	3.26E+00
Co-58	1.33E+02	6.91E+01	4.15E+01	2.75E+01	1.95E+01	1.45E+01
Co-60	3.20E+02	1.66E+02	1.00E+02	6.64E+01	4.71E+01	3.51E+01
Cs-137	7.92E+01	4.12E+01	2.48E+01	1.64E+01	1.16E+01	8.64E+00
Fe-55	4.53E-01	2.69E-01	1.57E-01	9.67E-02	6.31E-02	4.31E-02
Mn-54	1.12E+02	5.82E+01	3.50E+01	2.32E+01	1.64E+01	1.22E+01
Ni-59	5.50E-01	3.27E-01	1.91E-01	1.17E-01	7.66E-02	5.23E-02
Pu-238	1.05E-01	6.16E-02	3.60E-02	2.23E-02	1.46E-02	1.01E-02
Pu-239	5.02E-02	2.89E-02	1.70E-02	1.07E-02	7.10E-03	4.96E-03
Sb-124	2.34E+02	1.22E+02	7.33E+01	4.86E+01	3.45E+01	2.57E+01
Sb-125	6.59E+01	3.43E+01	2.06E+01	1.36E+01	9.65E+00	7.17E+00
Sn-113	4.63E+01	2.42E+01	1.45E+01	9.56E+00	6.76E+00	5.01E+00
Sr-89	1.80E-02	9.37E-03	5.64E-03	3.73E-03	2.65E-03	1.97E-03
Tc-99	1.38E-04	7.32E-05	4.40E-05	2.90E-05	2.04E-05	1.51E-05
Zn-65	7.59E+01	3.95E+01	2.38E+01	1.58E+01	1.12E+01	8.32E+00

The conversion factors were multiplied by the respective activity for each nuclide from the waste manifest. Each of the individual values were summed to provide the total exposure rate from the container. The results are provided in Table 3.

Table 3 Exposure Rate per Nuclide over Distances

		Exposure Rates in mR/hr					
	Ci	0.5m	1m	1.5m	2m	2.5m	3m
Am-241	0.00131	9.39E-03	5.01E-03	3.02E-03	1.99E-03	1.40E-03	1.03E-03
Ce-144	1.04E-03	9.26E-03	4.85E-03	2.92E-03	1.93E-03	1.37E-03	1.01E-03
Cm-242	7.80E-05	7.28E-06	4.29E-06	2.51E-06	1.55E-06	1.02E-06	7.01E-07
Cm-243	4.58E-04	1.19E-02	6.29E-03	3.77E-03	2.48E-03	1.75E-03	1.30E-03
Co-57	6.37E-01	1.92E+01	1.02E+01	6.09E+00	4.00E+00	2.81E+00	2.08E+00
Co-58	8.96E+00	1.19E+03	6.19E+02	3.72E+02	2.46E+02	1.75E+02	1.30E+02
Co-60	1.83E+01	5.85E+03	3.04E+03	1.83E+03	1.21E+03	8.62E+02	6.43E+02
Cs-137	3.20E+00	2.53E+02	1.32E+02	7.92E+01	5.24E+01	3.72E+01	2.77E+01
Fe-55	5.70E+00	2.58E+00	1.53E+00	8.95E-01	5.51E-01	3.59E-01	2.46E-01
Mn-54	1.25E+00	1.40E+02	7.28E+01	4.37E+01	2.90E+01	2.05E+01	1.53E+01
Ni-59	1.03E+00	5.67E-01	3.37E-01	1.96E-01	1.21E-01	7.89E-02	5.39E-02
Pu-238	7.14E-04	7.47E-05	4.40E-05	2.57E-05	1.59E-05	1.05E-05	7.20E-06
Pu-239	4.75E-04	2.39E-05	1.37E-05	8.08E-06	5.06E-06	3.37E-06	2.36E-06
Sb-124	1.33E-01	3.12E+01	1.62E+01	9.75E+00	6.47E+00	4.59E+00	3.42E+00
Sb-125	2.14E+00	1.41E+02	7.35E+01	4.41E+01	2.92E+01	2.07E+01	1.54E+01
Sn-113	4.53E-02	2.10E+00	1.09E+00	6.56E-01	4.33E-01	3.06E-01	2.27E-01
Sr-89	1.23E-02	2.22E-04	1.15E-04	6.93E-05	4.59E-05	3.26E-05	2.43E-05
Tc-99	5.80E-02	8.03E-06	4.24E-06	2.55E-06	1.68E-06	1.18E-06	8.76E-07
Zn-65	5.73E-02	4.35E+00	2.27E+00	1.36E+00	9.03E-01	6.40E-01	4.77E-01
Total (mR/hr)		**7.63E+03**	**3.97E+03**	**2.39E+03**	**1.58E+03**	**1.12E+03**	**8.37E+02**

Exposure rate at 3 meters is 837 mR per hour. Positioning of measurement is critical in this geometry for any measurements taken with survey instruments. A position less than 50cm from the container can result in greater than 1R/hr readings.

4 Conclusion

The calculations resulted in an exposure rate of 837 mR per hour at 3 meters based on the information provided. Positioning of the detector is critical and should be done with marked positions. Use of an instrument such as a "telepole" at some distance could result in readings greater than desired due to the ability to gauge the distance from the surface of the container. This result can be used to provide documented support for classification of the waste shipment. This model also shows that a deviation of just 50 cm while performing a 3 meter field measurement would be expected to result in a dose rate measurement of over 1 R/hr. Based on the ALARA controls during the field survey and the lack of clearly marked 3 meter distance demarcations for some of the measurements, this model demonstrates a telepole positioning error as a plausible scenario for the inconsistent results in the shipment survey.

Attachment 1

USNRC Letter EA-20-081

UNITED STATES
NUCLEAR REGULATORY COMMISSION
REGION III
2443 WARRENVILLE ROAD, SUITE 210
LISLE, ILLINOIS 60532-4352

August 3, 2020

EA-20-081

Mr. Michael Strope
Site Director
NextEra Energy Point Beach, LLC
6610 Nuclear Road
Two Rivers, WI 54241-9516

SUBJECT: POINT BEACH NUCLEAR PLANT, UNITS 1 AND 2 – NRC INSPECTION REPORT 05000266/2020012 AND 05000301/2020012; PRELIMINARY WHITE FINDING AND APPARENT VIOLATIONS

Dear Mr. Strope:

On June 23, 2020, the U.S. Nuclear Regulatory Commission (NRC) completed an inspection at Point Beach Nuclear Plant, Units 1 and 2 and discussed the results of this inspection with you and other members of your staff. The results of this inspection are documented in the enclosed report.

Section 71124.08 of the enclosed report documents a finding with associated apparent violations that the NRC has preliminarily determined to be White- "a finding with low to moderate increased safety significance." Your staff offered for transport a radioactive material package as Low Specific Activity – II (LSA-II) that did not meet the radiation level limits specified in 49 CFR 173.427 for shipping as LSA. Point Beach staff did not recognize that measured radiation levels were in excess of 10 mSv/ hour (1 Rem/hour) at 3 meters from the unshielded package, exceeding the conditions of transport for LSA material and requiring the package be shipped as a Type B shipment. Consequently, the shipment did not contain the appropriate emergency response information for a shipment containing primary resin, which is required by 49 CFR 172.602(a) and the appropriate package markings required by 49 CFR 172.302(a). The finding was assessed based on the best available information, using the applicable significance determination process (SDP). The finding also resulted in apparent violations of NRC requirements and is being considered for escalated enforcement action in accordance with the Enforcement Policy, which can be found at the NRC's website at http://www.nrc.gov/about-nrc/regulatory/enforcement/enforce-pol.html. In accordance with NRC Inspection Manual Chapter 0609, we intend to complete our evaluation using the best available information and issue our final significance determination and enforcement decision, in writing, within 90 days from the date of this letter. The NRC's significance determination process (SDP) is designed to encourage an open dialogue between your staff and the NRC; however, neither the dialogue nor the written information you provide should affect the timeliness of our final determination.

Before we make a final decision, we are providing you with an opportunity to (1) attend a Regulatory Conference where you can present to the NRC your perspective on the facts and assumptions the NRC used to arrive at the finding and assess its significance, or (2) submit your position on the finding to the NRC in writing. If you request a Regulatory Conference, it should be held within 40 days of the receipt of this letter, and we encourage you to submit supporting documentation at least one week prior to the conference in an effort to make the conference more efficient and effective. The focus of a regulatory conference is to discuss the significance of the finding and not necessarily the root cause(s) or corrective action(s) associated with the finding. If you choose to attend a regulatory conference, it will be open for public observation. If you decide to submit only a written response, it should be sent to the NRC within 40 days of your receipt of this letter. If you decline to request a Regulatory Conference or to submit a written response, you relinquish your right to appeal the final SDP determination, in that by not doing either, you fail to meet the appeal requirements stated in the Prerequisite and Limitation sections of Attachment 2 of NRC Inspection Manual Chapter 0609.

If you choose to send a response, it should be clearly marked as a "Response to Apparent Violations in NRC Inspection Report 05000266/2020012 and 05000301/2020012; (EA-20-081)" and should include for the apparent violations: (1) the reason for the apparent violations or, if contested, the basis for disputing the apparent violations; (2) the corrective steps that have been taken and the results achieved; (3) the corrective steps that will be taken; and (4) the date when full compliance will be achieved. Your response should be submitted under oath or affirmation and may reference or include previously docketed correspondence, if the correspondence adequately addresses the required response. Additionally, your response should be sent to the U.S. Nuclear Regulatory Commission, ATTN: Document Control Center, Washington, DC 20555-0001 with a copy to the Regional Administrator, Region III, and a copy to the NRC Resident Inspector at the Point Beach Station within 40 days of the date of this letter. If an adequate response is not received within the time specified or an extension of time has not been granted by the NRC, the NRC will proceed with its enforcement decision or schedule a Regulatory Conference.

Please contact Steven K. Orth at 630-829-9757, and in writing, within 10 days from the issue date of this letter to notify the NRC of your intentions. If we have not heard from you within 10 days, we will continue with our significance determination and enforcement decision.

Because the NRC has not made a final determination in this matter, no Notice of Violation is being issued at this time. In addition, please be advised that the number and characterization of the apparent violations described in the enclosed inspection report may change as a result of further NRC review. The final resolution of this finding will be conveyed in separate correspondence.

In accordance with 10 CFR 2.390 of the NRC's "Rules of Practice," a copy of this letter and its enclosure and your response (if any) will be made available electronically for public inspection in the NRC Public Document Room and the NRC's Agencywide Documents Access and Management System (ADAMS), accessible from the NRC Website at http://www.nrc.gov/reading-rm/adams.html.

Sincerely,

David Curtis

Digitally signed by David Curtis
Date: 2020.08.03 16:16:46 -05'00'

Mohammed A. Shuaibi, Director
Division of Reactor Safety

Docket Nos. 05000266 and 05000301
License Nos. DPR-24 and DPR-27

Enclosure:
As stated

cc w/ encl: Distribution via LISTSERV®

Letter to Michael Strope from Mohammed A. Shuaibi dated August 3, 2020.

SUBJECT: POINT BEACH NUCLEAR PLANT, UNITS 1 AND 2 – NRC INSPECTION REPORT 05000266/2020012 AND 05000301/2020012; PRELIMINARY WHITE AND APPARENT VIOLATIONS

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U.S. NUCLEAR REGULATORY COMMISSION
Inspection Report

Docket Numbers:	05000266 and 05000301
License Numbers:	DPR-24 and DPR-27
Report Numbers:	05000266/2020012 and 05000301/2020012
Enterprise Identifier:	I-2020-012-0023
Licensee:	NextEra Energy Point Beach, LLC
Facility:	Point Beach Nuclear Plant, Units 1 and 2
Location:	Two Rivers, WI
Inspection Dates:	June 1, 2020 to June 23, 2020
Inspectors:	J. Cassidy, Senior Health Physicist G. Edwards, Health Physicist
Approved By:	Steven K. Orth, Chief Plant Support Branch Division of Reactor Safety

SUMMARY

The U.S. Nuclear Regulatory Commission (NRC) continued monitoring the licensee's performance by conducting a NRC inspection at Point Beach Nuclear Plant, Units 1 and 2, in accordance with the Reactor Oversight Process. The Reactor Oversight Process is the NRC's program for overseeing the safe operation of commercial nuclear power reactors. Refer to https://www.nrc.gov/reactors/operating/oversight.html for more information.

List of Findings and Violations

Failure to Properly Ship Radioactive Material			
Cornerstone	Significance	Cross-Cutting Aspect	Report Section
Public Radiation Safety	Preliminary White AV 05000266/2020012-01 Open EA-20-081	[H.12] - Avoid Complacency	71124.08 April 2020
A finding of low to moderate safety significance (Preliminary White) and associated Apparent Violations were reviewed and evaluated by the inspectors involving the licensee's transport of a radioactive material package as Low Specific Activity – II (LSA-II) that exceeded the LSA shipping limits for radiation levels as specified in 49 CFR 173.427. The licensee's staff did not recognize that measured radiation levels were in excess of 10 mSv/ hour (1 Rem/hour) at 3 meters from the unshielded package which exceeded the conditions for transporting LSA material; and thus, failed to ship the package as a Type B shipment. Consequently, the shipment did not contain the appropriate emergency response information for a shipment containing primary resin as required by 49 CFR 172.602(a) and did not contain the appropriate package markings as required by 49 CFR 172.302(a).			

Additional Tracking Items

None.

INSPECTION SCOPES

Inspections were conducted using the appropriate portions of the inspection procedures (IPs) in effect at the beginning of the inspection unless otherwise noted. Currently approved IPs with their attached revision histories are located on the public website at http://www.nrc.gov/reading-rm/doc-collections/insp-manual/inspection-procedure/index.html. Samples were declared complete when the IP requirements most appropriate to the inspection activity were met consistent with Inspection Manual Chapter (IMC) 2515, "Light-Water Reactor Inspection Program - Operations Phase." The inspectors reviewed selected procedures and records, observed activities, and interviewed personnel to assess licensee performance and compliance with Commission rules and regulations, license conditions, site procedures, and standards.

Starting on March 20, 2020, in response to the National Emergency declared by the President of the United States on the public health risks of the coronavirus (COVID-19), regional inspectors were directed to begin telework. For the inspection documented below, it was determined that the objectives and requirements stated in the IP could be performed remotely.

RADIATION SAFETY

71124.08 April 2020 - Radioactive Solid Waste Processing & Radioactive Material Handling, Storage, & Transportation

Waste Characterization and Classification (IP Section 03.03) (2 Samples)

(1) The inspectors evaluated the licensee's characterization and classification of radioactive waste shipment 20-015.
(2) The inspectors evaluated the licensee's characterization and classification of radioactive waste shipment 19-037.

Shipping Records (IP Section 03.05) (5 Samples)

The inspectors evaluated the following non-excepted radioactive material shipments through a record review:

(1) Shipment Number 19-063; UN3321, Radioactive Materials, Low Specific Activity (LSA-II)
(2) Shipment Number 19-045; UN2915, Radioactive Materials, Type A Package
(3) Shipment Number 20-015; UN3321, Radioactive Materials, Low Specific Activity (LSA-II)
(4) Shipment Number 19-033; UN2913, Radioactive Materials, Surface Contaminated Objects (SCO-II)
(5) Shipment Number 19-037; UN3321, Radioactive Materials, Low Specific Activity (LSA-II)

INSPECTION RESULTS

Failure to Properly Ship Radioactive Material			
Cornerstone	Significance	Cross-Cutting Aspect	Report Section
Public Radiation Safety	Preliminary White AV 05000266/2020012-01 Open EA-20-081	[H.12] - Avoid Complacency	71124.08 April 2020

A finding of low to moderate safety significance (Preliminary White) and associated Apparent Violations were reviewed and evaluated by the inspectors involving the licensee's transport of a radioactive material package as Low Specific Activity – II (LSA-II) that exceeded the LSA shipping limits for radiation levels as specified in 49 CFR 173.427. The licensee's staff did not recognize that measured radiation levels were in excess of 10 mSv/ hour (1 Rem/hour) at 3 meters from the unshielded package which exceeded the conditions for transporting LSA material; and thus, failed to ship the package as a Type B shipment. Consequently, the shipment did not contain the appropriate emergency response information for a shipment containing primary resin as required by 49 CFR 172.602(a) and did not contain the appropriate package markings as required by 49 CFR 172.302(a).

Description: On May 30, 2019, the licensee sent a radioactive material (primarily resin) shipment for waste processing. During April 2019, the licensee's staff sampled the primary resin that entered the liner and sent this sample to a vendor for analyses. The licensee used the data provided by vendor analysis as inputs into its waste characterization software for the Department of Transportation (DOT) Classification Summary analysis. The computer software calculated a radiation dose rate of 814 mrem/hour at 3 meters from the liner. The inspectors noted that the software output indicated that the package contained Part 37 Category 2 Quantity and reportable quantities of radionuclides. Because the software calculated a dose rate less than 1000 mrem/hour at 3 meters from the liner, the computer applied an exemption for Low Specific Activity (LSA) that is allowed by the regulations.

During the shipping preparation process, the licensee conducted routine and required infield pre-shipping radiation measurements of the liner for the purpose of recording dose rates at several locations and distances in relation to the liner's position. The licensee's survey results ranged from 600 mrem/hour to 1400 mrem/hour, with 5 of the 10 measurements exceeding 1000 mrem/hour, which exceeded the LSA exemption criteria in 49 CFR 173.427(a)(1). The licensee packaged the material in an NRC approved Type B package; however, the licensee prepared the shipment for transport as an LSA-II shipment. Thus, the resin was incorrectly shipped as LSA-II instead of Type B as required by 49 CFR Part 173. The shipment arrived at the waste processor without any incident during transport from the licensee facility.

The licensee's failure to identify that the dose rates measured at 3 meters from the unshielded liner were different from the computer calculated results, caused the licensee to assign an incorrect description (basic) and package markings to the shipment. The basic description is required to be documented on shipping papers and is composed of the UN Identification Number, Proper Shipping Name, Hazard Class, maximum activity contained in each package in SI units and number and type of packages. Markings on bulk packages such as this shipment are comprised of the identification number on orange or white square-on-point displays. As documented on the shipping papers, the licensee assigned a basic description of "UN 3321, Class 7, Radioactive Material, Low Specific Activity (LSA-II),"

as opposed to the required basic description of "UN 2916, Class 7, Radioactive Material, Type B(U) Package (non-fissile or fissile excepted)." In the case of the markings, the licensee provided package markings of "UN 3321" on an orange panel/display, as opposed to the required markings of "UN 2916" on an orange panel/display. The misclassification also caused the licensee to provide the carrier with the incorrect emergency response information. The licensee provided the carrier with emergency response information that did not communicate the hazards associated with the shipment.

The emergency response information that was supplied to the carrier by the licensee failed to include relevant information for materials that exceed the conditions of transport for LSA materials. Specifically, the basic description of the package was incorrect, and the information provided by the licensee for immediate hazards to health stated "some material may be released from packages during accidents of moderate severity, but risks to people are not great;" however, the radiological conditions in the shipment (primary resins) had unshielded dose rates of greater than 1 Rem/hour at 3 meters, representing risks to people. Additionally, the information provided by the licensee for the immediate precautions to be taken in the event of accident or incident stated "Positive pressure self-contained breathing apparatus (SCBA) and structural firefighters' protective clothing will provide adequate protection;" however, the SCBA and protective clothing would not have provided protection from the substantial external radiation exposure potential from a package failure.

Corrective Actions: This issue was identified during a Nuclear Assurance Radiation Protection Audit during March of 2020. After the issue was identified, the licensee's staff generated a condition report and notified the Site Resident Inspectors and the Regional Health Physicist of the issue of concern.

Corrective Action References: AR 02346768, "Gaps in CAT 2 Radwaste Shipment Documentation Identified during Nuclear Assurance PBN 20-003, Radiation Protection Audit."

Performance Assessment:

Performance Deficiency: The licensee failed to identify that the radiation dose rates, measured 3 meters from the unshielded liner, were higher than the calculated value for the primary resin liner associated with shipment 19-037. Specifically, the licensee failed to identify dose rates that were greater than 10 mSv/hour (1 Rem/hour) at 3 meters from the un-shielded material on 5 of 10 measurements, exceeding the conditions of transport for LSA material. This failure led the licensee to assign the incorrect basic description and markings to the shipment package. Additionally, this failure caused the licensee to supply the carrier with the incorrect emergency response information.

Screening: The inspectors determined the performance deficiency was more than minor because it was associated with the Program & Process attribute of the Public Radiation Safety cornerstone and adversely affected the cornerstone objective to ensure adequate protection of public health and safety from exposure to radioactive materials released into the public domain as a result of routine civilian nuclear reactor operation. The licensee failed to identify that the radiation dose rates, measured 3 meters from the unshielded liner, were higher than the calculated value for the primary resin liner associated with shipment 19-037. This failure led the licensee to assign the incorrect basic description and markings to the shipment package. Additionally, this failure caused the licensee to supply the carrier with the incorrect emergency response information.

Significance: The inspectors assessed the significance of the finding using Appendix D, "Public Radiation Safety SDP." The inspectors determined that the violations were of low to moderate safety significance (White) because it was a finding in the transportation branch in which: there was a failure to provide emergency response information as required by 49 CFR 172.602 (Block N2). Specifically, the licensee did not provide the correct package markings and did not provide the emergency response information for the shipment required by 49 CFR 172.602, which described the basic description, immediate hazards to health and immediate precautions to be taken in the event of an accident or incident.

Cross-Cutting Aspect: H.12 - Avoid Complacency: Individuals recognize and plan for the possibility of mistakes, latent issues, and inherent risk, even while expecting successful outcomes. Individuals implement appropriate error reduction tools. Specifically, the licensee determined that complacency within the staff caused multiple individuals to not identify various technical issues associated with the shipment. Radioactive shipments and shipping documentation completion at the site are viewed as routine but given the rarity of shipments from the site containing primary resin, more attention to detail should have been invoked.

Enforcement:

Violation: 1) Title 10 CFR 71.5 (a) requires, in part, that each licensee who transports licensed material outside the site of usage, as specified in the NRC license, or where transport is on public highways, or who delivers licensed material to a carrier for transport, shall comply with the applicable requirements of the DOT regulations in 49 CFR parts 171 through 180, appropriate to the mode of transport.

Title 49 CFR 172.600 (c) requires that no person to whom this subpart applies may offer for transportation, accept for transportation, transfer, store or otherwise handle during transportation a hazardous material unless: (1) Emergency response information conforming to this subpart is immediately available for use at all times the hazardous material is present; and (2) Emergency response information, including the emergency response telephone number, required by this subpart is immediately available to any person who, as a representative of a Federal, State or local government agency, responds to an incident involving a hazardous material, or is conducting an investigation which involves a hazardous material.

Title 49 CFR 172.602 (a) requires that for purposes of this subpart, the term "emergency response information" means information that can be used in the mitigation of an incident involving hazardous materials and, as a minimum, must contain the following information: (1) The basic description and technical name of the hazardous material as required by 49 CFR 172.202 and 172.203(k), the ICAO Technical Instructions, the IMDG Code, or the TDG Regulations, as appropriate (IBR, see CFR 171.7 of this subchapter); (2) Immediate hazards to health; (3) Risks of fire or explosion; (4) Immediate precautions to be taken in the event of an accident or incident; (5) Immediate methods for handling fires; (6) Initial methods for handling spills or leaks in the absence of fire; and (7) Preliminary first aid measures.

On May 30, 2019, the licensee delivered to a carrier for transport licensed material , and, the emergency response information that accompanied the shipment did not include the basic description of the hazardous material as required by CFR 172.202 and 172.203 (k); failed to adequately describe the immediate hazards to health associated with the resin shipment (a Type B quantity of material); and failed to adequately describe the immediate precautions to be taken in the event of an accident or incident:

- the basic description of the hazardous material was for a low specific activity shipment rather than a Type B shipment;
- for the immediate hazards to health, the licensee supplied information to the carrier that stated, "some material may be released from packages during accidents of moderate severity, but risks to people are not great" however, the radiological conditions in the shipment (primary resin) had un-shielded dose rates of greater than 1 Rem/hour at 3 meters, representing risks to people; and
- the immediate precautions to be taken in the event of accident or incident stated "Positive pressure self-contained breathing apparatus (SCBA) and structural firefighters' protective clothing will provide adequate protection;" however, the SCBA and protective clothing would not have provided protection from the external radiation exposure potential from a package failure.

Violation: 2) Title 10 CFR 71.5 (a) requires, in part, that each licensee who transports licensed material outside the site of usage, as specified in the NRC license, or where transport is on public highways, or who delivers licensed material to a carrier for transport, shall comply with the applicable requirements of the DOT regulations in 49 CFR parts 171 through 180, appropriate to the mode of transport.

Title 49 CFR 172.302 (a) requires, in part, except as otherwise provided in this subpart, no person may offer for transportation or transport a hazardous material in a bulk packaging unless the packaging is marked as required by 49 CFR 172.332 with the identification number specified for the material in the CFR 172.101.

Title 49 CFR 172.332 requires, in part, that identification number markings must be displayed on orange panels or placards as specified this section.

Title 49 CFR 172.101 requires, in part, that the designation of UN 3321 be assigned to LSA-II, non-fissile or fissile-excepted packages and the designation of UN 2916 be assigned to Type B(U), non-fissile or fissile-excepted packages.

On May 30, 2019, the licensee offered a bulk package containing hazardous material for transport and failed to mark the packaging with the identification number specified in 49 CFR 172.101 (table). Specifically, the licensee incorrectly marked the Type B radioactive material with the United Nations (UN) number UN 3321 which is for LSA-II radioactive material. The Type B package was required to be marked as UN 2916.

Violation: 3) Title 10 CFR 71.5 (a) requires, in part, that each licensee who transports licensed material outside the site of usage, as specified in the NRC license, or where transport is on public highways, or who delivers licensed material to a carrier for transport, shall comply with the applicable requirements of the DOT regulations in 49 CFR parts 171 through 180, appropriate to the mode of transport.

Title 49 CFR 173.427 (a)(1) requires, in part, that low specific activity material must be transported in accordance with the condition that the external dose rate may not exceed an external radiation level of 10 mSv/h (1 rem/h) at 3 m (10 feet) from the unshielded material.

On May 30, 2019, the licensee offered a LSA-II bulk package for transport with spent resin, that when unshielded, exceeded the external radiation level limit of 10 mSv/hour

(1 Rem/hour) at 3 meters (10 feet) from the unshielded material. Specifically, the licensee was required label the shipment as Type B because survey results revealed that 5 of 10 measurements had dose rates greater than 10 mSv/hour (1 Rem/hour) with the highest reading being 14 mSv/hour (1.4 Rem/hour).

Violation: 4) Title 10 CFR 71.5 (a) requires, in part, that each licensee who transports licensed material outside the site of usage, as specified in the NRC license, or where transport is on public highways, or who delivers licensed material to a carrier for transport, shall comply with the applicable requirements of the DOT regulations in 49 CFR parts 171 through 180, appropriate to the mode of transport.

Title 49 CFR 173.22 (a) requires, in part, that except as otherwise provided in this part, a person may offer a hazardous material for transportation in a packaging or container required by this part only in accordance with the following: (1) the person shall class and describe the hazardous material in accordance with Parts 172 and 173 of this subchapter.

Title 49 CFR 173.427 (a)(1) requires, in part, that low specific activity material must be transported in accordance with the condition that the external dose rate may not exceed an external radiation level of 10 mSv/h (1 rem/h) at 3 m (10 feet) from the unshielded material.

On May 30, 2019, the licensee failed to describe the hazardous material in accordance with Parts 172 and 173 of this subchapter. Specifically, radiation level surveys of the package indicated the hazardous material should be described as Radioactive Material, Type B(U) package non-fissile or fissile-excepted; however, the material was described as Radioactive Material, LSA.

Enforcement Action: These violations are being treated as apparent violations pending a final significance (enforcement) determination.

EXIT MEETINGS AND DEBRIEFS

The inspectors verified no proprietary information was retained or documented in this report.

- On June 23, 2020, the inspectors presented the NRC inspection results to Mr. Michael Strope, Site Engineering Director (Acting Site Director) and other members of the licensee staff.

DOCUMENTS REVIEWED

Inspection Procedure	Type	Designation	Description or Title	Revision or Date
71124.08 April 2020	Corrective Action Documents	AR 022694878	NRC RP INSPECTION - SHIPMENT DOCUMENTATION - MINOR	06/27/2018
71124.08 April 2020	Corrective Action Documents	AR 02346912	Required Survey Documentation Missed - RW Shipments	03/20/2020
71124.08 April 2020	Corrective Action Documents	AR 02347115	RW Shipping Record Accuracy and Completeness Gaps	04/20/2020
71124.08 April 2020	Corrective Action Documents	AR 02347870	Negative Trend: PBN Rad Materials Shipping Process	03/12/2020
71124.08 April 2020	Corrective Action Documents	AR 2346878	Gaps in Cat 2 Radwaste Shipment Documentation	03/04/2020
71124.08 April 2020	Miscellaneous		2020 DAW Data Analysis per 10CFR61	02/06/2020
71124.08 April 2020	Miscellaneous		2017 DAW Data Analysis per 10CFR61	04/02/2018
71124.08 April 2020	Miscellaneous	HP-100-032718 R0	Plant Source Term and Impact on RP Program	03/27/2018
71124.08 April 2020	Self-Assessments		Evaluation of NOS RP Radwaste Findings Summary	03/09/2020
71124.08 April 2020	Self-Assessments	PBN 20-003	Point Beach Nuclear Assurance Report - Radiological Protection and Radwaste	03/12/2020
71124.08 April 2020	Shipping Records	19-033	UN2913, Radioactive Materials, Surface Contaminated Objects (SCO-II)	05/10/2019
71124.08 April 2020	Shipping Records	19-037	UN3321, Radioactive Materials, Low Specific Activity (LSA-II)	05/30/2019
71124.08 April 2020	Shipping Records	19-045	UN2915, Radioactive Materials, Type A Package	07/17/2019
71124.08 April 2020	Shipping Records	19-063	UN3321, Radioactive Materials, Low Specific Activity (LSA-II)	12/12/2019
71124.08 April 2020	Shipping Records	20-015	UN3321, Radioactive Material, Low Specific Activity (LSA-II)	03/25/2020

Attachment 2

Liner Information

Liner[1]	Top Type	Cask Compatability[11]	Empty Weight (lbs.)[5]	Gross Weight (lbs.)[5]	Burial Volume (ft3)[2]	Max Overall Diameter (in)[6]	Max Container Diameter (in)[6]	Wall Thickness (in)[12]	Max Height (in)[7]	Max Container Height (in)[7]	Manway Opening (in)[9] (NON-SEDS ONLY)	Internal Type	Max Internal Volume (ft3)[4]	Filter Volumes (ft3)	Usable Internal Volume (ft3)[3]	Volume at Depth on Ruler (ft3) (for SEDS/SERDS ONLY)						85% Full Volume (ft3)[12]
																1 in	2 in	3 in	4 in	5 in	6 in	
PL 14-215	—	14-210, 14-215, 18-450, 21-300	--	13000	205.8	76.125	76	0.64	79.6	78	20	MTIF	170	—	—	—	—	—	—	—	—	145
												MT	188	0	181	—	—	—	—	—	—	154
												FR		1	181	178	176	173	171	168	166	153
												FP		4	177	175	172	170	167	165	162	151
												FEDX		10	172	169	167	164	162	159	157	146
PL 21-300	—	21-300	--	18750	314.2	83	81	0.45	108.5	108.25	20	MTIF	282	—	—	—	—	—	—	—	—	222
												MT	284	0	282	—	—	—	—	—	—	240
												FR		1	281	280	278	276	274	272	270	239
												FP		7	276	274	272	270	268	266	264	234
												FEDX		16	266	265	263	261	259	257	255	226
L 6-80	Wide Mouth	6-80-2, 8-120, 8-120, 10-142, 10-160, 14-170, 14-190, 14-195, 14-210, 14-215, 18-450, 21-300	--	9900	87.2	58.125	58.125	0.1196	57.125	55.5	47.875	—	—	—	—	—	—	—	—	—	—	—
	Wide Top			10052	84.1				55.46875	55.5	43											
	Square Top			9900	87.2				57.125	55.5	32x32											
	Barrel Top			9900	87.2				57.125	55.5	22.5											
	Barrel Top Flat Wall (SEDS Compatible)			9900					57.125	55.5	—	MT	82	0	82	81	80	78	77	75	74	70
												FR		5	77	76	74	73	72	70	69	65
												FP		0	82	81	80	78	77	75	74	70
												FEDX		0	82	81	80	78	77	75	74	70
L 8-120	Wide Mouth	8-120, 10-160, 14-195, 14-210, 14-215, 18-450, 21-300	--	14500	125.2	61.125	61.125	0.1196	74.125	72.5	50.875	—	120	—	—	—	—	—	—	—	—	—
	Wide Top			14675	122.6				72.96875	72.5	46											
	Square Top			14500	125.2				74.125	75.5	36x36											
	Barrel Top			14500	125.2				74.125	75.5	22.5											
	Barrel Top Flat Wall (SEDS Compatible)			14500	125.2				74.125	72.5	—	MT		0	120	119	117	115	114	112	110	102
												FR		1	119	118	116	115	113	111	110	101
												FP		3	116	115	114	112	110	109	107	99
												FEDX		8	112	111	109	107	106	104	103	95

Liner[1]	Top Type	Cask Compatability[11]	Empty Weight (lbs.)[6]	Gross Weight (lbs.)[6]	Burial Volume (ft3)[2]	Max Overall Diameter (in)[8]	Max Container Diameter (in)[8]	Wall Thickness (in)[13]	Max Height (in)[7]	Max Container Height (in)[7]	Manway Opening (in)[9] (NON-SEDS ONLY)	Internal Type	Max Internal Volume (ft3)[4]	Filter Volumes (ft3)	Usable Internal Volume (ft3)[3]	Volume at Depth on Ruler (ft3) (for SEDS/SERDS ONLY)						85% Full Volume (ft3)[12]
																1 in	2 in	3 in	4 in	5 in	6 in	
EL-190	—	14-170	**	11950	174.3	73.5	73.5	0.7	71	70	19.75	—	151 151 145	—	—	—	—	—	—	—	—	—
EL-210	—	14-195, 14-215	**	13000	202.1	75.5	75.5	0.7	78	77	19.75	—	177 177 171	—	—	—	—	—	—	—	—	—
Radlok 500	—	14-170, 14-195, 14-215	**	9500	135.8	64.875	64.875	0.575	71.875	71	15.8125	—	111	—	—	—	—	—	—	—	—	—
PV-24-79	—	—	**	1900	20.7	24.25	24.25	0.25	79.125	79	—	—	18	—	16	—	—	—	—	—	—	—
PV-24-72	—	—	**	1750	18.8	24.25	24.25	0.25	71.75	71	—	—	16	—	14	—	—	—	—	—	—	—
PV-24-51	—	—	**	1150	13.4	24.25	24.25	0.25	51.25	51	—	—	11	—	9	—	—	—	—	—	—	—

NOTES:
— Information not applicable
** Empty weight stenciled on each container.
1 - Identifies liner material, liner size, and internal components. Only dewatering internals are included in this table. In-situ, solidification, mixers, etc. are not included.
2 - A simple geometric shape derived using maximum container dimensions (includes any void spaces within the envelope of the container).
3 - Internal volume less any internal components and void spaces above the maximum fill point.
4 - Total volume of completely empty container.
5 - Maximum load capacity of the final container package (includes liner, internal components, waste).
6 - Weight of container package less any added waste (weight as shipped from ES to end user).
7 - Maximum height includes lifting devices. Maximum container height is the HIC or liner container height.
8 - Maximum overall diameter includes lifting bails or outer shell. Maximum container diameter is the container shell only.
9 - Opening for man entry into the container.
10 - Reduced opening size for fillport (applicable to liners with secondary lids only).
11 - Casks the liner can fit into (shoring may be required for liners fitting into larger casks).
12 - 85% Full Volume is 85% of the internal usable volume.
13 - Minimum wall thickness for PL, EL, and Radlok series liners. Nominal wall thickness for L series liners and PVs.

LEGEND			
CONTAINERS		INTERNALS	
PL	Poly Liner	MT	Empty
RDLK	Radlok Poly	MTIF	Empty w/ Foam
EL	Envirolene Poly	FR	Bead Resin
L	Carbon Steel	FP	Powdex
ES	Enviro Steel	FEDX	Ecodex

Attachment 3

Waste Manifest

ENERGYSOLUTIONS WASTE PROCESSOR SHIPMENT CHECKLIST

(Page 1 of 4)

Shipment Number: 19-037 Date: 5/30/19

Carrier: Hittmann Transport Tractor / Trailer No.: 1004 / CKB 17084

SELECT type(s) of Shipment:

____ UN2910, Radioactive material, excepted package-limited quantity of material, 7
____ UN2912, Radioactive material, low specific activity (LSA-I), 7
__X__ UN3321, Radioactive material, low specific activity (LSA-II), 7
____ UN2913, Radioactive material, surface contaminated objects (SCO-I), 7
____ UN2913, Radioactive material, surface contaminated objects (SCO-II), 7
____ UN2915, Radioactive material, Type A package, 7
____ UN2916, Radioactive material, Type B(U) package, 7

Description (Type / Contents):
Primary Resin

Destination / Contact:
Resin Solutions Storage @ Bear Creek OPS

(Initial) Verified transferee's license authorizes the receipt of the type, form and quantity of byproduct material to be transferred. For Category 1/Category 2 quantity of radioactive material shipments, verification is performed with the NRC's license verification system or the issuing authority (i.e. state).

Consignee's License Number: ~~R-86011-L27~~ R-73008-D24 Expiration date: ~~12/31/27~~ 4/29/24
5-23-19 5-24-19

NOTE

If the shipment is Class A Low Level Radioactive waste, then it must be shipped for processing and disposal through the Energy Solutions / Duratek Life-of-Plant Agreement (LOP), with very few exceptions. Contact Procurement for exceptions.

(Initial) Waste meets the requirements of the Waste Processor Acceptance Criteria and License.

(Initial) Conveyance activity within limits of 49 CFR 173.427 Table 5 for LSA/SCO shipments.

(Initial) Verify pre-shipment notifications made.

N/A (Initial) Florida Plants - Waste Shipment Inspection Scheduled with State of Florida.

N/A (Initial) Verify SC DHEC 802 prior notification form sent to DHEC if shipment will transit South Carolina.

ENERGYSOLUTIONS WASTE PROCESSOR SHIPMENT CHECKLIST

(Page 2 of 4)

NOTE

10 CFR 71.97 Advance notification is required for radioactive waste material (other than irradiated fuel) which:

a. Requires Type B packaging
b. Is being transported to a disposal site or to a collection point for transport to a disposal site, AND
c. The quantity of licensed material in a single package exceeds 3000 times the A1 or A2 values as specified in 10 CFR 71 Appendix A, Table A-1 or 27,000 curies.

N/A (Initial) 10 CFR 71.97 Advance Notifications have been made in accordance with Attachment 6.

(Initial) Vehicle properly placarded.

(Initial) Vehicle radiation and contamination levels are within the allowable limits.

(Initial) General transportation requirements of 49CFR173.448 are met, including cargo being secured to prevent shifting during normal transportation conditions.

N/A (Initial) If any portion of the transportation is to be by air, the applicable requirements of IATA's Dangerous Goods Regulations have been met.

(Initial) Category 1/Category 2 quantity of radioactive material determination has been performed for material to be shipped.

N/A (Initial) Verify Reactor Engineering has approved all shipments which contain SNM (U-233, U-235 and plutonium) of greater than 1 gram. A NRC Form 741 is required in accordance with 10 CFR 74.15. Submittal of this form is required within one day of shipment.

(Initial) If applicable, the carrier maintains a Transportation Security Plan covering applicable requirements of 49CFR172.800-804. The use of a contractual agreement may be utilized to ensure this is met.

N/A (Initial) For ANI Special Shipments, notifications have been made in accordance with RP-AA-108-1002 section 4.4.

N/A (Initial) For shipments of Category 1 quantities of radioactive material, advance notifications have been made in accordance with Attachment 8.

N/A (Initial) For shipments of Category 1 quantities of radioactive material, preplanning and coordination activities have been completed and documented.

(Initial) For shipments of Category 2 quantities of radioactive material, shipment no-later-than arrival time and expected shipment arrival has been coordinated with the receiving facility.

ENERGYSOLUTIONS WASTE PROCESSOR SHIPMENT CHECKLIST
(Page 3 of 4)

If the material meets the definition of "Highway Route Controlled Quantity" in 49CFR173.403, the following requirements have been met:	
Item	**Initials**
Yellow III labels applied per 49CFR172.403	
Background placard used per 49CFR172.507(a)	
"Highway Route Controlled Quantity" entered in association with the basic description on the shipping papers per 49CFR172.203(d)(4)	N/A
The requirements of 49CFR397 Subpart D have been met, including trained drivers, designated preferred routes and a written route plan	
Notify QA/QP Department prior to shipment (if applicable)	

ENERGYSOLUTIONS WASTE PROCESSOR SHIPMENT CHECKLIST
(Page 4 of 4)

Each document listed has been completed, distributed and/or retained by the station as follows:		
DOCUMENT	**PREPARER**	**REVIEWER**
• UNIFORM MANIFEST - NRC 540/541 OR EQUIVALENT	[signature]	RO
• BILL OF LADING (if required)	N/A	N/A
• ASBESTOS WASTE SHIPMENT RECORD (if required)	N/A	N/A
• DOE/NRC Form 741 for Special Nuclear Material	N/A	N/A
• SC DHEC 802 (if shipment will transit SC)	N/A	N/A
• EXCLUSIVE USE INSTRUCTIONS (N/A for Non-exclusive Use)	[signature]	RO
• CATEGORY 1 / CATEGORY 2 SHIPMENT DRIVER INSTRUCTIONS (If required)	[signature]	RO
• EMERGENCY RESPONSE INFORMATION	[signature]	RO
• VEHICLE DEPARTURE SURVEY (N/A for Non-exclusive Use)	[signature]	RO
PACKAGE DEPARTURE SURVEY(S)	[signature]	RO
PACKAGE INSPECTION CHECKLIST(S)	[signature]	RO
VEHICLE INSPECTION CHECKLIST (N/A for Non-exclusive Use)	[signature]	RO
PACKAGE DOT / 10 CFR 61 CLASSIFICATION INFORMATION	[signature]	RO
ADDITIONAL SHIPMENT DOCUMENTATION (e.g., Gamma Spectroscopy printout)	[signature]	RO
SHIFT MANAGER / EMERGENCY RESPONDER RADIOACTIVE MATERIAL SHIPMENT NOTIFICATION	[signature]	RO
Florida Plants - WASTE SHIPMENT INSPECTION REPORT	N/A	N/A
Additional documents for shipment to EnergySolutions Waste Processing Facilities in Tennessee		
• Shipment Summary Form WAG-501-F1	[signature]	RO
Notice to Transport Form WAG-501A-F1 (Mixed Waste Only)	N/A	N/A
5 Working Day Shipment Notification Form WAG-501A-F2 (Mixed Waste Only)	N/A	N/A
Additional documents for shipment to the Erwin ResinSolutions Facility		
• Waste Profile Form ER-WM-WAG-001-F1	N/A	N/A
• Customer Sampling Summary Form ER-WM-WAG-001-F2	N/A	N/A

• Receiver Copy and Carriers Copy

[signature] (Initial) Shipment emergency response information has been provided to the Emergency Response contact / provider listed on shipping papers.

Shipment Preparer (Printed Name / Signature / Initials):

Gene LeClair [signature] Date: 5/30/19

Shipment Reviewer (Printed Name / Signature / Initials):

Tom Wilson [signature] RO Date: 5/30/19

ENERGYSOLUTIONS

Friday, May 31, 2019

Gene F. LeClair
NEXTera Point Beach Nuclear
6610 Nuclear Road
Two Rivers, WI 54241

Dear Mr. LeClair:

The attached signed shipping manifest copies are your notice of receipt of the radioactive waste materials shipment specified on the manifest number below.

Manifest Number	Date Received
5499-1134-19-037	05/31/2019

Thank you for your business.

Sincerely,

Tammy Hall

Shipping and Receiving

cc: Manifest File
Shipping and Receiving file

ENERGYSOLUTIONS

Manifest Discrepancies

None

FORM 540 (05-2018) U.S. NUCLEAR REGULATORY COMMISSION

UNIFORM LOW-LEVEL RADIOACTIVE WASTE MANIFEST SHIPPING PAPER

1. EMERGENCY TELEPHONE NUMBER (Include Area Code): (920)755-6218	5. SHIPPER - NAME AND FACILITY: NextEra Energy Point Beach, Point Beach Nuclear Plant, 6610 Nuclear Rd, Two Rivers, Wisconsin 54241	SHIPPER ID NUMBER: 19-037	7. FORM 540 AND 540A PAGE 1 OF 1 PAGE(S); FORM 541 AND 541A 2 PAGE(S); FORM 542 AND 542A ___ PAGE(S); ADDITIONAL INFORMATION ___ PAGE(S)
ORGANIZATION: Control Room Supervisor	USER PERMIT NUMBER: T-WI002-L19	SHIPMENT NUMBER: 19-037	X GENERATOR TYPE (Specify) NP; COLLECTOR; PROCESSOR
2. IS THIS AN "EXCLUSIVE USE" SHIPMENT? [X] YES [ ] NO	3. TOTAL NUMBER OF PACKAGES IDENTIFIED ON THIS MANIFEST: 1	6. CARRIER - Name and Address: Hittman, 1560 Bear Creek Road, Center CTR STE 5, Oak Ridge, Tennessee 37830	EPA ID. NUMBER: N/A
4. DOES EPA REGULATED WASTE REQUIRING MANIFEST THIS SHIPMENT? [ ] YES [X] NO; If "Yes," provide	EPA MANIFEST NUMBER: N/A	CONTACT: Karen Kirby; SIGNATURE - Authorized carrier acknowledging waste receipt	TELEPHONE NUMBER (Include Area Code): (800)233-9533; DATE: 5/30/19
CONTACT: Gene F. Lecker	TELEPHONE NUMBER (Include Area Code): (920)755-6053	SHIPPING DATE: 05/29/2019	

8. MANIFEST NUMBER (Use this number on all continuation pages): 19-037

9. CONSIGNEE - Name and Facility Address: Energy Solutions, Duratek Inc, 1560 Bear Creek Road, Oak Ridge, Tennessee 37830

CONTACT: David Wry; TELEPHONE NUMBER (Include Area Code): (865) 220-1645

SIGNATURE - Authorized carrier acknowledging waste receipt; DATE: 5-31-19

12. CERTIFICATION - I hereby certify that the herein - named materials are properly classified, described, packaged, marked and labeled, and are in proper condition for transportation according to the applicable regulations of the Department of Transportation. This also certifies that the materials are classified, packaged, marked, and labeled and are in proper condition for transportation and disposal as described in accordance with the applicable requirements of 10 CFR Parts 20 and 61, or equivalent state regulations.

AUTHORIZED SIGNATURE; TITLE: Site Waste Supervisor; DATE: 5-30-19

11. U.S. DEPARTMENT OF TRANSPORTATION DESCRIPTION (including UN ID number, proper shipping name, hazard class, and any additional information)	12. DOT LABEL "RADIOACTIVE"	13. TRANSPORT INDEX	14. PHYSICAL AND CHEMICAL FORM	15. INDIVIDUAL RADIONUCLIDES		16. TOTAL PACKAGE ACTIVITY Bq	(mCi)	17. LSA/SCO CLASS	18. TOTAL WEIGHT OR VOLUME (Use appropriate units)	19. IDENTIFICATION NUMBER OF PACKAGE
UN3321, Radioactive material, low specific activity(LSA-II), 7 Fissile Excepted, RQ - Radionuclides 1 LB-120 BTFR	YELLOW II	5.0	Solid Metal Oxides	H-3	C-14	4.35E+06	(1.16E+05)	LSA-II	30,380.4 Kg	USA/9168/B(U)
038712-1				Mn-54	Fe-55				68,300.0 Lbs	B-1208 / B-1208-7
				Co-57	Co-58					
				Co-60	Ni-59					
				Ni-63	Zn-65					
				Sr-90	Sr-90					
				Tc-99	Sn-113					
				Sb-124	Sb-125					
				I-129-LLC)	Cs-137					
				Ce-144	Pu-238					
				Pu-239	Pu-241					
				Am-241	Cm-242					
				Cm-243						

FOR CONSIGNEE USE ONLY

RICK FORD #4004
ORDER#117183
TRL.# CKB17084

NRC FORM 540 (05-2018) RSW 9.5.0

FORM 541 (05-2016) — U.S. NUCLEAR REGULATORY COMMISSION

UNIFORM LOW-LEVEL RADIOACTIVE WASTE MANIFEST
CONTAINER AND WASTE DESCRIPTION

Additional Nuclear Regulatory Commission (NRC) Requirements for Control, Transfer, and Disposal of Radioactive Waste

1. MANIFEST TOTALS

NUMBER OF PACKAGES/ DISPOSAL CONTAINERS	NET WASTE VOLUME	NET WASTE WEIGHT	SPECIAL NUCLEAR MATERIAL (grams) U-233	U-235	Pu	TOTAL
1	m³ 2.83 / ft³ 100.00	kg 2,041.2 / lb 4,500.0	NP	NP	8.69E-03g (1 Pkg(s))	8.69E-03 g

ACTIVITY (MBq/mCi)	ALL NUCLIDES	TRITIUM	C-14	Tc-99	I-129	SOURCE (kg)
MBq	4.35E+06	4.62E+05	1.85E+03	2.18E+01	(6.15E+00)	NP
mCi	1.18E+05	1.25E+02	4.98E+01	5.90E-01	(1.66E-01)	

2. MANIFEST NUMBER: 19-037

3. PAGE 1 OF 2 PAGE(S)

4. SHIPPER NAME: NextEra Energy Point Beach

SHIPPER ID NUMBER: 19-037

DISPOSAL CONTAINER DESCRIPTION

5. CONTAINER IDENTIFICATION NUMBER / GENERATOR ID NUMBER(S)	6. CONTAINER DESCRIPTION (See Note 1)	7. VOLUME m³ / ft³	8. WASTE AND CONTAINER WEIGHT kg / lb	9. SURFACE RADIATION LEVEL mSv/hr / mRem/hr	10. SURFACE CONTAMINATION MBq/100 cm2 or dpm/100 cm2 ALPHA	BETA-GAMMA
6307712-1	5	3.55 / 125.20	2,608.2 Kg / 5,750.0 Lbs	144.00 / 14,400.0	< 3.33E-07 / < 2.00E+01	< 1.67E-05 / < 1.00E+03
39011597						

WASTE DESCRIPTION FOR EACH WASTE TYPE IN CONTAINER

11. WASTE DESCRIPTOR (See Note 2 & Note 2A)	12. APPROXIMATE WASTE VOLUME(S) IN CONTAINER m³ / ft³	13. SORBENT SOLIDIFICATION, STABILIZATION, MEDIA (See Note 3 & Note 3A)	14. CHEMICAL DESCRIPTION: CHEMICAL FORM / CHELATING AGENT	WEIGHT % CHELATING AGENT (IF > 0.1%)	15. RADIOLOGICAL DESCRIPTION: INDIVIDUAL RADIONUCLIDES AND ACTIVITY AND CONTAINER TOTAL OR CONTAINER TOTAL ACTIVITY AND RADIONUCLIDE PERCENT — RADIONUCLIDES [Shall Grams/Source Kilograms]		MBq	mCi	16. WASTE CLASSIFICATION A-Class A Stable A-Unstable B-Class B C-Class C
32	2.83 / 100.00	100	Metal Oxides / N P	N P	H-3		4.62E-03	1.25E+02	B
					C-14		1.65E-03	4.46E-01	
					Mn-54		4.62E+04	1.25E+03	
					Fe-55		2.11E+05	5.70E+03	
					Co-57		2.38E-04	6.37E+02	
					Co-58		3.31E+05	8.95E+03	
					Co-60		6.73E-05	1.82E+04	
					Ni-59		3.8CE-04	1.03E+03	
					Ni-63		2.81E-00	7.60E+04	
					Zn-65		3.23E+03	8.73E+01	
					Sr-89		4.53E+02	1.22E+01	
					Sr-90 D		1.76E-03	4.75E+01	
					Tc-99		2.18E-01	5.90E-01	
					Sn-113		1.68E+03	4.53E+01	
					Sb-124		4.93E-03	1.33E+02	
					Sb-125		7.91E-04	2.14E+03	
					Cs-137 D		1.21E+05	3.26E+03	
					Ce-144 D		3.85E+01	1.04E+00	
					Pu-238	[4.20E-05 g]	2.64E+01	7.14E-01	
					Pu-239	[7.05E-03 g]	1.76E+01	4.75E-01	
					Package	Continued	On Next	Page	

NOTE 1. Container Description Codes. For containers people requiring disposal in approved structural overpacks, the numerical code must be followed by "-OP."

1. Wooden Box or Crate
2. Metal Box
3. Plastic Drum or Pail
4. Metal Drum or Pail
5. Metal Tank or Liner
6. Concrete Tank or Liner
7. Polyethylene Tank or Liner
8. Fiberglass Tank or Liner
9. Demineralizer
10. Gas Cylinder
11. Bulk Unpackaged Waste
12. Unpackaged Components
13. High Integrity Container
19. Other. Describe in item 6, or continued page

NOTE 2. Waste Descriptor Codes (Choose up to three which predominate by volume.)

20. Charcoal
21. Incinerator Ash
22. Soil
23. Gas
24. Oil
25. Aqueous Liquid
26. Filter Media
27. Mechanical Filter
28. EPA or State Hazardous
29. Demolition Rubble
30. Cation Ion-exchange Media
31. Anion Ion-exchange Media
32. Mixed Bed Ion-exchange Media
33. Contaminated Equipment
34. Organic Liquid (except oil)
35. Glassware or Labware
36. Sealed Source/Device
37. Paint or Plating
38. Evaporator Bottoms/Sludges/Concentrates
39. Compactible Trash
40. Noncompactible Trash
41. Animal Carcass
42. Biological Material (except animal carcass)
43. Activated Material
59. Other. Describe in item 11 or additional page

NOTE 3. For solidification media that meet disposal site structural stability requirements, the numerical code must be followed by "-S." For all solidification media, the vendor (manufacturer) and brand name must also be identified in item 13 Comments. Code "00-NONE" REQUIRED.

SORBENT
60. Speed Dri
61. Celetom
62. Floor Dry/ Superfine
63. Hi Dri
64. Safe T Sorb
65. Safe N Dri
66. Fiberg
67. Fiberg X
68. Solid A Sorb
69. Chemisil 30
70. Chemisil 50
71. Chemisil 3000
72. Dicapel HP200
73. Dicapel HP500
74. Petroset
75. Petroset B
76. Aquaset
77. Aquaset II

SOLIDIFICATION
89. Other. Describe in Item 13, or additional page
90. Cement
91. Concrete [encapsulation]
92. Bitumen
93. Vinyl Chloride
94. Vinyl Ester Styrene
99. Other. Describe in item 13, or additional page
100. None Required

NRC FORM 541 (05-2016) — REV 9.3.0

FORM 541A
(05-2016)

U.S. NUCLEAR REGULATORY COMMISSION

UNIFORM LOW-LEVEL RADIOACTIVE WASTE MANIFEST
CONTAINER AND WASTE DESCRIPTION (CONTINUATION)

2. MANIFEST NUMBER: 19-037

3. PAGE 2 OF 2 PAGE(S)

5. CONTAINER IDENTIFICATION NUMBER / GENERATOR ID NUMBER(S)	6. CONTAINER DESCRIPTION (See Note 1)	7. VOLUME m³ / ft³	8. WASTE AND CONTAINER WEIGHT Kg / lb	9. SURFACE RADIATION LEVEL mSv/hr / mRem/hr	10. SURFACE CONTAMINATION MBq/100 cm2 / cpm/100 cm2 ALPHA	10. SURFACE CONTAMINATION MBq/100 cm2 / cpm/100 cm2 BETA-GAMMA	PHYSICAL DESCRIPTION 11. WASTE DESCRIPTOR (See Note 2 & Note 2A)	PHYSICAL DESCRIPTION 12. APPROXIMATE WASTE VOLUME IN CONTAINER m³ / ft³	PHYSICAL DESCRIPTION 13. SORBENT SOLIDIFICATION, STABILIZATION MEDIA (See Note 3 & Note 3A)	14. CHEMICAL DESCRIPTION CHEMICAL FORM / CHELATING AGENT	14. CHEMICAL DESCRIPTION WEIGHT % CHELATING AGENT IF > 0.1%	15. RADIOLOGICAL DESCRIPTION INDIVIDUAL RADIONUCLIDES AND ACTIVITY AND CONTAINER TOTAL OR CONTAINER TOTAL ACTIVITY AND RADIONUCLIDE PERCENT: RADIONUCLIDES (SNM Grams/Source Kilograms)	MBq	mCi	16. WASTE CLASSIFICATION A/S-Class A Stable AU-Class A Unstable B-Class B C-Class C
												Pu-241 [0.03E-04 g]	3.77E+03	1.02E+02	
												Am-241	4.84E+01	1.31E+00	
												Cm-242	2.80E+00	7.80E-02	
												Cm-243	1.70E+01	4.55E-01	
												I-129	(6.15E+00)	(1.66E-01)	
												TOTALS.	4.30E+05	1.18E+04	
												SNM Source [8.69E-03 g]			
Shipment Total:		3.55 / 125.20	2,608.2 Kg / 5,750.0 Lbs									SNM Source [8.69E-03 g]	4.30E+05	1.18E+04	

NRC FORM 541A (05-2016)

RNV 9.3.0

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ENERGYSOLUTIONS

HITTMAN TRANSPORT SERVICES, INC.
A Subsidiary of *EnergySolutions*

To: Brian Hall
Hittman Driver
Barnwell Security Guards
Point Beach Plant Rad Waste Manager

Date: May 29, 2019
Revision: 0

From: Matthew Thompson

Subject: Tracking of Point Beach Plant RAMQC Category 2 Shipment (HTS 117183)

THESE INSTRUCTIONS ARE TO BE READ AND IMPLEMENTED IN ITS ENTIRETY

[redacted]

[redacted]

[redacted]

[redacted]

ENERGYSOLUTIONS

HITTMAN TRANSPORT SERVICES, INC.

[redacted]

Leclair, Gene F

From: Leclair, Gene F
Sent: Friday, May 31, 2019 7:23 AM
To: 'Matthew C. Thompson'
Cc: 'April Moors (ammoors@energysolutions.com)'; Laurin, Matthew; Walters, Jerri; 'Katie L. McReynolds (klmcreynolds@energysolutions.com)'; Lulloff, James; Meyer, James; Swanson, Douglas; OLSON, Ronald
Subject: RE: Point Beach Shipment to Energy Solutions Bear Creek operations

As reported by Barnwell Security, Shipment 19-037 from Point Beach to Bear Creek arrived safely at 0725 EST (0625 CST)

Thank you to all involved,

Thanks,
Gene LeClair, NRRPT
Site Waste Shipping Supervisor – Radioactive/Hazardous Waste
Gene.f.leclair@nee.com
6610 Nuclear Road
Two Rivers, WI 54241
(920)755-6953
C (920)-901-5196

From: Leclair, Gene F
Sent: Thursday, May 30, 2019 11:03 AM
To: 'Matthew C. Thompson'
Cc: April Moors (ammoors@energysolutions.com); Laurin, Matthew; Walters, Jerri; Katie L. McReynolds (klmcreynolds@energysolutions.com)
Subject: Point Beach Shipment to Energy Solutions Bear Creek operations

Shipment 19-037 on its way as of 1056 CST. As required by 10CFR37, the expected arrival time at Bear Creek is 5/31/2019 07:00 with a No Later Than delivery time of 1300. Rick is going to call me when they arrive.

Call with any questions

Gene F LeClair
Site Waste Supervisor

Hazardous and Radioactive Waste
NextEra Energy, Point Beach
6610 Nuclear Road
Two Rivers, WI 54241
Phone 920-755-6953
Fax 920-755-6227
Cell 920-901-5196

From: Matthew C. Thompson [mailto:mcthompson@energysolutions.com]
Sent: Wednesday, May 29, 2019 9:30 AM
To: Leclair, Gene F; Bernard Curry; Brian Hall; Chad Creech; Karen Steinmeyer; Paul C. Weber
Cc: Jeff Packett
Subject: Shipping Documents

CAUTION - EXTERNAL EMAIL

See attached. Password to follow.

Thank you,

Matthew Thompson
Terminal Manager
Hittman Transport Services, Inc.
Office 865-220-5820
Fax 865-220-1561
Cell 865-603-9688

FORM 540 (05-2010) U.S. NUCLEAR REGULATORY COMMISSION

UNIFORM LOW-LEVEL RADIOACTIVE WASTE MANIFEST SHIPPING PAPER

1. EMERGENCY TELEPHONE NUMBER (Include Area Code)	(920)755-4918
ORGANIZATION	Control Room Supervisor
2. IS THIS AN "EXCLUSIVE USE" SHIPMENT?	[X] YES [ ] NO
3. TOTAL NUMBER OF PACKAGES IDENTIFIED ON THIS MANIFEST	1
4. DOES EPA REGULATED WASTE REQUIRING MANIFEST THIS SHIPMENT?	[ ] YES [X] NO
If "Yes," provide	EPA MANIFEST NUMBER: N/A

5. SHIPPER - NAME AND FACILITY	NextEra Energy Point Beach Point Beach Nuclear Plant 6610 Nuclear Rd Two Rivers, Wisconsin 54241
USER PERMIT NUMBER	T-WI022-L10
SHIPMENT NUMBER	19-037
CONTACT	Gene F. Leclair
6. CARRIER - Name and Address	Hittman 1560 Bear Creek Road Center CTR STE.5 Oak Ridge , Tennessee 37830
CONTACT	Karen Kirby
SIGNATURE - Authorized carrier acknowledging waste receipt	
DATE	5/30/19

SHIPPER I.D. NUMBER	19-037
[ ] COLLECTOR	
[ ] PROCESSOR	
[X] GENERATOR TYPE (Specify)	NP
TELEPHONE NUMBER (Include Area Code)	(920)755-6958
EPA I.D. NUMBER	N/A
SHIPPING DATE	05/30/2019
TELEPHONE NUMBER (Include Area Code)	(800)233-9933

7. FORM 540 AND 540A PAGE 1 OF 1 PAGE(S); FORM 541 AND 541A 2 PAGE(S); FORM 542 AND 542A ___ PAGE(S); ADDITIONAL INFORMATION ___ PAGE(S)

8. MANIFEST NUMBER (Use this number on all continuation pages): 19-037

9. CONSIGNEE - Name and Facility Address: Energy Solutions, Duratek Inc., 1560 Bear Creek Road, Oak Ridge , Tennessee 37830

CONTACT: Dana Wry

TELEPHONE NUMBER (Include Area Code): (865) 220-1645

SIGNATURE - Authorized consignee acknowledging waste receipt

DATE

10. CERTIFICATION - "This is to certify that the herein - named materials are properly classified, described, packaged, marked and labeled, and are in proper condition for transportation according to the applicable regulations of the Department of Transportation. This also certifies that the materials are classified, packaged, marked, and labeled and are in proper condition for transportation and disposal as described in accordance with the applicable requirements of 10 CFR Parts 20 and 61, or equivalent state regulations."

AUTHORIZED SIGNATURE | TITLE: Site Waste Supervisor | DATE: 5-30-19

11. U.S. DEPARTMENT OF TRANSPORTATION DESCRIPTION (Including UN ID number, proper shipping name, hazard class, and any additional information)	12. DOT LABEL "RADIOACTIVE"	13. TRANSPORT INDEX	14. PHYSICAL AND CHEMICAL FORM	15. INDIVIDUAL RADIONUCLIDES		16. TOTAL PACKAGE ACTIVITY (MBq)	(mCi)	17. LSA/SCO CLASS	18. TOTAL WEIGHT OR VOLUME (Use appropriate units)	19. IDENTIFICATION NUMBER OF PACKAGE
UN2912, Radioactive material, low specific activity (LSA-II), 7 Fissile Excepted, RQ - Radionuclides 1 LE-120 DTFR	YELLOW III	5.0	Solid/ Metal Oxides	H-3	C-14	4.52E+00	(1.16E-01)	LSA-II	33,560.4 Kg 68,309.0 Lbs	USA/9108/B(U) E-1228 / E-1229-T
523712-1				Co-57	Co-58					
				Co-60	Ni-59					
				Ni-63	Zn-65					
				Sr-89	Sr-90					
				Tc-99	Sn-113					
				Sb-124	Sb-125					
				(I-129 LLD)	Cs-137					
				Ce-144	Pu-239					
				Pu-238	Pu-241					
				Am-241	Cm-242					
				Cm-243						

FOR CONSIGNEE USE ONLY

FORM 541 (05-2016) — U.S. NUCLEAR REGULATORY COMMISSION

UNIFORM LOW-LEVEL RADIOACTIVE WASTE MANIFEST
CONTAINER AND WASTE DESCRIPTION

Additional Nuclear Regulatory Commission (NRC) Requirements for Control, Transfer, and Disposal of Radioactive Waste

1. MANIFEST TOTALS

NUMBER OF PACKAGES/ DISPOSAL CONTAINERS	NET WASTE VOLUME	NET WASTE WEIGHT	SPECIAL NUCLEAR MATERIAL (grams) U-233	U-235	Pu	TOTAL
1	m³ 2.83 / ft³ 100.00	kg 2,041.2 / lb 4,500.0	N P	N P	8.69E-03g (1 Pkg(s))	8.69E-03 g

ACTIVITY (MBq/mCi)	ALL NUCLIDES	TRITIUM	C-14	Tc-99	I-129	SOURCE (kg)
MBq	4.36E+06	4.62E+03	1.65E+03	2.18E+01	(6.15E+00)	NP
mCi	1.18E+05	1.25E+02	4.46E+01	5.90E-01	(1.66E-01)	

2. MANIFEST NUMBER: 19-037

3: PAGE 1 OF 2 PAGE(S)

4. SHIPPER NAME: NextEra Energy Point Beach

SHIPPER ID NUMBER: 19-037

DISPOSAL CONTAINER DESCRIPTION / **WASTE DESCRIPTION FOR EACH WASTE TYPE IN CONTAINER**

5. CONTAINER IDENTIFICATION NUMBER / GENERATOR ID NUMBER(S)	6. CONTAINER DESCRIPTION (See Note 1)	7. VOLUME m³ / ft³	8. WASTE AND CONTAINER WEIGHT kg / lb	9. SURFACE RADIATION LEVEL mSv/hr / mRem/hr	10. SURFACE CONTAMINATION MBq/100 cm2 dpm/100 cm2 ALPHA	BETA-GAMMA	11. WASTE DESCRIPTOR (See Note 2 & Note 2A)	12. APPROXIMATE WASTE VOLUME(S) IN CONTAINER m³ / ft³	13. SORBENT SOLIDIFICATION, STABILIZATION, MEDIA (See Note 3 & Note 3A)	14. CHEMICAL DESCRIPTION: CHEMICAL FORM / CHELATING AGENT	WEIGHT % CHELATING AGENT IF > 0.1%	15. RADIOLOGICAL DESCRIPTION: INDIVIDUAL RADIONUCLIDES AND ACTIVITY AND CONTAINER TOTAL; OR CONTAINER TOTAL ACTIVITY AND RADIONUCLIDE PERCENT — RADIONUCLIDES [SNM Grams/Source Kilograms]	MBq	mCi	16. WASTE CLASSIFICATION A-Class A Stable A/U-Class A Unstable B-Class B C-Class C
638712-1	5	3.55	2,608.2 Kg	144.00	< 3.33E-07	< 1.67E-05	32	2.83	100	Metal Oxides	N P	H-3	4.62E+03	1.25E+02	B
		125.20	5,750.0 Lbs	14,400.0	< 2.00E+01	< 1.00E+03		100.00		N P		C-14	1.65E+03	4.46E+01	
												Mn-54	4.67E+04	1.25E+03	
												Fe-55	2.11E+05	5.70E+03	
												Co-57	2.36E+04	6.37E+02	
												Co-58	3.31E+05	8.96E+03	
												Co-60	6.73E+05	1.82E+04	
												Ni-59	3.80E+04	1.03E+03	
												Ni-63	2.81E+06	7.60E+04	
												Zn-65	3.23E+03	8.73E+01	
												Sr-89	4.53E+02	1.23E+01	
												Sr-90 D	1.76E+03	4.75E+01	
												Tc-99	2.18E+01	5.90E-01	
												Sn-113	1.68E+03	4.53E+01	
												Sb-124	4.93E+03	1.33E+02	
												Sb-125	7.81E+04	2.14E+03	
												Cs-137 D	1.21E+05	3.26E+03	
												Co-144 D	3.85E+01	1.04E+00	
												Pu-238 [4.20E-05 g]	2.64E+01	7.14E-01	
												Pu-239 [7.65E-03 g]	1.76E+01	4.75E-01	
												Package Continued	On Next	Page	

NOTE 1: Container Description Codes. For containers waste requiring disposal in approved structural overpacks, the numerical code must be followed by "-OP."

1 Wooden Box or Crate
2 Metal Box
3 Plastic Drum or Pail
4 Metal Drum or Pail
5 Metal Tank or Liner
6 Concrete Tank or Liner
7 Polyethylene Tank or Liner
8 Fiberglass Tank or Liner
9 Demineralizer
10 Gas Cylinder
11 Bulk Unpackaged Waste
12 Unpackaged Components
13 High Integrity Container
19 Other. Describe in item 6, or additional page

NOTE 2: Waste Descriptor Codes (Choose up to three which predominate by volume.)

20 Charcoal
21 Incinerator Ash
22 Soil
23 Gas
24 Oil
25 Aqueous Liquid
26 Filter Media
27 Mechnical Filter
28 EPA or State Hazardous
29 Demolition Rubble
30 Cation Ion-exchange Media
31 Anion Ion-exchange Media
32 Mixed Bed Ion-exchange Media
33 Contaminated Equipment
34 Organic Liquid (except oil)
35 Glassware or Labware
36 Sealed Source/Device
37 Paint or Plating
38 Evaporator Bottoms/Sludges/Concentrates
39 Compactible Trash
40 Noncompactible Trash
41 Animal Carcass
42 Biological Material (except animal carcass)
43 Activated Material
59 Other. Describe in item 11, or additional page

NOTE 3: For solidification media that meet disposal site structural stability requirements, the numerical code must be followed by "-S." For all solidification media, the vendor (manufacturer) and brand name must also be identified in item 13.CompareTo Code 100=NONE REQUIRED

SORPTION

60 Speed Dri
61 Celatom
62 Floor Dry/ Superfine
63 Hi Dri
64 Safe T Sorb
65 Safe N Dri
66 Florco
67 Florco X
68 Solid A Sorb
69 Chemsil 30
70 Chemsil 50
71 Chemsil 3030
72 Dicaperl HP200
73 Dicaperl HP500
74 Petroset
75 Petroset II
76 Aquaset
77 Aquaset II

SOLIDIFICATION

89 Other Describe in item 13, or additional page
90 Cement (encapsulation)
91 Concrete
92 Bitumen
93 Vinyl Chloride
94 Vinyl Ester Styrene
99 Other Describe in item 13, or additional page
100 None Required

FORM 541A
(05-2016)

U.S. NUCLEAR REGULATORY COMMISSION

UNIFORM LOW-LEVEL RADIOACTIVE WASTE MANIFEST
CONTAINER AND WASTE DESCRIPTION (CONTINUATION)

2. MANIFEST NUMBER: 19-037

3. PAGE 2 OF 2 PAGE(S)

5. CONTAINER IDENTIFICATION NUMBER / GENERATOR ID NUMBER(S)	6. CONTAINER DESCRIPTION (See Note 1.)	7. VOLUME m³ / ft³	8. WASTE AND CONTAINER WEIGHT kg / lb	9. SURFACE RADIATION LEVEL mSv/hr / mRem/hr	10. SURFACE CONTAMINATION MBq/100 cm2 / dpm/100 cm2 ALPHA	10. SURFACE CONTAMINATION BETA-GAMMA	PHYSICAL DESCRIPTION 11. WASTE DESCRIPTOR (See Note 2 & Note 2A)	PHYSICAL DESCRIPTION 12. APPROXIMATE WASTE VOLUME IN CONTAINER m³ / ft³	PHYSICAL DESCRIPTION 13. SORBENT SOLIDIFICATION, STABILIZATION, MEDIA (See Note 3 & Note 3A)	14. CHEMICAL DESCRIPTION: CHEMICAL FORM / CHELATING AGENT	14. CHEMICAL DESCRIPTION: WEIGHT % CHELATING AGENT IF > 0.1%	15. RADIOLOGICAL DESCRIPTION: INDIVIDUAL RADIONUCLIDES AND ACTIVITY AND CONTAINER TOTAL OR CONTAINER TOTAL ACTIVITY AND RADIONUCLIDE PERCENT — RADIONUCLIDES [SNM Grams/Source Kilograms]	MBq	mCi	16. WASTE CLASSIFICATION AS-Class A Stable AU-Class A Unstable B-Class B C-Class C
												Pu-241 [9.93E-04 g]	3.77E+03	1.02E+02	
												Am-241	4.84E+01	1.31E+00	
												Cm-242	2.85E+00	7.80E-02	
												Cm-243	1.70E+01	4.59E-01	
												I-129	(6.15E+00)	(1.66E-01)	
												TOTALS:	4.36E+06	1.18E+05	
												SNM [8.69E-03 g]			
												Source:			
Shipment Total		3.55 / 125.20	2,608.2 Kg / 5,750.0 Lbs									SNM [8.69E-03 g]	4.36E+06	1.18E+05	
												Source:			

NRC FORM 541A (05-2016)

RIW 9.3.0

LSA / SCO EMERGENCY RESPONSE INFORMATION

(Page 1 of 3)

SHIPMENT No. 19-037

Proper Shipping Name and Hazard Class
(Check one of the types listed below)

- ☐ UN2912, Radioactive material, low specific activity, (LSA-I), 7
- ☐ UN3321, Radioactive material, low specific activity, (LSA-II), 7
- ☐ UN3322, Radioactive material, low specific activity, (LSA-III), 7
- ☐ UN2913, Radioactive material, surface contaminated objects (SCO-I or SCO-II), 7

24 HOUR EMERGENCY CONTACT

Telephone No.: 920-755-4919

Ask for Shift Manager or Unit Supervisor and state your situation.

POTENTIAL HAZARDS

HEALTH

1. Radiation presents minimal risk to transport workers, emergency response personnel, and the public during transportation accidents. Packaging durability increases as potential hazard of radioactive content increases.
2. Undamaged packages are safe; contents of damaged packages may cause higher external radiation exposure, or both external and internal radiation exposure if contents are released.
3. Low radiation hazard when material is inside container. If material is released from package or bulk container, hazard will vary from low to moderate. Level of hazard will depend on the type and amount of radioactivity, the kind of material it is in, and/or the surface it is on.
4. Some material may be released from packages during accidents of moderate severity but risks to people are not great.
5. Released radioactive materials or contaminated objects usually will be visible if packaging fails.
6. Some exclusive use shipments of bulk and packaged material will not have "RADIOACTIVE" labels. Placards, markings, and shipping papers provide identification.
7. Some packages may have a "RADIOACTIVE" label and a second hazard label. The second hazard is usually greater than the radiation hazard; so follow this Guide as well as the response Guide for the second hazard class label.
8. Some radioactive materials cannot be detected by commonly available instruments.
9. Runoff from control of cargo fire may cause low-level pollution.

FIRE OR EXPLOSION

1. Some of these materials may burn, but most do not ignite readily.
2. Uranium and Thorium metal cuttings or granules may ignite spontaneously if exposed to air.
3. Nitrates are oxidizers and may ignite other combustibles.

LSA / SCO EMERGENCY RESPONSE INFORMATION

(Page 2 of 3)

PUBLIC SAFETY

1. CALL Emergency Response Telephone Number on Shipping Paper first.
2. Priorities for rescue, life-saving, first aid, and control of fire and other hazards are higher than the priority for measuring radiation levels.
3. Radiation Authority **must** be notified of accident conditions. Radiation Authority is usually responsible for decisions about radiological consequences and closure of emergencies.
4. As an immediate precautionary measure, isolate spill **or** leak area immediately for at least 25 meters (75 feet) in all directions. Stay upwind. Keep unauthorized personnel away.
5. Detain **or** isolate uninjured persons **or** equipment suspected to be contaminated; delay decontamination and cleanup until instructions are received from Radiation Authority.

PROTECTIVE CLOTHING

1. Positive pressure self contained breathing apparatus (SCBA) and structural firefighters' protective clothing will provide adequate protection.

EVACUATION

1. Large Spill - Consider initial down wind evacuation for at least 100 meters (330 feet).
2. Fire - When a large quantity of this material is involved in a major fire, consider an initial evacuation distance of 300 meters (1000 feet) in all directions.

EMERGENCY RESPONSE

FIRE

1. Presence of radioactive material will **not** influence the fire control processes and should not influence selection of techniques.
2. Move containers from fire area if you can do it without risk.
3. Do **not** move damaged packages; move undamaged packages out of fire zone.
4. Small Fires - Dry chemical, CO2, water spray **or** regular foam.
5. Large Fires
    a. Water spray, fog (flooding amounts).
    b. Dike fire-control water for later disposal.

SPILL OR LEAK

1. Do **not** touch damaged packages **or** spilled material.
2. Cover liquid spill with sand, earth **or** other noncombustible absorbent material.
3. Dike to collect large liquid spills.
4. Cover powder spill with plastic sheet **or** tarp to minimize spreading.

LSA / SCO EMERGENCY RESPONSE INFORMATION

(Page 3 of 3)

FIRST AID

1. Medical problems take priority over radiological concerns.
2. Use first aid treatment according to the nature of the injury.
3. Do **not** delay care and transport of a seriously injured person.
4. Give artificial respiration if victim is **not** breathing.
5. Administer oxygen if breathing is difficult.
6. In case of contact with substance, wipe from skin immediately; flush skin **or** eyes with running water for at least 20 minutes.
7. Injured persons contaminated by contact with released material are not a serious hazard to health care personnel, equipment or facilities.
8. Ensure that medical personnel are aware of the material(s) involved, and take precautions to protect themselves.

EXCLUSIVE USE SHIPMENT DRIVER INSTRUCTIONS

(Page 1 of 1)

This transport vehicle is designated as "EXCLUSIVE USE". It has been loaded by the consignor, and it shall only be unloaded by the consignee. The material is **not** to be transferred to another cargo carrying body unless under the direction of the consignor. **No** additional material may be loaded to this vehicle while this vehicle is enroute.

ADDITIONAL INSTRUCTIONS

1. If the vehicle is involved in an accident, vehicle malfunction or other deviation, notify the shipper immediately by calling the Emergency Telephone Number listed on the shipping paper.
2. If the security of the vehicle is threatened or suspected suspicious activities occur near the vehicle, notify law enforcement personnel immediately and then notify the consignor by calling the Emergency Telephone Number listed on the shipping paper.
3. The vehicle is required to remain locked while unattended.
4. If the vehicle has been placarded "RADIOACTIVE," the driver is responsible for the maintenance of the placards while the shipment is enroute.
5. If the package(s) is labeled, the driver is responsible for the maintenance of the labels while the shipment is enroute.
6. If the package(s) is marked with orange identification (ID) panels, the driver is responsible for maintenance of these panels while the shipment is enroute.
7. Do **not** change the following without prior approval from the shipper by calling the shipper contact specified on the shipping paper:
   - Tractor, or
   - Driver, or
   - Fifth wheel adjustment
8. Shipping papers must be readily accessible and easily recognizable. Specifically, they must be easily within your reach while you are restrained by a seat belt and they must be readily visible to a person entering the vehicle.
9. Certain shipments of radioactive materials cannot be transported through or on certain highway facilities (i.e., certain tunnels, bridges, toll roads, etc.)
10. Radiological survey of the vehicle is required after each use as required by 49CFR 173.443(c) before the vehicle is released back to service.

I approve of the loading arrangement and placement of packages for this shipment and have been verbally briefed and understand the preceding instructions.

Driver Signature

5/30/18

Date

RADIOACTIVE SHIPMENT EMERGENCY RESPONSE AND CALL LIST INFORMATION

(Page 1 of 1)

SHIPMENT INFORMATION

Shipment No.: 19-037 Shipment Date: 05/30/19 Est. Arrival Date: 05/31/19
Proper Shipping Name: RQ, UN3321, Radioactive Material, Low Specific Activity, (LSA-II), 7
Basic Description of Shipment/Contents: Resin for storage/processing
No./Type of Packages: 1
Total Shipment Activity, mCi: 118,000 mCi
Highest Package Dose Rate: 15
Highest Dose Rate of Contents: 14,400 mR/hr
Transporter: Hittman
Driver Name: Ralph Hudson / Harold Ford Contact No.: (828)-644-8879 / (865)719-5104
Destination: Energy Solutions Bear Creek Operations
Destination Contact: Katie McReynolds Contact No.: 865-776-3774

(Initial) **Shipment manifest and Emergency Response Information sheets are attached.**

IMMEDIATE ACTIONS

1. Upon receiving notification of an accident involving this Radioactive shipment obtain as much of the following information from the caller as possible:
   - Caller Name
   - Call back Phone Number(s)
   - Name of Carrier or Carrier Representative
   - Nature, location and time of accident/incident (injured people, fire, spill, radioactive release, etc.):
   - Any identifying information of the material involved in the incident (container types, labels, placards, etc.)
   - Vehicle(s) information (vehicle type(s), number of vehicles involved, etc.)
   - Names of all Emergency Response Groups who have been notified
2. Provide caller with emergency response information included with this form.
3. Immediately contact at least one of the following personnel and provide them with details of the accident:

Contact Person	Phone Number	Cell Number	Pager Number
Gene LeClair	NA	920-901-5196	218-4865
Jerri Walters	NA	920-794-4537	218-4611

ENERGYSOLUTIONS

Shipment Summary Form

Required for Energy*Solutions* Bear Creek & Gallaher Rd. Processing Facilities

Form WAG-501-F1
Rev. 10

Generator:	1134 NextEra Energy Point Beach LLC	Shipment Date:	5/30/19
Shipment Number:	19-037	TN License for Delivery No:	T-WI002-L19
Contract/Release Number:	21839	Total # of Containers:	1
Special Quote #:		Total Activity (mCi):	118'000
Shipment Weight:	5750	SNM Grams:	0.00869
Highest Contact Dose Rate Package:	14,400 mR	Highest Contact Dose Rate Material:	14,400

MATERIALS SHIPPED

Please Estimate Percentage of Total Material by Weight (Must Add to 100%)

DAW (Incineration, Compaction)	DAW	%		Asbestos	%
METALS (Melting, Volume Reduction & Disposal)	Metals	%		Asbestos	%
	Lead Blankets	%		Lead Sheets	%
	Lead Brick	%		Other (*specify*):	%
Resins (Dewatering, Incineration)	Powdex	%		Bead	100 %
	Charcoal	%		Type of Liner	
LIQUIDS (Incineration, Drying, Solidification)	Aqueous Liquids	%		Sludge	%
	Oil	%		Oily Waste	%
	Grease	%		EHC	%
POTENTIALLY CLEAN MATERIAL (Green Is Clean)	Debris(Plant Trash and Demo Debris)	%		Debris with Asbestos(Plant Trash and Demo Debris)	%
	Filter Media/Sludge (NOTE 1)	%		Absorbed Liquids	%
	Paint Chip/Grit (NOTE 1)	%		Soil/Rock/Gravel	%
	Other(Specify)_____	%			

SPECIAL PROJECT — Describe nature of project in Special Instructions, below (e.g., Transship, Source Encapsulation, RCRA, etc.)

NOTE 1: Requires TCLP Analysis prior to shipment of each campaign of similar waste.

WASTE INFORMATION

(ITEMS IDENTIFIED WITH ** REQUIRE ENERGY*SOLUTIONS* APPROVAL PRIOR TO SHIPMENT; SEE SECTION B OF THE WAG)

3 day prior notification required for OOW	☐			**Metals > 200 mrem/hr @ contact with waste	☐			**SNM/Source Material	☐
**DAW > 200 mrem/hr @ contact with waste	☐			Liquid Filters (Separate Isotopics Required)	☐			**Trans-shipment	☐
**High Smearable	☐	**Sealed Sources	☐	Activated Material	☐	Refrigeration Equipment	☐	**Lead-Acid Batteries	☐
CLASSIFIED/NOFORN	☐	Biological	☐	Asbestos	☐	Sharps ☐	Beryllium ☐	**PCBs	☐
**Mixed Waste	☐	RCRA Empties	☐	Hot Particles	☐	**Paint Chips (NOTE 1)	☐	**Used Oil Flashpoint ≥100 °F and <140°F	☐
**Small Sharp Objects	☐	Controlled Substances	☐						

Class 7 Labeled Waste — White I ☐ Yellow II ☐ Yellow III ☐

SHIPMENT CONFIGURATION/SPECIAL INSTRUCTIONS

(Include Package Tare Weight for RTC)

If necessary, provide additional information on a separate page. Shipment will arrive in a 8-120B container for storage pending processing at Erwin. Liner is an L8-120 with serial number L638712-1

DISPOSAL SITE

Clive ☐ | Other/Return (specify):

CONTAINERS

Energy*Solutions*-Owned Containers ☐ | Containers to Be Returned to Generator ☐

ENERGYSOLUTIONS

Shipment Summary Form

Required for Energy*Solutions* Bear Creek & Gallaher Rd. Processing Facilities

Form WAG-501-F1
Rev. 10

COMPLETE AND SIGN EITHER SECTION 1 OR SECTION 2 AS APPLICABLE

SECTION 1 - SHIPMENT WASTE/MATERIAL CHARACTERIZATION CERTIFICATION

Waste/Material Description: Resin for storage pending processing by Resin Solutions

This certification must be completed and signed by an individual knowledgeable in environmental compliance regulations referenced herein. This waste/material has been characterized per 40 CFR 262.11, 40 CFR 279.11 and 40 CFR 761 as applicable, using the following: (Check all that apply).

☒ Laboratory Analysis** ☐ Process Knowledge**

***EnergySolutions personnel may request characterization documentation for purposes of surveillances, audits or regulatory inspections as applicable to 40 CFR 262.40(c) and 40 CFR 279.72.*

Check all that applies to the contents of this shipment.

☒ **Non-Hazardous Waste or Exempted Material (i.e. lead for recycle, universal waste, etc.)**
I certify, to the best of my knowledge: the waste identified above does not meet the definition of *hazardous waste* as defined in 40 CFR 261.3 when measured in each container delivered to Energy*Solutions* Bear Creek and Gallaher Rd. Facilities.

☐ **Hazardous Waste**
I certify, to the best of my knowledge: The waste identified above meets definition of *hazardous waste* as defined in 40 CFR 261.3 when measured in each container delivered to Energy*Solutions* BCF. (WAG-501 Appendix A requirements must be met.)

☐ **Used Oil (as defined in 40 CFR 279.1 Definitions)**
I certify, to the best of my knowledge: The waste identified above complies with the On-Specification criteria listed in 40 CFR 279.11 and contains less than 1,000 parts per million of halogens and less than 2 parts per million unregulated PCBs.

☒ **Non-Poly Chlorinated Biphenyl (PCB) (note: bulk product PCBs are the only PCBs authorized for acceptance at the BCF).**
I certify, to the best of my knowledge: The waste identified above does not meet the definition of PCB Articles, Containers, Remediation Waste, Bulk Product Waste, R&D waste, regulated PCB liquid waste or PCB contaminated waste per 40 CFR 761.3.

☐ **Poly Chlorinated Biphenyl (PCB) (note: bulk product PCBs are the only PCBs authorized for acceptance at the BCF)**
I certify, to the best of my knowledge: The waste identified above meets definition of PCB Bulk Product Waste per 40 CFR 761.3

I certify, to the best of my knowledge, that the above information is complete and accurate. No deliberate or willful omissions of composition or properties exist and that all known or suspected hazards have been disclosed. I certify that the waste stream has been characterized and identified to EnergySolutions per 40 CFR 262.11, 40 CFR 279.11 and 40 CFR 761 as applicable. I certify that this waste meets the EnergySolutions Bear Creek Facility Waste Acceptance Guidelines (WAG-501) or has been granted Special Approval by EnergySolutions for waste acceptance.

Gene LeClair — *Printed Name*
Signature
Site Waste Supervisor — *Title*
5/25/19 — *Date*

Technical Contact(s) must be identified below.

Name	Title	Phone Number/Email Address
Gene LeClair	Site Waste Supervisor	920-755-6953 / 920-901-5196 (Cell)

SECTION 1

SECTION 2 - WASTE/MATERIAL CHARACTERIZATION CERTIFICATION – REQUIRES PRIOR DOCUMENTATION ON FILE

Energy*Solutions* has received waste characterization information from the Generator and has documents on file for the waste/material identified on page one of this Form. This shipment meets Energy*Solutions'* waste certification requirements.

Printed Name — *Signature*
Title — *Date*

SECTION 2

During Shipment

WMG Suite 9.3.0

* Waste

DOT Classification Summary

Package ID: 638712-1

Material Weight (g): 2.04E+06

Nuclide	Activity (mCi)	A2 Calculation		RQ Calculation		LSA II Fraction
		Limit (Ci)	Fraction	Limit (Ci)	Fraction	(A2/g)
Co-60	1.82E+04	1.08E+01	1.68E+00 *	1.00E+01	1.82E+00	8.25E-07
Co-58	8.96E+03	2.70E+01	3.32E-01 *	1.00E+01	8.96E-01	1.63E-07
Cs-137	3.26E+03	1.62E+01	2.01E-01 *	1.00E+00	3.26E+00	9.85E-08
Ni-63	7.60E+04	8.10E+02	9.39E-02 *	1.00E+02	7.60E-01	4.60E-08
Sb-125	2.14E+03	2.70E+01	7.92E-02 *	1.00E+01	2.14E-01	3.88E-08
Pu-241	1.02E+02	1.62E+00	6.29E-02 *	1.00E+00	1.02E-01	3.08E-08
Am-241	1.31E+00	2.70E-02	4.84E-02 *	1.00E-02	1.31E-01	2.37E-08
Mn-54	1.25E+03	2.70E+01	4.63E-02 *	1.00E+01	1.25E-01	2.27E-08
Pu-238	7.14E-01	2.70E-02	2.65E-02	1.00E-02	7.14E-02	1.30E-08
Pu-239	4.75E-01	2.70E-02	1.76E-02	1.00E-02	4.75E-02	8.62E-09
Cm-243	4.59E-01	2.70E-02	1.70E-02	1.00E-02	4.59E-02	8.32E-09
Sb-124	1.33E+02	1.62E+01	8.22E-03	1.00E+01	1.33E-02	4.03E-09
Sr-90	4.75E+01	8.10E+00	5.87E-03	1.00E-01	4.75E-01	2.87E-09
Fe-55	5.70E+03	1.08E+03	5.28E-03	1.00E+02	5.70E-02	2.58E-09
Co-57	6.37E+02	2.70E+02	2.36E-03	1.00E+02	6.37E-03	1.16E-09
Zn-65	8.73E+01	5.40E+01	1.62E-03	1.00E+01	8.73E-03	7.92E-10
Sn-113	4.53E+01	5.40E+01	8.39E-04	1.00E+01	4.53E-03	4.11E-10
Sr-89	1.23E+01	1.62E+01	7.56E-04	1.00E+01	1.23E-03	3.71E-10
C-14	4.46E+01	8.10E+01	5.50E-04	1.00E+01	4.46E-03	2.70E-10
Cm-242	7.80E-02	2.70E-01	2.89E-04	1.00E+00	7.80E-05	1.42E-10
Ce-144	1.04E+00	5.40E+00	1.93E-04	1.00E+00	1.04E-03	9.43E-11
H-3	1.25E+02	1.08E+03	1.16E-04	1.00E+02	1.25E-03	5.66E-11
Tc-99	5.90E-01	2.43E+01	2.43E-05	1.00E+01	5.90E-05	1.19E-11
Ni-59	1.03E+03	No A2	0.00E+00	1.00E+02	1.03E-02	0.00E+00
TOTALS	**1.18E+05**		**2.63E+00**		**8.05E+00**	**1.29E-06 ****

* Nuclides included in 95% of the hazard fraction as per 49 CFR 173.433(g)

** Compare LSA Fraction to LSA II (solid) limit of <= 1.00E-04 A2/g

During Shipment
WMG Suite 9.3.0

DOT Shipment Classification Summary for Type A/B and RQ

Shipment Number: 19-037 Shipment Date: 05/30/2019

Number of Containers 1

Nuclide	Activity (mCi)	A2 Calculation		RQ Calculation	
		Limit (Ci)	Fraction	Limit (Ci)	Fraction
Co-60	1.82E+04	1.08E+01	1.68E+00 *	1.00E+01	1.82E+00
Co-58	8.96E+03	2.70E+01	3.32E-01 *	1.00E+01	8.96E-01
Cs-137	3.26E+03	1.62E+01	2.01E-01 *	1.00E+00	3.26E+00
Ni-63	7.60E+04	8.10E+02	9.39E-02 *	1.00E+02	7.60E-01
Sb-125	2.14E+03	2.70E+01	7.92E-02 *	1.00E+01	2.14E-01
Pu-241	1.02E+02	1.62E+00	6.29E-02 *	1.00E+00	1.02E-01
Am-241	1.31E+00	2.70E-02	4.84E-02 *	1.00E-02	1.31E-01
Mn-54	1.25E+03	2.70E+01	4.63E-02 *	1.00E+01	1.25E-01
Pu-238	7.14E-01	2.70E-02	2.65E-02	1.00E-02	7.14E-02
Pu-239	4.75E-01	2.70E-02	1.76E-02	1.00E-02	4.75E-02
Cm-243	4.59E-01	2.70E-02	1.70E-02	1.00E-02	4.59E-02
Sb-124	1.33E+02	1.62E+01	8.22E-03	1.00E+01	1.33E-02
Sr-90	4.75E+01	8.10E+00	5.87E-03	1.00E-01	4.75E-01
Fe-55	5.70E+03	1.08E+03	5.28E-03	1.00E+02	5.70E-02
Co-57	6.37E+02	2.70E+02	2.36E-03	1.00E+02	6.37E-03
Zn-65	8.73E+01	5.40E+01	1.62E-03	1.00E+01	8.73E-03
Sn-113	4.53E+01	5.40E+01	8.39E-04	1.00E+01	4.53E-03
Sr-89	1.23E+01	1.62E+01	7.56E-04	1.00E+01	1.23E-03
C-14	4.46E+01	8.10E+01	5.50E-04	1.00E+01	4.46E-03
Cm-242	7.80E-02	2.70E-01	2.89E-04	1.00E+00	7.80E-05
Ce-144	1.04E+00	5.40E+00	1.93E-04	1.00E+00	1.04E-03
H-3	1.25E+02	1.08E+03	1.16E-04	1.00E+02	1.25E-03
Tc-99	5.90E-01	2.43E+01	2.43E-05	1.00E+01	5.90E-05
Ni-59	1.03E+03	No A2	0.00E+00	1.00E+02	1.03E-02
TOTALs	**1.18E+05**		**2.63E+00**		**8.05E+00**

* Nuclides included in 95% of the hazard fraction as per 49 CFR 173.433(g)

10 CFR Part 37 Shipment

Category 1 & 2 Radioactive Materials

WMG Suite 9.3.0

Printed On: 05/29/2019 During Shipment

Manifest Number: 19-037

Activity Decayed To: 05/30/2019

			Category 2		Category 1	
Nuclide	**Activity (Ci)**	**Activity (TBq)**	**Threshold Limit (TBq)**	**% of Limit**	**Threshold Limit (TBq)**	**% of Limit**
Co-60	1.82E+01	6.73E-01	3.00E-01	224.25%	3.00E+01	2.24%
Sr-90	4.75E-02	1.76E-03	1.00E+01	0.02%	1.00E+03	0.00%
Cs-137	3.26E+00	1.21E-01	1.00E+00	12.05%	1.00E+02	0.12%
Pu-238	7.14E-04	2.64E-05	6.00E-01	0.00%	6.00E+01	0.00%
Am-241	1.31E-03	4.84E-05	6.00E-01	0.01%	6.00E+01	0.00%
TOTALS:	**1.18E+02**	**4.36E+00**		**236.33%**		**2.36%**

WMG Suite 9.3.0

* Waste

NRC and DOT Regulations Messages for Package

Printed On: 05/29/2019 During Shipment Shipment Date: 05/30/2019

Package ID: 638712-1 Shipment Number: 19-037

NRC:

Long lived nuclide content exceeds 1 uCi/cc.

Part 37 Category 2 Package

DOT:

>A LSA-II

RQ - Radionuclides

Package is Fissile Excepted.

Grams of U-233 = 0.00E+00

Grams of U-235 = 0.00E+00

Grams of Pu-239 = 7.65E-03

Grams of Pu-241 = 9.93E-04

A1 Fraction = 2.26E+00

3 Meter Dose = 8.14E+02 (*)

* Indicates User Override

WMG Suite 9.3.0 Report Date: 05/29/2019 * Waste During Shipment

10 CFR Part 61 Documentation

Classification Documentation Record		Waste Volume:	100 ft³
Package ID:	638712-1		2.83E+06 cc
Waste Description:	2019 Primary Resin sample	Waste Weight:	4,500.0 lbs
Container Type:	L8-120 FR		2.04E+06 gms

Nuclide	Activity	Specific Activity	Class A		Class B	
			Limits	% of Limits	Limits	% of Limits
Table 1	mCi	uCi / cc	uCi / cc		uCi / cc	
C-14	4.46E+01	1.57E-02	8.00E-01	1.968%		
Ni-59	1.03E+03	3.62E-01	2.20E+01 *	1.647%		
Nb-94	0.00E+00	0.00E+00	2.00E-02 *	0.000%		
Tc-99	5.90E-01	2.08E-04	3.00E-01	0.069%		
I-129	0.00E+00	0.00E+00	8.00E-03	0.000%		
Ra-226	0.00E+00	0.00E+00	1.00E+01	0.000%		
Subtotal				3.68%		
Transuranics	mCi	nCi / gm	nCi / gm		nCi / gm	
Pu-241	1.02E+02	4.99E+01	3.50E+02	14.265%		
Cm-242	7.80E-02	3.82E-02	2.00E+03	0.002%		
TRUs	2.96E+00	1.45E+00	1.00E+01	14.482%		
Subtotal				28.75%		
Table 1 Total				32.43%		
Table 2 < 5 yr	mCi	uCi / cc	uCi / cc		uCi / cc	
Mn-54	1.25E+03	4.41E-01	7.00E+02	0.063%		
Fe-55	5.70E+03	2.01E+00	7.00E+02	0.287%		
Co-57	6.37E+02	2.25E-01	7.00E+02	0.032%		
Co-58	8.96E+03	3.16E+00	7.00E+02	0.452%		
Zn-65	8.73E+01	3.08E-02	7.00E+02	0.004%		
Sr-89	1.23E+01	4.33E-03	7.00E+02	0.001%		
Sn-113	4.53E+01	1.60E-02	7.00E+02	0.002%		
Sb-124	1.33E+02	4.70E-02	7.00E+02	0.007%		
Sb-125	2.14E+03	7.55E-01	7.00E+02	0.108%		
Ce-144	1.04E+00	3.67E-04	7.00E+02	0.000%		
Subtotal				0.96%		
Table 2 > 5 yr	mCi	uCi / cc	uCi / cc		uCi / cc	
H-3	1.25E+02	4.41E-02	4.00E+01	0.110%	N/A	0.000%
Co-60	1.82E+04	6.42E+00	7.00E+02	0.917%	N/A	0.000%
Ni-63	7.60E+04	2.69E+01	3.50E+00	767.155%	7.00E+01	38.358%
Sr-90	4.75E+01	1.68E-02	4.00E-02	41.952%	1.50E+02	0.011%

* - Metal Limits

WMG Suite 9.3.0 Report Date: 05/29/2019 * Waste

During Shipment

10 CFR Part 61 Documentation

Table 2 > 5 yr	mCi	uCi / cc	uCi / cc		uCi / cc	
Cs-137	3.26E+03	1.15E+00	1.00E+00	115.035%	4.40E+01	2.614%
Subtotal				925.17%		40.98%
Table 2 Totals:				926.13%		40.98%

* - Metal Limits

WMG Suite 9.3.0

During Distribution Creation

Nuclide Distribution Report

Report Date: 05/24/2019 Revision Date: 05/24/2019

Distribution:	2019 Primary Resin sample	Distribution Date:	04/18/2019
Chemical Form:	Metal Oxides	Physical Form:	Solid
Derivation:	Single	Activity Units:	uCi/gm
Sample ID:	19-04-18 Resin	Sample Date:	04/18/2019
H3 Override:	N/A	Notes:	

Nuclide Distribution

Nuclide Name	Activity	Abundance	Nuclide Type	Base Nuclide	Scaling Factor
H-3	3.810E-02	0.11%	FP	Cs-137	3.83E-02
C-14	1.360E-02	0.04%	AP	Co-60	2.45E-03
Mn-54	3.820E-01	1.06%	AP	Co-60	6.88E-02
Fe-55	1.740E+00	4.84%	AP	Co-60	3.14E-01
Co-57	1.950E-01	0.54%	AP	Co-60	3.51E-02
Co-58	2.760E+00	7.67%	AP	Co-60	4.97E-01
Co-60	5.550E+00	15.43%	AP	N/A	N/A
Ni-59	3.130E-01	0.87%	AP	Co-60	5.64E-02
Ni-63	2.320E+01	64.50%	AP	Co-60	4.18E+00
Zn-65	2.670E-02	0.07%	AP	Co-60	4.81E-03
Sr-89	3.790E-03	0.01%	FP	Cs-137	3.81E-03
Sr-90	1.450E-02	0.04%	FP	Cs-137	1.46E-02
Tc-99	1.800E-04	0.00%	FP	Cs-137	1.81E-04
Sn-113	1.390E-02	0.04%	AP	Co-60	2.50E-03
Sb-124	4.110E-02	0.11%	AP	Co-60	7.41E-03
Sb-125	6.530E-01	1.82%	FP	Cs-137	6.57E-01
I-129	5.070E-05	<LLD>	FP	Cs-137	5.10E-05
Cs-137	9.940E-01	2.76%	FP	N/A	N/A
Ce-144	3.180E-04	0.00%	FP	N/A	N/A
Pu-238	2.180E-04	0.00%	TR	Ce-144	6.86E-01
Pu-239	1.450E-04	0.00%	TR	Ce-144	4.56E-01
Pu-241	3.110E-02	0.09%	TR	Ce-144	9.78E+01
Am-241	3.990E-04	0.00%	TR	Ce-144	1.25E+00
Cm-242	2.390E-05	0.00%	TR	Ce-144	7.52E-02
Cm-243	1.400E-04	0.00%	TR	Ce-144	4.40E-01

WMG Suite 9.3.0
Report Date: 05/24/2019
Revision Date: 05/24/2019

Sample Report

Sample ID:	19-04-18 Resin	Description:	Gross Dewatered
Sample Date:	04/18/2019	Waste Form:	Resin
Activity Units:	uCi/gm	Physical Form:	Solid
Vendor:	Teledyne Brown Engineering, In		

Sample Nuclides

Nuclide Name	Activity	LLD	Abundance	Scaling Nuclide	Scaling Factor
H-3	3.810E-02	False	0.11%	Cs-137	3.83E-02
C-14	1.360E-02	False	0.04%	Co-60	2.45E-03
Mn-54	3.820E-01	False	1.06%	Co-60	6.88E-02
Fe-55	1.740E+00	False	4.84%	Co-60	3.14E-01
Co-57	1.950E-01	False	0.54%	Co-60	3.51E-02
Co-58	2.760E+00	False	7.67%	Co-60	4.97E-01
Co-60	5.550E+00	False	15.43%	N/A	N/A
Ni-59	3.130E-01	False	0.87%	Co-60	5.64E-02
Ni-63	2.320E+01	False	64.50%	Co-60	4.18E+00
Zn-65	2.670E-02	False	0.07%	Co-60	4.81E-03
Sr-89	3.790E-03	False	0.01%	Cs-137	3.81E-03
Sr-90	1.450E-02	False	0.04%	Cs-137	1.46E-02
Tc-99	1.800E-04	False	0.00%	Cs-137	1.81E-04
Sn-113	1.390E-02	False	0.04%	Co-60	2.50E-03
Sb-124	4.110E-02	False	0.11%	Co-60	7.41E-03
Sb-125	6.530E-01	False	1.82%	Cs-137	6.57E-01
I-129	5.070E-05	True	<LLD>	Cs-137	5.10E-05
Cs-137	9.940E-01	False	2.76%	N/A	N/A
Ce-144	3.180E-04	False	0.00%	N/A	N/A
Pu-238	2.180E-04	False	0.00%	Ce-144	6.86E-01
Pu-239	1.450E-04	False	0.00%	Ce-144	4.56E-01
Pu-241	3.110E-02	False	0.09%	Ce-144	9.78E+01
Am-241	3.990E-04	False	0.00%	Ce-144	1.25E+00
Cm-242	2.390E-05	False	0.00%	Ce-144	7.52E-02
Cm-243	1.400E-04	False	0.00%	Ce-144	4.40E-01

TELEDYNE BROWN ENGINEERING, INC.
A Teledyne Technologies Company

Report of Analysis

05/23/19 16:07

L82198

Point Beach Nuclear Plant

NE001-3P61PB-11

Sample ID: RESIN
Station:
Description:
LIMS Number: L82198-1

Collect Start: 04/18/2019 00:00
Collect Stop:
Receive Date: 04/26/2019

Matrix: Resins
Volume:
% Moisture:

(RS)

Radionuclide	SOP#	Activity Conc	Uncertainty 2 Sigma	MDC	Units	Run #	Aliquot Volume	Aliquot Units	Reference Date	Count Date	Count Time	Count Units	Flag Values	
C-14	2002	1.36E-02	1.32E-04		uCi/g		.1841	g wet		05/10/19	30	M	+	
CE-144 (RAD)	2004	3.18E-04	9.95E-05		uCi/G		.2651	g wet	04/18/19 00:00	05/20/19	3600	Sec	+	Yes
FE-55	2006	1.74E+00	5.08E-02		uCi/g		.1325	g wet	04/18/19 00:00	05/21/19	300	Sec	+	Yes
H-3	2010	3.81E-02	7.53E-04		uCi/g		.0736	g wet		05/11/19	5	M	+	
I-129	2012	<		5.07E-05	uCi/g		.3681	g wet	04/18/19 00:00	05/10/19	669	Sec	U	No
NI-59	2013	3.13E-01	5.33E-03		uCi/g		.2651	g wet	04/18/19 00:00	05/16/19	1205	Sec	+	Yes
NI-63	2013	2.32E+01	8.34E-03		uCi/g		.2651	g wet		05/17/19	5	M	+	
SR-89	2018	3.79E-03	1.31E-04		uCi/g		.2651	g wet	04/18/19 00:00	05/15/19	15	M	+	
SR-90	2018	1.45E-02	1.64E-04		uCi/g		.2651	g wet	04/18/19 00:00	05/15/19	15	M	+	
TC-99	2021	1.80E-04	4.15E-05		uCi/g		.0265	g wet		05/11/19	30	M	+	
BE-7	2007	<		6.87E-02	UCI/G		4.5006	g wet	04/18/19 00:00	05/06/19	3600	Sec	U	No
K-40	2007	<		2.14E-02	UCI/G		4.5006	g wet	04/18/19 00:00	05/06/19	3600	Sec	U	No
CR-51	2007	<		7.23E-02	UCI/G		4.5006	g wet	04/18/19 00:00	05/06/19	3600	Sec	U	No
MN-54	2007	3.82E-01	9.31E-03		UCI/G		4.5006	g wet	04/18/19 00:00	05/06/19	3600	Sec	+	Yes
CO-57	2007	1.95E-01	3.96E-03		UCI/G		4.5006	g wet	04/18/19 00:00	05/06/19	3600	Sec	+	Yes
CO-58	2007	2.76E+00	1.85E-02		UCI/G		4.5006	g wet	04/18/19 00:00	05/06/19	3600	Sec	+	Yes
FE-59	2007	<		1.16E-02	UCI/G		4.5006	g wet	04/18/19 00:00	05/06/19	3600	Sec	U	No
CO-60	2007	5.55E+00	1.68E-02		UCI/G		4.5006	g wet	04/18/19 00:00	05/06/19	3600	Sec	+	Yes
ZN-65	2007	2.67E-02	1.48E-02		UCI/G		4.5006	g wet	04/18/19 00:00	05/06/19	3600	Sec	+	Yes
NB-94	2007	<		6.55E-03	UCI/G		4.5006	g wet	04/18/19 00:00	05/06/19	3600	Sec	U	No
NB-95	2007	<		8.56E-03	UCI/G		4.5006	g wet	04/18/19 00:00	05/06/19	3600	Sec	U	No
ZR-95	2007	<		1.55E-02	UCI/G		4.5006	g wet	04/18/19 00:00	05/06/19	3600	Sec	U	No
MO-99	2007	<		3.16E-01	UCI/G		4.5006	g wet	04/18/19 00:00	05/06/19	3600	Sec	U	No
RU-103	2007	<		8.90E-03	UCI/G		4.5006	g wet	04/18/19 00:00	05/06/19	3600	Sec	U	No
RU-106	2007	<		7.08E-02	UCI/G		4.5006	g wet	04/18/19 00:00	05/06/19	3600	Sec	U	No
AG-110M	2007	<		1.30E-02	UCI/G		4.5006	g wet	04/18/19 00:00	05/06/19	3600	Sec	U*	No

Flag Values
U = Compound/Analyte not detected (< MDC) or less than 3 sigma
\+ = Activity concentration exceeds MDC and 3 sigma; peak identified(gamma only)
U* = Compound/Analyte not detected. Peak not identified, but forced activity concentration exceeds MDC and 3 sigma
High = Activity concentration exceeds customer reporting value
Spec = MDC exceeds customer technical specification
L = Low recovery
H = High recovery

Bolded text indicates reportable value.

No = Peak not identified in gamma spectrum
Yes = Peak identified in gamma spectrum

**** Unless otherwise noted, the analytical results reported are related only to the samples tested in the condition they are received by the laboratory.

MDC - Minimum Detectable Concentration

TBE-ROA002

TELEDYNE BROWN ENGINEERING, INC.
A Teledyne Technologies Company

Report of Analysis

05/23/19 16:07

L82198

Point Beach Nuclear Plant

Gene LeClair

NE001-3P61PB-11

Sample ID: RESIN
Station:
Description:
LIMS Number: L82198-1

Collect Start: 04/18/2019 00:00
Collect Stop:
Receive Date: 04/26/2019

Matrix: Resins
Volume:
% Moisture:

(RS)

Radionuclide	SOP#	Activity Conc	Uncertainty 2 Sigma	MDC	Units	Run #	Aliquot Volume	Aliquot Units	Reference Date	Count Date	Count Time	Count Units	Flag Values	
SN-113	2007	1.39E-02	6.09E-03		UCI/G		4.5006	g wet	04/18/19 00:00	05/06/19	3600	Sec	+	Yes
SB-124	2007	4.11E-02	5.36E-03		UCI/G		4.5006	g wet	04/18/19 00:00	05/06/19	3600	Sec	+	Yes
SB-125	2007	6.53E-01	1.40E-02		UCI/G		4.5006	g wet	04/18/19 00:00	05/06/19	3600	Sec	+	Yes
I-131	2007	<		2.85E-02	UCI/G		4.5006	g wet	04/18/19 00:00	05/06/19	3600	Sec	U	No
CS-134	2007	<		8.86E-03	UCI/G		4.5006	g wet	04/18/19 00:00	05/06/19	3600	Sec	U	No
CS-137	2007	9.94E-01	9.69E-03		UCI/G		4.5006	g wet	04/18/19 00:00	05/06/19	3600	Sec	+	Yes
BA-140	2007	<		6.43E-02	UCI/G		4.5006	g wet	04/18/19 00:00	05/06/19	3600	Sec	U	No
LA-140	2007	<		5.31E-03	UCI/G		4.5006	g wet	04/18/19 00:00	05/06/19	3600	Sec	U	No
CE-141	2007	<		8.33E-03	UCI/G		4.5006	g wet	04/18/19 00:00	05/06/19	3600	Sec	U	No
CE-144	2007	<		2.63E-02	UCI/G		4.5006	g wet	04/18/19 00:00	05/06/19	3600	Sec	U	No
EU-154	2007	<		1.06E-02	UCI/G		4.5006	g wet	04/18/19 00:00	05/06/19	3600	Sec	U	No
HF-181	2007	<		9.12E-03	UCI/G		4.5006	g wet	04/18/19 00:00	05/06/19	3600	Sec	U	No
RA-226	2007	<		9.33E-02	UCI/G		4.5006	g wet	04/18/19 00:00	05/06/19	3600	Sec	U	No
TH-232	2007	<		3.44E-02	UCI/G		4.5006	g wet	04/18/19 00:00	05/06/19	3600	Sec	U	No
AM-241 (AS)	2001	3.99E-04	3.75E-05		uCi/g		.1325	g wet		05/09/19	60003	sec	+	
CM-242 (AS)	2001	2.39E-05	2.83E-06		uCi/g		.1325	g		05/09/19	60003	sec	+	
CM-243,244 (AS)	2001	1.40E-04	1.36E-05		uCi/g		.1325	g		05/09/19	60003	sec	+	
PU-238 (AS)	2001	2.18E-04	4.21E-05		uCi/g		.1325	g wet		05/09/19	60002	sec	+	
PU-239/240 (AS)	2001	1.45E-04	2.82E-05		uCi/g		.1325	g wet		05/09/19	60002	sec	+	
PU-241	2001	3.11E-02	4.11E-04		uCi/g		.1325	g wet		05/10/19	30	M	+	

Flag Values
U = Compound/Analyte not detected (< MDC) or less than 3 sigma
\+ = Activity concentration exceeds MDC and 3 sigma; peak identified(gamma only)
U* = Compound/Analyte not detected. Peak not identified, but forced activity concentration exceeds MDC and 3 sigma
High = Activity concentration exceeds customer reporting value
Spec = MDC exceeds customer technical specification
L = Low recovery
H = High recovery

Bolded text indicates reportable value.

No = Peak not identified in gamma spectrum
Yes = Peak identified in gamma spectrum

**** Unless otherwise noted, the analytical results reported are related only to the samples tested in the condition they are received by the laboratory.

MDC - Minimum Detectable Concentration

10 CFR Part 37

Category 1 & 2 Radioactive Materials

WMG Suite 9.3.0

Printed On: 05/29/2019 During Package Characterization

Package ID: 638712-1

Waste Description: 2019 Primary Resin sample

Container Type: L8-120 FR

Activity Decayed To: 05/29/2019

			Category 2		Category 1	
Nuclide	**Activity (Ci)**	**Activity (TBq)**	**Threshold Limit (TBq)**	**% of Limit**	**Threshold Limit (TBq)**	**% of Limit**
Co-60	1.82E+01	6.73E-01	3.00E-01	224.33%	3.00E+01	2.24%
Sr-90	4.75E-02	1.76E-03	1.00E+01	0.02%	1.00E+03	0.00%
Cs-137	3.26E+00	1.21E-01	1.00E+00	12.05%	1.00E+02	0.12%
Pu-238	7.14E-04	2.64E-05	6.00E-01	0.00%	6.00E+01	0.00%
Am-241	1.31E-03	4.84E-05	6.00E-01	0.01%	6.00E+01	0.00%
TOTALS:	**1.18E+02**	**4.36E+00**		**236.41%**		**2.36%**

Package Characterization Report

Waste

WMG Suite 9.3.0

Printed On: 05/29/2019 During Package Characterization

Activity Decayed To: 05/29/2019

Method Used: GrossGamma

Signature:

Date: 5-29-19

Date:	05/29/2019	**Liner Serial No:**	638742-1
Package ID:	638712-1	**Container Type:**	L8-120 FR
Waste Class:	B	**DOT Package Class:**	>A LSA-II
Description:	2019 Primary Resin sample	**Chelating Agent:**	N P
Chemical Form:	Metal Oxides	**Weight % Chelating:**	N P
Physical Form	Solid	**Package Volume (ft³):**	125.2
Waste Volume (ft³):	100	**Package Weight (lbs):**	5,750.0
Waste Weight (lbs):	4,500.0	**3 Meter Dose (mR/hr):**	814
Dose / Curie Factor:	4.3736E+01	**Material Height (in):**	64.912

Contact Rad Level (mR/hr): 14,400 **1 Meter Rad Level (mR/hr):** 4,400 **Survey Date:** 05/29/2019

This Package Contains a Part 37 Category 2 Quantity

This Package Contains Reportable Quantities Of Radionuclides

Package Activity By Nuclide

Nuclide	(mCi)	Nuclide	(mCi)	Nuclide	(mCi)
H-3	1.25E+02	C-14	4.46E+01	Mn-54	1.25E+03
Fe-55	5.70E+03	Co-57	6.39E+02	Co-58	9.05E+03
Co-60	1.82E+04	Ni-59	1.03E+03	Ni-63	7.60E+04
Zn-65	8.75E+01	Sr-89	1.24E+01	Sr-90	4.75E+01
Tc-99	5.90E-01	Sn-113	4.56E+01	Sb-124	1.35E+02
Sb-125	2.14E+03	I-129 <LLD>	1.66E-01	Cs-137	3.26E+03
Ce-144	1.04E+00	Pu-238	7.14E-01	Pu-239	4.75E-01
Pu-241	1.02E+02	Am-241	1.31E+00	Cm-242	7.83E-02
Cm-243	4.59E-01				

* - Indicates Entered Value # - Indicates Override LLD's Not Included TOTAL: 1.18E+05

Part 61 Information

Sample ID:	19-04-18 Resin
Sample Date:	04/18/2019
Activity Units:	uCi/gm
Analysis Vendor:	Teledyne Brown Engineering, In

Entered Dose Rates in mR/hr:

3,200	3,000	2,000	2,300	2,800	2,200
3,250	2,000	3,100	4,400	1,400	

Characterization Distance (in): 39.37 **AVERAGE: 2,695.45**

VSDS Standard Map Survey Report

Outgoing Cask and Truck	Survey #: PBPROD-M-20190529-11	Date/Time: 5/29/2019 17:32

Outgoing - Cask and Truck

Package Appears Stong Tight: yes

Consignor: energy solutions bco

Sealed / Seal #: yes
Primary Seal #pbnp 1386 | Upper Impact Limiter: #0571895
Secondary Seal #822422 | Lower Impact limiter #001808

Tractor #: 4004 Trailer #: CKb170084

Cask Secured to prevent movement: yes

Cask #: 8-120B-7 NRC #: USA/9168/B(U)-96

Placarded: yes

Shipment #: 19-037

CASK List Marking / Labeling: Yellow III TI=5.0
Orange Panels 3321
2 Placards on Cask

Truck Trailor & Cask Inspection:

Tires/Rims SAT	Wipers SAT	Placards SAT	Headlights SAT	Brake/Tail Lights SAT
Mirrors SAT	Horn SAT		Turn Signals SAT	General Apperance SAT

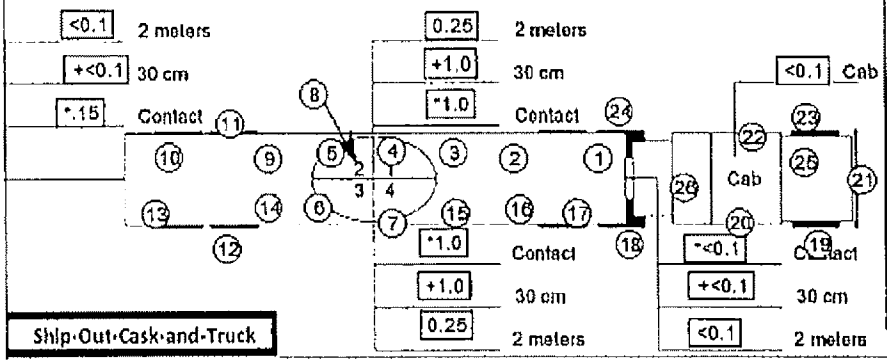
Inspection Performed By: Jim meyer

Inspection DATE: 5/30/19

Gross Weight: 68300 Lbs

Truck Top: *14 Contact 5 1 Meter

Truck Bottom: *1 Contact NA 1 Meter



Readings On Cask mR/hr

	Contact	1 Meter
1	*2.4	0.8
2	*2.2	0.8
3	*2.3	.9
4	*2.7	0.8
Top	*14	5

Postings

Lead Surveyor: Meyer James

Instrument Serial #'s:

Date	Survey #	Surveyed By

β/γ Contamination Results

1)	<MDA DPM/100 cm2	25)	<MDA DPM/100 cm2
2)	<MDA DPM/100 cm2	26)	<MDA DPM/100 cm2
3)	<MDA DPM/100 cm2		
4)	<MDA DPM/100 cm2		
5)	<MDA DPM/100 cm2		
6)	<BKG DPM/100 cm2		
7)	<MDA DPM/100 cm2		
8)	<MDA DPM/100 cm2		
9)	<MDA DPM/100 cm2		
10)	<MDA DPM/100 cm2		
11)	<MDA DPM/100 cm2		
12)	<MDA DPM/100 cm2		
13)	<MDA DPM/100 cm2		
14)	<MDA DPM/100 cm2		
15)	<MDA DPM/100 cm2		
16)	<MDA DPM/100 cm2		
17)	<MDA DPM/100 cm2		
18)	<MDA DPM/100 cm2		
19)	<MDA DPM/100 cm2		
20)	<MDA DPM/100 cm2		
21)	<MDA DPM/100 cm2		
22)	<MDA DPM/100 cm2		
23)	<MDA DPM/100 cm2		
24)	<MDA DPM/100 cm2		

Alpha (Y/N): n

Survey #: PBPROD-M-20190529-11 - Printed On: 5/30/2019 09:37

Image File: Ship-Out-Cask-and-Truck

VSDS Standard Map Survey Report

Outgoing Cask and Truck	Survey #: PBPROD-M-20190529-11	Date/Time: 5/29/2019 17:32

Outgoing - Cask and Truck

Consignor: energy solutions bco

Tractor #: 4004 Trailer #: CKb170084

Cask #: 8-120B-7 NRC #: USA/9168/B(U)-96

Shipment #: 19-037

Package Appears Stong Tight: yes

Sealed / Seal #: yes — Primary Seal #pbnp 1385 — Upper Impact Limiter: #0571895 — Secondary Seal #822422 — Lower Impact limiter #001908

Cask Secured to prevent movement: yes

Placarded: yes

CASK List Marking / Labeling: Yellow III TI=5.0 — Orange Panels 3321 — 2 Placards on Cask

Truck Trailor & Cask Inspection:

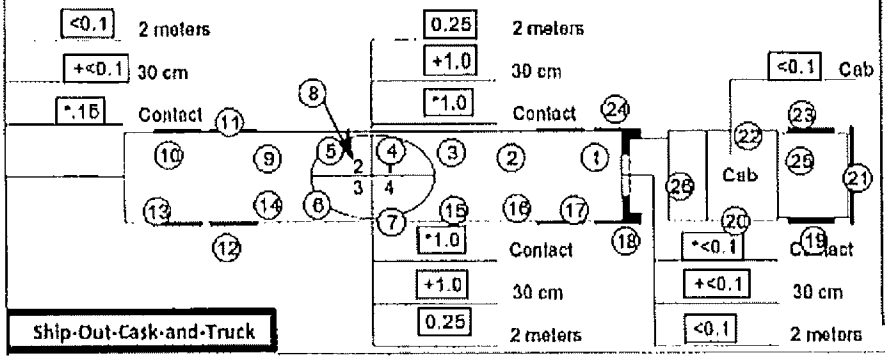
Tires/Rims SAT | Wipers SAT | Placards SAT | Headlights SAT | Brake/Tail Lights SAT | Mirrors SAT | Horn SAT | Turn Signals SAT | General Apperance SAT

Inspection Performed By: Jim meyer / Inspection DATE: 5/30/19

Gross Weight: 68300 Lbs

Truck Top: *14 Contact 6 1 Meter

Truck Bottom: *1 Contact NA 1 Meter



Readings On Cask mR/hr

	Contact	1 Meter
1	*2.4	0.8
2	*2.2	0.8
3	*2.3	.9
4	*2.7	0.8
Top	*14	5

Comments: beta mda 171.6 dpm

alpha mda 19.4 dpm

Summary of Highest Readings
(All available values may not be listed)

Smears	Air Samples & Wipes
26) <MDA DPM/100 cm2 β/γ	
26) <MDA DPM/100 cm2 α	

Type: Shipping

Symbol Legend (for example only)

Dose Rate: *150 Contact Reading; + 76 30 cm Reading; 20 General Area

HS-50 Hot Spot; RCA Posting; Dip Bag

(15) Smear; 15 Air Sample; RM; Wipe

RWP #: 19-0010 task 4
Short Name: outgoing cask

Unless otherwise noted, dose rates in mrem/hr.

Lead Surveyor: Meyer James

Status: Approved by: LeClair Gene, 6/20/2019 06:17:31

Location Code: Rad-Waste-Shipments

Bldg/Area Name: Outgoing Shipment

Location Description: Outgoing Cask and Truck

Alpha (Y/N): n

Image File: Ship-Out-Cask-and-Truck

VSDS Standard Map Survey Report

Outgoing Liner	Survey #: PBPROD-M-20190529-10	Date/Time: 5/29/2019 16:48

Outgoing Liner

Highest 1 Meter Dose rate	4400
3 Meter Dose rate	1400
Avg. 1 Meter dose Rate	178.33

Liner Type:	LB120 BTFR
Liner Serial #	638712-1
Liner Size:	8 -120
Type processing performed:	gross Dewatered

Top

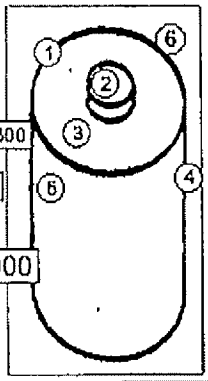
3 Meter Dose rate	863
1 Meter Dose rate	3250
Contact Dose Rate	*12200

Side

Contact Dose Rate	*14400	*1160	*9600
1 Meter Dose rate	3200	3000	2000
3 Meter Dose rate	1200	1300	1000

Side

Contact Dose Rate	*8700	*7500	*8500
1 Meter Dose rate	2300	2800	2200
3 Meter Dose rate	1200	1300	1400



LINER	Date	RP Int
Package Inspected prior to use	8/29/17	jm
Liner Filled	2/11/19	jm
Liner Processed	5/23/19	jm
Lid Gasket Installed & in good condition	5/23/19	ds
Lid Installed	5/23/19	DS
Liner Weight in lbs.	6750 Lbs	jm
Liner marked for shipment	5/30/19	jm
Markings applied	na	na
Package Inspected:		jm

Bottom

Contact Dose Rate	*6000
1 Meter Dose Rate	2000
3 Meter Dose Rate	600

side

	contact	1 meter	3 meters
top	*10000	3100	650
middle	*6300	4400	800
bottom	*8800	1400	700

side

contact
*14000
*10000
*10000

Ship-Out-Liner

Postings	β/γ Contamination Results
	1) <MDA DPM/100 cm2
	2) <MDA DPM/100 cm2
	3) <MDA DPM/100 cm2
	4) <MDA DPM/100 cm2
	5) <MDA DPM/100 cm2
	6) <MDA DPM/100 cm2

Lead Surveyor: Meyer James

Instrument Serial #'s:

Date	Survey #	Surveyed By

Alpha (Y/N): n

Survey #: PBPROD-M-20190529-10 - Printed On: 5/30/2019 09:38

Image File: Ship-Out-Liner

VSDS Standard Map Survey Report

Outgoing Liner	Survey #: PBPROD-M-20190529-10	Date/Time: 5/29/2019 16:48

Outgoing Liner

Contact / 1 Meter

Highest 1 Meter Dose rate	250
3 Meter Dose rate	N/A
Avg. 1 Meter dose Rate	178.33

Liner Type:	
Liner Serial #	038712-1
Liner Size:	
Type processing performed:	gross Dewatered

Top

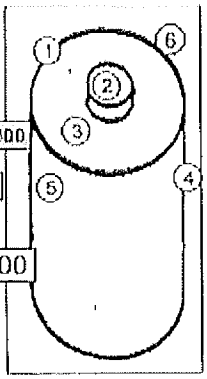
3 Meter Dose rate	863
1 Meter Dose rate	3250
Contact Dose Rate	*12200

Side

Contact Dose Rate	*14400	*1100	*8600
1 Meter Dose rate	3200	3000	2000
3 Meter Dose rate	1200	1300	1000

Side

Contact Dose Rate	*8700	*7600	*8500
1 Meter Dose rate	2300	2800	2200
3 Meter Dose rate	1200	1300	1400



LINER	Date	RP Int
Package Inspected prior to use	2/1/17	jm
Liner Filled	4/20/18	jm
Liner Processed	5/5/18	jm
Lid Gasket Installed & In good condition	5/9/18	jm
Lid Installed	5/9/18	DS
Liner Weight in lbs.	10025 Lbs	jm
Liner marked for shipment	Yes	jm
Markings applied	Class AU	jm
Package Inspected:		jm

Bottom

Contact Dose Rate	*6000
1 Meter Dose Rate	2000
3 Meter Dose Rate	600

side

	contact	1 meter	3 meters
top	*10000	3100	650
middle	*6300	1400	800
bottom	*8800	1400	700

side

contact	
	*14000
	*10000
	*10000

Ship-Out-Liner

Comments: beta mda 171.3 dpm
alpha mda 19.5 dpm

Summary of Highest Readings
(All available values may not be listed)

Smears	Air Samples & Wipes
6) <MDA DPM/100 cm2 β/γ	
6) <MDA DPM/100 cm2 α	

Type: Shipping

Symbol Legend (for example only) RWP #: 18-0010

Dose Rate
*100 Contact Reading
+ 76 30 cm Reading
20 General Area
HS-50 Hot Spot
RCA Posting
Drip Bag
15 Smear 15 Air Sample RM 15 Wipe

Unless otherwise noted, dose rates in mrem/hr.

Lead Surveyor: Meyer James	Status: In Process
Location Code: Rad-Waste-Shipments	Bldg/Area Name: Outgoing Shipment
Location Description: Outgoing Liner	

WMG Suite 9.3.0

During Package Characterization

* Waste

1R @ 3 Meters Calculation Summary for 638712-1

49 CFR 173.427(a1)

Packaging Requirement for LSA

3 Meter: **8.14E+02 mR/hr**

2A1 Frac: **1.131**

Package Summary Information:

Date:	05/29/2019	Waste Weight (lbs):	4,500.0
Container Type:	L8-120 FR	Waste Volume (ft³):	100

Source Summary Information:

Geometry:	Cylinder	Density (g/cm³):	0.721
Height (in):	64.912	Material [1]:	Water
Radius (in):	30.5		

Nuclide Values

Nuclide	Activity-mCi	A1 Fraction	Nuclide	Activity-mCi	A1 Fraction	Nuclide	Activity-mCi	A1 Fraction
H-3	1.25E+02	0.000	C-14	4.46E+01	0.000	Mn-54	1.25E+03	0.046
Fe-55	5.70E+03	0.005	Co-57	6.39E+02	0.002	Co-58	9.05E+03	0.335
Co-60	1.82E+04	1.684	Ni-59	1.03E+03	No A1	Ni-63	7.60E+04	0.070
Zn-65	8.75E+01	0.002	Sr-89	1.24E+01	0.001	Sr-90	4.75E+01	0.006
Tc-99	5.90E-01	0.000	Sn-113	4.56E+01	0.000	Sb-124	1.35E+02	0.008
Sb-125	2.14E+03	0.040	Cs-137 [2]	3.26E+03	0.060	Ce-144	1.04E+00	0.000
Pu-238	7.14E-01	0.000	Pu-239	4.75E-01	0.000	Pu-241	1.02E+02	0.000
Am-241	1.31E+00	0.000	Cm-242	7.83E-02	0.000	Cm-243	4.59E-01	0.000

Notes:

[1] Material Based on Waste Type - Uniform Manifest Note 2

[2] Cs-137 converted to Ba-137m by factor of 0.946 for 3-meter dose calculation.

Reference:

NUREG 1608

General Payload Calculation

Payload material =	Resin				
Payload weight =	4500	lbs	Payload density =	0.72	g/cm^3
Payload volume =	100	ft^3	Payload density < 9.0 g/cm^3?	Yes	
Special material 1 =					
Special material 1 weight =		g	Special material 1 density =		g/cm^3

Payload material calculation

		Gamma Energy (MeV) [Gamma fraction data is from Kocher Rad Decay Data Tables, DOE/TIC-11026]							
Nuclide	Activity (Ci)	0.50	0.70	0.90	1.17	1.50	1.83	2.25	2.75
Am-241	1.31E-03	Considered insignificant and not included in the sum-of-fractions					Beta or gamma <0.3MEV		
H-3	1.25E-01	Considered insignificant and not included in the sum-of-fractions					Beta or gamma <0.3MEV		
Mn-54	1.25E+00			1.00E+00					
Fe-55	5.70E+00	Considered insignificant and not included in the sum-of-fractions					Beta or gamma <0.3MEV		
Zn-65	8.75E-02				5.08E-01				
Tc-99	5.90E-04	Considered insignificant and not included in the sum-of-fractions					Beta or gamma <0.3MEV		
Sb-125	2.14E+00	4.21E-01	3.60E-01						
Pu-238	7.14E-04	Considered insignificant and not included in the sum-of-fractions					Beta or gamma <0.3MEV		
Cm-242	7.83E-05	Considered insignificant and not included in the sum-of-fractions					Beta or gamma <0.3MEV		
C-14	4.46E-02	Considered insignificant and not included in the sum-of-fractions					Beta or gamma <0.3MEV		
Co-57	6.39E-01		1.60E-03						
Ni-59	1.03E+00	Considered insignificant and not included in the sum-of-fractions					Beta or gamma <0.3MEV		
Sr-89	1.24E-02								
Sn-113	4.56E-02	Considered insignificant and not included in the sum-of-fractions					Beta or gamma <0.3MEV		
Ag-110m		3.75E-02	1.15E+00	1.24E+00	3.43E-01	2.84E-01	1.42E-01		
Pu-239	4.75E-04	Considered insignificant and not included in the sum-of-fractions					Beta or gamma <0.3MEV		
Cm-243	4.59E-04	Considered insignificant and not included in the sum-of-fractions					Beta or gamma <0.3MEV		
Co-58	9.05E+00			1.00E+00			5.40E-03		
Ni-63	7.60E+01	Considered insignificant and not included in the sum-of-fractions					Beta or gamma <0.3MEV		
Y-90									
Sr-90	4.75E-02								
Sb-124	1.35E-01	3.39E-03	1.05E+00	1.58E-01	3.78E-02	7.44E-02	4.96E-01	5.73E-02	
Ce-144	1.04E-03	Considered insignificant and not included in the sum-of-fractions					Beta or gamma <0.3MEV		
Pu-241	1.02E-01	Considered insignificant and not included in the sum-of-fractions					Beta or gamma <0.3MEV		
Co-60	1.82E+01	Resin							
Cs-137	3.26E+00	Resin							
I-129	1.66E-04	Considered insignificant and not included in the sum-of-fractions					Beta or gamma <0.3MEV		
Total	1.18E+02								

General Payload Calculation

Source (γ/sec)	3.33E+10	3.38E+10	3.82E+11	1.83E+09	3.71E+08	4.29E+09	2.86E+08	0.00E+00
Source Density (γ/sec-g)	1.63E+04	1.65E+04	1.87E+05	8.97E+02	1.82E+02	2.10E+03	1.40E+02	0.00E+00
Co-60 (γ/sec)	1.35E+12	Resin						
Co-60 (γ/sec-g)	6.59E+05	Resin						
Cs-137 (γ/sec)	1.03E+11	Resin						
Cs-137 (γ/sec-g)	5.02E+04	Resin						
Co-60 (γ/sec)								
Co-60 (γ/sec-g)								
Limits								
Source (γ/sec)	7.075E+12	2.131E+12	8.635E+11	2.142E+11	6.111E+10	3.040E+10	1.823E+10	1.285E+10
Source Density (γ/sec-g)	1.298E+09	1.887E+08	5.539E+07	1.640E+07	4.938E+06	2.061E+06	1.055E+06	6.515E+05
Co-60 (γ/sec)	1.393E+11							
Co-60 (γ/sec-g)	1.182E+07							
Cs-137 (γ/sec)	2.580E+12							
Cs-137 (γ/sec-g)	2.556E+08							
Fractions								
Source (γ/sec)	4.71E-03	1.58E-02	4.43E-01	8.55E-03	6.08E-03	1.41E-01	1.57E-02	0.00E+00
Source Density (γ/sec-g)	1.26E-05	8.76E-05	3.38E-03	5.47E-05	3.68E-05	1.02E-03	1.32E-04	0.00E+00
Co-60 (γ/sec)	9.67E+00	Resin						
Co-60 (γ/sec-g)	5.58E-02	Resin						
Cs-137 (γ/sec)	3.97E-02	Resin						
Cs-137 (γ/sec-g)	1.96E-04	Resin						
Co-60 (γ/sec)	0.00E+00	0						
Co-60 (γ/sec-g)	0.00E+00	0						
Minimum Fractions								
Source	1.26E-05	8.76E-05	3.38E-03	5.47E-05	3.68E-05	1.02E-03	1.32E-04	0.00E+00
Co-60	5.58E-02	Resin						
Cs-137	1.96E-04	Resin						
Co-60	0.00E+00	0						
Sum of fractions =	6.07E-02							
Is sum of fractions < 0.95?	Yes							

TYPE B CASK INSPECTION CHECKLIST
(Page 2 of 2)

AFTER CASK IS LOADED	Initials	
	Packager	Shipper
Shoring placed between secondary container(s) and cask cavity to minimize movement during normal conditions of transport. (N/A if container(s) fill cask cavity and excessive movement is unlikely.)	N/A	N/A
Cask lid(s) gasket / o-ring is properly installed and free of visible damage (N/A if lid security seal is intact).		
Cask lid(s) properly aligned and installed on the cask.		
Cask lid(s) lifting lug covers properly positioned and secured.		
Cask lid properly installed and tightened (lid hold down bolts, studs, nuts, ratchet binders, pins, etc). Torque Wrench # MCTC-02 Cal Due Date: 9-14-19 Primary lid torque value 500 ft-lbs Secondary lid torque value: 500 ft-lbs		
Security seal attached to the secondary cask lid.		
Security seal attached to the primary lid closure device. If a metal rain cover is provided, the rain cover tie down device can be sealed in place of the primary lid.		
Cask lid vent plug(s) and cask drain plug properly installed and security seal attached.		
Cask and cask tie down devices are free of visible exterior damage, properly positioned and securely tightened (chains, cables, base-plate, rain cover, tarp, etc).		
Cask rain tarp or metal rain cover (as appropriate) properly installed and securely fastened.		
The cask and contents meet the allowed weight requirements: Max Allowed Gross Weight: 12,250 lbs Actual Weight: 5760 lbs		
H2 Generation Calculation Performed and acceptable. (N/A if NOT required by the C of C.)	NA	N/A
The cask and contents meet the Certificate of Compliance decay heat requirements (N/A if not applicable): C of C Max Allowed Decay Heat: 200 Watts Actual Decay Heat: 0.341 Watts		
Cask leak test performed and is acceptable. (N/A if not applicable.)		
Cask is marked with the Certificate of Compliance Number. Cask is marked with serial number: USA/9168/B(U)		
Maximum allowed A fraction: 3000 Actual A fraction: 2.63 (N/A if not required by C of C)	N/A	
Package is marked and labeled with necessary communications as specified by Radwaste Supervision.		
External radiation and contamination levels are within the allowable limits specified in RP-AA-108-1003, Radioactive Material Surveys for Shipment.		

Certification: The entries on this checklist have been reviewed and the package is in compliance with the applicable Certificate of Compliance and is acceptable for shipment.

Packager: Jim Meyer _____ **Date:** 5-30-19
(Printed Name / Signature / Initials)

Shipper: Gene McClair _____ **Date:** 5/30/19
(Printed Name / Signature / Initials)

TYPE B CASK INSPECTION CHECKLIST
(Page 1 of 2)

Cask Model	8-120B
Cask Serial Number	8-120B-7

PRIOR TO CASK LOADING	Initials	
	Packager	Shipper
The Station is a registered user with the NRC under the current Corporate name.		
Personnel barrier exterior, closure system, and barrier to vehicle tie down devices free of visible damage (chains, cables, baseplate, etc.) (N/A if barrier not used).		
Cask exterior and cask tie down devices are free of visible exterior damage (chains, cables, base-plate, rain cover, tarp, etc)		
Cask closure system is free of visible damage (studs, nuts, ratchets, binders, pins, primary lid hold-down bolts, etc)		
Cask and lid lifting hardware is available and is free of visible damage.		
The cask is properly braced on the vehicle (as appropriate).		
Cask primary and secondary lid gaskets are properly installed, free of visible damage, and have been replaced per the Certificate of Compliance (N/A as appropriate). Primary lid gasket o-ring replacement due date: 9-6-19 Secondary lid gasket o-ring replacement due date: 9-6-19		
Cask interior is free of liquids and foreign objects such as resin, wood, metal paint chips, etc (Use of portable, hand-held bright light is required. If loaded underwater ensure this inspection is repeated after the cask is submerged).		
Pre-loading survey has been completed on cask interior.		
Container(s) being placed in cask have been surveyed and documented on applicable survey forms.		

EITHER BEFORE OR AFTER CASK IS LOADED	Initials	
	Packager	Shipper
Container(s) lids have been properly secured and tightened.		
Waste container(s) lids or tops marked with the waste class (AU, AS, B, or C) unless approved by the disposal site.	N/A	N/A
Waste container vent is free and clear from obstructions, if applicable.		
Contents are approved for shipment in accordance with the applicable Certificate of Compliance. (Check One) [X] Dewatered [ ] Solid [ ] Solidified [ ] Activated Solid [ ] Liquid [ ] Other Gross Activity		
Contents chemically compatible with waste containers.		
Container(s) identification numbers loaded into cask. Liner Number: 63312-1		
Drum pallet, liner or HIC lifting slings securely attached and secured for retrieval by the receiver. (N/A if grappable container without slings are used.)		

ENERGYSOLUTIONS TR-OP-035

Handling Procedure for Transport Cask Model 8-120B Certificate of Compliance Number 9168

Revision 29

Authored By: Thomas Bell — Digitally signed by Thomas Bell, DN: cn=Thomas Bell, o=Cask Logistics, ou, email=thbell@energysolutions.com, c=US, Date: 2019.01.08 14:28:31 -05'00'
Thomas Bell, Cask Supervisor - Logistics — Date

Reviewed By: Aleksandr Gelfond — Digitally signed by Aleksandr Gelfond, DN: cn=Aleksandr Gelfond, o=EnergySolutions, ou=BLF, email=axgelfond@energysolutions.com, c=US, Date: 2019.01.08 16:00:50 -05'00'
Aleksandr Gelfond, Cask Operations Licensing Manager — Date

Reviewed By: Richard Byars — Digitally signed by Richard Byars, DN: o=energysolutions, email=rbyars@energysolutions.com, cn=Richard Byars, Date: 2019.01.09 10:53:27 -05'00'
Richard Byars, QA Director, LP&S — Date

Approved By: Phillip H. Thomas — Digitally signed by Phillip H. Thomas, DN: cn=Phillip H. Thomas, o, ou=Cask Logistics, email=phthomas@energysolutions.com, c=US, Date: 2019.01.09 11:01:15 -05'00'
Phillip Thomas, BLF Director of Operations — Date

[X] Non-Proprietary	[ ] New
[ ] Proprietary	[ ] Title Change
[ ] Restricted Information	[X] Revision
[ ] Safeguards Information	[ ] Rewrite
[ ] Sensitivite Security Information	[ ] Cancellation

Effective Date Jan. 10, 2019

Table of Contents

1.0 SCOPE

1.1 Purpose

This procedure establishes instructions for routine handling, loading, and unloading of Energy*Solutions* Cask Model 8-120B.

1.2 Applicability

This procedure applies to all Energy*Solutions* Model 8-120B Casks operated under Certificate of Compliance Number 9168.

2.0 CASK DESCRIPTION

The packaging is a carbon steel-encased, lead shielded cask with a pair of cylindrical foam-filled impact limiter installed on the cask ends. The cask is a right circular cylinder with a nominal internal cavity size of 61 13/16-inch by 74 7/8-inch high. The walls of the cask contain a minimum lead thickness of 3.35 inches encased between a 0.75-inch thick inner steel shell and a 1-1/2-inch thick outer steel shell. The exposed sides of the package (between the impact limiters) are provided with a thermal barrier consisting of a 5/32-inch diameter wire wrap on 12-inch centers and covered with 3/16-inch thick steel jacket. The secondary lid is covered with a separate, removable thermal shield. The bottom weldment is made of two, 3-1/4-inch thick carbon steel plates. The primary lid is sealed with a double seals (o-rings) and 20 equally spaced 2-inch diameter bolts. The 29-inch diameter centered secondary lid is sealed with a double seals (o-rings) and twelve equally spaced 2-inch diameter bolts. The lid sealing surfaces are stainless steel and the space between the double o-ring seals is provided with a test port for leak testing. The top and bottom of the cask is provided with steel encased, rigid polyurethane foam impact limiters. The impact limiters are secured to each other about the cask with eight 1-inch diameter ratchet binders. The impact limiters are 102 inches in diameter and the overall height of the package with the impact limiters attached is 132-1/4 inches. The package is provided with four tie-down and two (or four) removable lifting devices. Each lid is provided with three lifting lugs. The maximum gross weight of the packaging and contents is approximately 74,000 pounds. The weights[1] of the packaging components and payload are:

Cask Weight Empty (Including Lids and Thermal Shield) ..... 51,550 pounds
- Cask Primary Lid ..... 5,200 pounds
- Cask Secondary Lid ..... 1,975 pounds
- Secondary Lid Thermal Shield ..... 250 pounds

Cask Payload[2] (Including Shoring) ..... 12,250 pounds

Impact Limiters (each) ..... 5,500 pounds

[1] Rigging used to lift cask components should be sized for the weights listed. These are bounding as-built weights that vary according to the individual cask units, and differ from the design weights in Reference 3.7 (SAR) due to fabrication tolerances.

[2] Note that Reference 3.7 (CoC) limits the maximum package weight to approximately 74,000 lbs. A cask payload meeting the listed weight will result in the maximum package weight complying with the CoC. For cask payloads that exceed 12,250 lbs, please contact Energy*Solutions* Cask Maintenance Facility (CMF) for assistance.

3.0 REFERENCES

3.1 CFR Title 49, Part 172

3.2 CFR Title 49, Parts 173.401-173.478

3.3 TR-TP-008, *Pre-Shipment Leak Tests for Model 8-120B Cask NRC Certificate of Compliance 9168,* effective revision

3.4 ES-QA-PR-031, *NRC Certified Components Quality Assurance Records,* effective revision

3.5 Code of Federal Regulations CFR Title 10, Part 20 and Part 71

3.6 Not Used

3.7 Transport Cask Model 8-120B Certificate of Compliance 9168, effective revision

3.8 Drawing C-110-E-0007, *8-120B Shipping Cask,* effective revision

3.9 ES-AD-PR-008, *Condition Reports,* effective revision

4.0 REQUIREMENTS

4.1 Tools, Materials, Equipment - At Loading Site

4.1.1 Energy*Solutions* - Furnished Items

4.1.1.1 8-120B cask, impact limiters, tiedowns, and trailer.

4.1.1.2 8-120B cask license and documentation.

4.1.1.3 8-120B cask lid seals.

4.1.1.4 8-120B cask disposable liner, shoring, or drum pallets, if required by the shipper.

4.1.1.5 Test manifold and MT&E for performing pre-shipment leak test.

4.1.2 Shipper - Furnished Items

4.1.2.1 Crane compatible with filled liner, loaded drum pallet, cask lids, and impact limiter.

4.1.2.2 Lifting hardware.

4.2.4 Lifting sling compatible with cask lids, filled liner, and loaded drum pallets.

4.2.5 Acceptable bolt lubricant (Moly-Z, Neolube, or Anti-Seize).

4.2.6 Health Physics (HP) instrumentation and support materials.

4.2.7 Primary/secondary lid and vent port seals.

4.2.8 Vacuum grease (for example, Parker Super-O-Lube).

4.3 Handling Precautions

Warning: If the lid or vent port seal require replacement, the cask will need to be unloaded and shipped back to the Energy*Solutions* Cask Maintenance Facility (CMF) for seal replacement and periodic leak testing.

4.3.1 Treat the inside of the cask, the bottom of the cask lids, and any materials removed as potentially radiologically contaminated.

4.3.2 **DO NOT** attempt to lift the cask by the lifting lugs on the impact limiter, primary cask lid, or secondary cask lid.

Caution: The cask must be lifted using the two (2) diametrically opposed primary lifting lugs that are bolted onto the cask body (Items 41, 42, and 43 of Reference 3.8). The optional redundant lifting lugs (if available) may also be used to lift the cask body, if required.

4.3.3 Survey the cask cavity for radiation and radiological contamination levels after the cask contents have been removed. Decontaminate as required by the Health Physics Department after the contents have been removed.

4.3.4 Remove any liquid or foreign materials from the cask cavity. Treat this liquid or material as potentially radiologically contaminated.

4.3.5 Visually inspect the cask for damage to the lid, impact limiter, seals, seal seating surfaces, ratchet binders, lifting lugs, lifting slings, and tie-downs.

4.3.6 When lowering a liner or pallet into cask, be alert to the possibility of airborne radiological contamination escaping the cask.

4.3.7 Visually inspect all bolts (i.e. primary and secondary lid bolts, lifting lug bolts, etc.), vent port socket head cap screw (if removed), and test port set screws for defects prior to each shipment and obtain replacements from Energy*Solutions* CMF for any parts that show cracking or other visual defects.

Caution: **Only remove the cask lid vent port socket head cap screw if there is a need to relieve internal pressure so that the primary lid can be removed. Use caution not to damage the vent port socket head cap screw or vent port seal.**

Note: **If shipping the cask as a Type-B, every 8-120B cask shipment, whether or not the lid bolts or vent port socket head cap screw have been removed, the primary lid, secondary lid, and vent port seals must be leak tested prior to shipment, in accordance with Reference 3.3.**

If shipping the cask as an Empty, Type-A, General design, LSA or SCO package, Reference 3.3 leak testing does not apply; however, this cask handling procedure along with all the torque requirements still apply. The cask stencils, including the CoC, Type-B, and the embossed Tri-Symbol located on the cask body, must also be covered up prior to shipment.

If shipping EMPTY, UN2908, Reference 3.3 leak testing does <u>not</u> apply; however, this cask handling procedure along with all the torque requirements still apply. Please do <u>not</u> cover up the cask stencils, including the CoC, Type-B, or Tri-Symbol located on the cask body

4.3.8 A packaging containing quantities of radioactive material in excess of Type "A" quantities specified in 10 CFR 20.1906(a) shall be received, monitored, and handled by the licensee receiving the package in accordance with the requirements of 10 CFR 20.1906, as applicable.

4.3.9 Before a loaded cask leaves the shipper's facility, the following shall be confirmed:

4.3.9.1 All lifting lugs are removed or properly stored for transport.

4.3.9.2 Trailer placarding and cask labeling and marking meet D.O.T. specifications (see References 3.1 and 3.2 as applicable).

4.3.9.3 Exterior radiation levels do not exceed 200 millirem per hour (2 mSv/h) on contact, 10 millirem per hour (0.1 mSv/h) at 2 meters, and 2 millirem per hour (0.02 mSv/h) in tractor cab, in accordance with 49 CFR 173.441 and 10 CFR 71.47 (see References 3.2 and 3.5).

4.3.9.4 Cask external removable contamination does not exceed Site Release Limits, 49 CFR 173.443, and 10 CFR 71.87, as applicable (see References 3.2 and 3.5).

4.3.9.5 Cask lid bolts and vent port socket head cap screw are properly torqued.

4.3.9.6 Cask lids and vent port have been leak tested in accordance with Reference 3.3.

4.3.9.7 That the cask lids and impact limiters are sealed with security seals.

4.3.9.8 That two independent physical verifications of the secondary container's closure system have been performed as part of the package loading operations to ensure that it is properly closed and secured. Record the compliance of this step in Attachment 7.1, Step 1.

Note: This requirement is waived for uniformly distributed resins, filters, and for solidified wastes with no dimension less than 1 cm.[3]

4.3.9.9 Radioactive contents in 8-120B cask (manifested as a Type B package) are to be transported as exclusive use, per 10 CFR 71.4.

4.3.10 Before an empty cask leaves the shipper's facility, the following shall be confirmed:

4.3.10.1 Cask verified to be empty of radioactive waste. For foreign material exclusion concerns, cask internals must also be verified clean and clear of all non-radioactive debris.

4.3.10.2 All cask-lifting lugs are removed and properly stored with cask for transport.

4.3.10.3 Trailer placarding and cask labeling and marking meet D.O.T. specifications (see References 3.1 and 3.2 as applicable).

4.3.10.4 Exterior radiation levels do not exceed limits per 49 CFR 173.441 and 10 CFR 71.47 (see References 3.2 and 3.5).

4.3.10.5 Cask internal and external removable contamination does not exceed Site Release Limits, 49 CFR 173.428, 49 CFR 173.443, and 10 CFR 71.87, as applicable (see References 3.2 and 3.5).

[3] The basis for double verification is to assure that small, high-specific activity particles do not have the potential to migrate up into the annular gap between the primary lid and the cask bolting flange. Payloads containing any form of isotope sources, or containing highly activated fines, swarf, crud, or other hot particles less than 1 cm in size are therefore not exempt.

4.3.10.6 Cask lid bolts and vent port socket head cap screw are properly torqued.

4.3.10.7 That the cask lids and impact limiters are sealed with security seals.

4.3.11 The inspection tag attached to the primary or secondary lid shall be reviewed to verify none of the maintenance, inspection or testing activities has passed the due dates recorded on the tag. If any dates have expired, or will expire prior to the cask reaching the destination where it will be unloaded, Energy*Solutions* CMF shall be contacted.

Maint

4.3.12 Use of impact wrenches to remove cask lid bolts is limited to breaking initial torque on the bolt. Once the bolt is free to rotate, further removal of bolt with impact wrench shall stop. Final removal of lid bolts is to be done by hand.

Note: **Pneumatic or hydraulic torque wrenches (non-impacting) may be used to remove the bolts.**

Maint

4.3.13 Impact wrenches should not be used for the installation of the cask lid bolts; bolts should be installed and hand-tightened then torqued using a star pattern.

Maint

Note: **Pneumatic or hydraulic torque wrenches (non-impacting) may be used to install the bolts.**

4.3.14 Flammable gas (hydrogen) concentration is limited to less than 5% in volume. Compliance with this concentration limit is determined by the methodology used in NUREG/CR-6673.

Note: **For any package containing materials with radioactive concentrations not exceeding that for LSA material, ensure that the shipment occurs within 10 days of preparation or 10 days of venting the loaded secondary container.**

4.3.15 All conditions from Reference 3.7 applicable for a shipment must be fulfilled.

4.3.16 The following recommendations are provided to users of the cask to ensure performance of a meaningful pre-shipment leak test per Reference 3.3

4.3.16.1 Prior to performing pre-shipment leak tests, the user shall conduct the following inspections (with ***exception*** listed below) regardless of whether the primary and/or secondary

lid is required to be removed during cask handling operations.

4.3.16.2 Visually inspect the accessible seals and seal seating surfaces of the primary and secondary lids. Ensure that these surfaces are free of debris, dirt and any other potential contaminants. If the seal surfaces have to be cleaned, use a lint free cloth with moderate amount of isopropyl alcohol or acetone and, if necessary, apply a very light (thin) coat of vacuum grease (for example, Parker Super-O-Lube or equivalent) on seal's exposed surfaces. Do not attempt to remove seals from their respective dovetail grooves located on a cask lid.

4.3.16.3 Inspect primary/secondary lid test ports to ensure that they are not blocked and free of dirt and/or grease. Clean lid test ports, as necessary.

4.3.16.4 Visually inspect the vent test port for any obstructions, and clean the port as necessary (the vent port socket head cap screw should only be loosened or removed to relieve internal cask pressure in order to lift lids or to investigate vent port test failures).

Exception: **If during loading process Energy*Solutions* optional tamper seal connecting two adjacent lid bolts on primary or secondary lid closure remain unbroken (primary or secondary lid and its bolts have not been removed during handling operations), the closure with untampered seal does not need to be removed for inspection of seals and sealing surfaces, however, verification of required lid bolt torque and cask closures pre-shipment leak test are required to verify proper cask assembly.**

4.4 Acceptance Criteria

4.4.1 The package has been prepared for shipment per this handling procedure and the requirements of Reference 3.7.

4.4.2 For an 8-120B cask Type B shipment, primary/secondary lid seal/seating surface inspections and pre-shipment leak tests have been satisfactorily performed prior to release of the cask for shipment in accordance with Reference 3.3.

5.0 DETAILED PROCEDURE

Note: **Prior to loading the cask, the payload must be qualified in accordance with the requirements of Reference 3.7. The maximum decay heat of the contents shall not exceed 200 watts. Contact Energy*Solutions* if the planned cask payload exceeds 12,250 pounds to ensure compliance with the maximum package weight of approximately 74,000 pounds. The maximum quantity of material in the contents shall be limited per Reference 3.7. The package shall be prepared for shipment and operated per Reference 3.7.**

Note: **Prior to loosening the impact limiter ratchet binders, inspect the exterior of the package for damage, e.g., large dents, gouges, tears to the impact limiter skin and thermal shield. Contact Energy*Solutions* CMF if damage is present. The cask may not be used as a Type B package until the damage is assessed by Energy*Solutions* CMF and repairs, if required, are made to achieve conformance with Reference 3.7.**

Note: **Steps of this procedure in Section 5.0 may be performed in non-sequential order.**

5.1 Loading Procedure

Note: **If it is necessary to remove the cask from the trailer, refer to Section 5.3.**

5.1.1 Prepare to Load the Cask

Warning: **Treat the underside of the lids, the inside surfaces of the cask, and any bolts or seals removed as potentially radiologically contaminated.**

Note: **The cask may be loaded using either pallets, or a liner processed through either the primary or secondary lid. Follow Step 5.1.2 for loading pallets. Follow Step 5.1.3 for loading a liner through the primary lid. Follow Step 5.1.4 for processing liner through secondary lid.**

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5.1.2 Procedure for Loading Pallets

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5.1.2.1 Remove upper impact limiter.

Note: **Position cask and trailer on a level surface (visual determination) to facilitate impact limiter and lid removal.**

5.1.2.1.1 Remove the security seal. Properly dispose of removed seal.

5.1.2.1.2 Remove impact limiter lifting lug covers.

5.1.2.1.3 Loosen ratchet binders securing impact limiter.

5.1.2.1.4 Remove holding pin and bolt from upper end of ratchet binder. Retain bolts and holding pins for reinstallation.

Note: **Do not lose the ratchet binder holding pins.**

5.1.2.1.5 Attach crane to lifting lugs on upper impact limiter using appropriate lifting gear.

5.1.2.1.6 Ensure alignment marks are on impact limiter and cask body.

Caution: **To prevent damage to the impact limiter, place impact limiter carefully in set-down area.**

5.1.2.1.7 Lift off impact limiter.

5.1.2.2 Remove Secondary Lid Thermal Shield

5.1.2.2.1 Remove the retaining device from each of the three retaining pins and remove the retaining pins from the secondary lid lift lugs.

5.1.2.2.2 Using suitable lifting equipment, remove the secondary lid thermal shield. In case required, it shall be verified that the secondary lid thermal shield swivel hoist ring is torqued to 14 ± 2 ft.-lbs. Care should be taken to prevent damage to the thermal shield during handling and storage.

5.1.2.3 Remove primary cask lid.

5.1.2.3.1 Prior to removing the cask primary lid, the inspection tag attached to the primary or secondary lid shall be reviewed to verify none of the maintenance, inspection or testing activities has passed the due dates recorded on the tag. If no tag is present, or if any dates have expired, or will expire prior to the cask reaching the destination where it will be unloaded, Energy*Solutions* CMF shall be contacted prior to proceeding.

Note: **Contact Energy*Solutions* CMF for further directions if no inspection tag is present, or if any of the due dates on the inspection tag have expired or will expire prior to unloading the cask.**

5.1.2.3.2 Remove the security seals. Properly dispose of removed seals.

Caution: **Use of impact wrenches to remove cask lid bolts is limited to breaking initial torque on the bolt. Once the bolt is free to rotate, stop using impact wrench. Final removal of lid bolts is to be done by hand.**

5.1.2.3.3 Loosen and remove the twenty (20) 2-inch hex head bolts from the primary cask lid, using a star pattern. Do not leave bolts in lid during removal. Retain them for reinstallation.

Note: **Pneumatic or hydraulic torque wrenches (non-impacting) may be used to install and remove the bolts.**

5.1.2.3.4 Attach crane hook to primary lid lifting lugs using appropriate lifting hardware.

Note: **The cables used to lift the primary lid must have a true angle of not less than 45° with respect to the horizontal.**

Caution: **Care should be taken during handling operations to prevent damage to cask sealing surfaces.**

5.1.2.3.5 Slowly raise the cask lid to clear cask and set the lid down on absorbent material or plastic sheeting, if required.

Warning: **Treat the underside of the lid, the inside surfaces of cask, and any bolts or seals removed as potentially radiologically contaminated.**

5.1.2.3.6 Visually inspect the cask lid bolts for defects and obtain replacement bolts from Energy*Solutions* CMF for any lid bolts that show cracking or other visual defects. Lubricate bolt threads, if required.

5.1.2.3.7 Visually inspect lid bolt holes for damage, defects and accumulation of debris. Remove debris, if required. Contact Energy*Solutions* CMF for any bolt holes that show signs of cracking or visual signs of distress.

5.1.2.3.8 Visually inspect and clean the seal seating surfaces.

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5.1.2.4 Remove the contents of the cask.

Warning: Treat the pallets as potentially radiologically contaminated items.

Caution: Care should be taken during handling operations to prevent damage to cask sealing surfaces.

5.1.2.4.1 Attach the crane hook to the pallet lifting ring.

5.1.2.4.2 Lifting the pallet straight up out of the cask and place it on absorbent material or plastic sheeting, if required.

5.1.2.4.3 Remove the crane hook.

5.1.2.4.4 Repeat Steps 5.1.2.4.1 through 5.1.2.4.3 as necessary to remove both pallets from the cask.

Warning: Radioactively contaminated liquids may be pumped out or removed by use of an absorbent material. Removal of any material from inside the cask shall be performed under the supervision of qualified health physics personnel with the necessary H.P. monitoring and radiological health safety precautions and safeguards.

5.1.2.4.5 Visually inspect the interior of the cask for any damage or defects that may affect the integrity of the cask or shielding provided by the cask. Also inspect for loose materials or moisture. Report any noted damage or defects to Energy*Solutions* CMF for resolution before proceeding with cask loading. Remove any liquids or foreign materials from the cask cavity.

5.1.2.5 Load the pallet into the cask.

Caution: Do not place the drums on the pallet lifting sling.

Caution: Confirm that the safety hook (if installed) on the pallet sling remains attached to the lifting ring.

Caution: Care should be taken during handling operations to prevent damage to cask sealing surfaces

Warning: Treat all debris removed from the pallet as potentially radiologically contaminated.

5.1.2.5.1 Clean each pallet before loading it. Load each pallet with a maximum of four 55-gallon drums, or equivalent.

5.1.2.5.2 Perform two independent physical verifications of each secondary container's closure system to ensure that it is properly closed and secured. Record the compliance of this step in Attachment 7.1, Step 1.

Note: This requirement is waived for uniformly distributed resins, filters, and for solidified wastes with no dimension less than 1 cm.

5.1.2.5.3 Attach the crane hook to the pallet lifting ring.

5.1.2.5.4 Carefully lift the pallet and place into the cask. Detach the crane hook and place pallet lifting ring on top of drums. DO NOT damage the inside of the cask.

Note: Shore drums if necessary to limit movement during normal transport conditions.

5.1.2.5.5 Repeat Steps 5.1.2.5.1 through 5.1.2.5.4 to load other pallet into the cask.

5.1.2.6 Replace the primary lid.

Caution: Care should be taken during handling operations to prevent damage to cask sealing surfaces.

Note: Confirm that the bolts on the secondary lid are torqued to a lubricated value of 500 ± 50 ft.-lbs (refer to Steps 5.1.4.5.5 through 5.1.4.5.8 for torqueing bolts), before the cask leaves the facility.

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5.1.2.6.1 Attach the lifting sling to the three (3) lifting lugs on the primary lid.

Note: **The cables used to lift the primary lid must have a true angle of not less than 45° with respect to the horizontal.**

5.1.2.6.2 Attach the crane hook to the lifting sling.

5.1.2.6.3 The primary lid seals shall be visually inspected for serviceability ensuring that they are in the proper position and free of cracks, tears, cuts or discontinuities which may prevent them from sealing properly. The seal seating surface shall be visually inspected to ensure that they are free of damage, debris, gravel, or any foreign matter, which might damage the seals or prevent the seals from properly sealing. If any defects are detected, that may prevent the seals from forming a seal contact Energy*Solutions* CMF. Refer to the provisions of Step 4.4.2 for leak test requirements. Inspect and clean the seal seating surfaces. A very thin coat of vacuum grease may be applied to the sealing surface of the seal prior to installing and torquing the lid. Inspect the air test annulus and leak test port to assure that they are free of foreign materials.

Warning: **Treating all debris removed from the bottom surface of the lid as potentially radiologically contaminated.**

5.1.2.6.4 Lift the primary lid, clean the bottom surface, and lower into position using alignment marks and alignment pins.

Caution: **The use of impact wrenches for the installation of cask lid bolts is not permitted.**

5.1.2.6.5 Replace and hand tighten the twenty (20) 2-inch hex head primary lid bolts.

Note: **Tighten all the bolts hand-tight before starting torque sequence.**

5.1.2.6.6 Torque all primary lid bolts to 250 ± 25 ft.-lbs. (lubricated), using a star pattern.

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It is recommended that the bolts be torqued a second time to 250 ± 25 ft. lbs., repeating the star pattern.

Note: **Pneumatic or hydraulic torque wrenches (non-impacting) may be used to install the bolts.**

Maint 5.1.2.6.7 Re-torque all primary lid bolts to 500 ± 50 ft.-lbs. (lubricated), using a star pattern. It is recommended that the bolts be torqued a second time to 500 ± 50 ft. lbs., repeating the star pattern.

Maint 5.1.2.6.8 Check torque on all primary lid bolts, at least once, using a circular pattern to 500 ± 50 ft.-lbs.

Maint 5.1.2.6.9 Torque the vent port socket head cap screw to 20 ± 2-ft. lbs.

Note: **If the vent port socket head cap screw is removed, the vent port seal shall be inspected and replaced, if damaged. Prior to installation, the vent port seal shall be installed on the vent port socket head cap screw; and a thin layer of anti-seize should be applied to the vent port socket head cap screw threads.**

5.1.2.6.10 Leak test the cask primary lid, secondary lid and vent port per Reference 3.3.

5.1.2.6.11 After completing the leak tests in accordance with Reference 3.3, ensure all three test port set screw plugs are in place.

5.1.2.6.12 If required by site procedures, install the optional security seal on the primary lid bolts.

5.1.2.6.13 Ensure that all dirt/clay/debris is removed from the cask lids prior to installation of the cask impact limiters.

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5.1.2.7 Replace secondary lid thermal shield and upper impact limiter.

Caution: **Ensure inner surfaces of impact limiter are below external package limits as specific in Reference 3.2. Also, this should include any enclosed surfaces of external cask body.**

5.1.2.7.1 Using suitable lifting equipment, lift, inspect for damage, and install the secondary lid thermal shield. Contact Energy*Solutions* CMF if any damage is present. In case required, it shall be verified that the secondary lid thermal shield swivel hoist ring is torqued to 14 ± 2 ft.-lbs.

5.1.2.7.2 Install the three secondary lid thermal shield retaining pins into the secondary lid lift lugs and insert the retaining device into the retaining pins.

5.1.2.7.3 Attach the crane hook to the lifting lugs on the impact limiter and lift it; inspect for damage.

5.1.2.7.4 Position the impact limiter on cask using alignment marks on the cask body and impact limiter.

5.1.2.7.5 Replace the bolts in the ratchet binders.

Note: **Visually inspect ratchet binder bolts for signs of cracking or other visual defects. Replace any defective materials. Contact Energy*Solutions* CMF prior to replacing any defective materials.**

5.1.2.7.6 Insert holding pins. Tighten the ratchet binders hand tight and return the ratchet handles to their storage position leaving the flip block in the on/tighten position.

5.1.2.7.7 Place security seals on the impact limiter or ratchet handles.

5.1.2.7.8 Install impact limiter lifting lug covers.

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5.1.3 Procedure for Loading Liner into Cask

Note: **If the liner is pre-filled, confirm that it has been capped using standard capping devices.**

Note: **If the cask contains an empty, unused liner, the liner may be filled by removing only the secondary lid. Refer to Section 5.1.4 for processing a liner through the secondary lid.**

5.1.3.1 Remove upper impact limiter and secondary lid thermal shield. Follow Steps 5.1.2.1 through 5.1.2.2.2.

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5.1.3.2 Remove primary cask lid. Follow Steps 5.1.2.3 through 5.1.2.3.8.

Caution: Care should be taken during liner handling operations to prevent damage to cask sealing surfaces.

5.1.3.3 Load the liner into the cask.

Warning: As the liner is lowered into the cask, the air in the cask will cushion and slow the liner. Be alert to the possibility of radiological airborne contamination escaping from the cask during this operation.

5.1.3.3.1 Visually inspect the interior of the cask for any defects which may affect the integrity of the cask or shielding provided by the cask. Also inspect for loose material or moisture. Report any noted defects to Energy*Solutions* CMF for resolution before proceeding with the cask loading. Remove any liquids or foreign materials from the cask cavity.

Caution: Radioactively contaminated liquids may be pumped out or removed by use of an absorbent material. Removal of any material from inside the cask shall be performed under the supervision of qualified Health Physics personnel with the necessary H.P. monitoring and radiological health safety precautions and safeguards.

5.1.3.3.2 Inspect and clean, if required, the external surfaces of the liner before placing it in the cask.

Warning: Treat all debris removed from the liner as potentially radiologically contaminated.

5.1.3.3.3 Perform two independent physical verifications of the liner's closure system to ensure that it is properly closed and secured. Record the compliance of this step in Attachment 7.1, Step 1.

Note: This requirement is waived for uniformly distributed resins, filters, and for solidified wastes with no dimension less than 1 cm.

5.1.3.3.4 Attach the crane hook to the cables or grapple ring on the liner and lift the liner.

Caution: **Care should be taken during liner handling operations to prevent damage to cask or lid seal surfaces.**

5.1.3.3.5 Lower the liner straight into cask.

5.1.3.3.6 Detach crane hook from the cables or grapple ring on the liner.

5.1.3.3.7 Ensure that liner lifting cables lay flat to allow proper installation of the cask lid.

Note: **Shore the liner, if necessary, to prevent movement during normal transport conditions.**

5.1.3.4 Replace primary cask lid. Follow Steps 5.1.2.6 through 5.1.2.6.13. page 15

5.1.3.5 Replace secondary lid thermal shield and upper impact limiter. Follow Steps 5.1.2.7 through 5.1.2.7.8. Page 17

5.1.4 Procedure for Processing Liner through Secondary Lid

5.1.4.1 Remove upper impact limiter and secondary lid thermal shield. Follow Steps 5.1.2.1 through 5.1.2.2.2.

5.1.4.2 Remove secondary cask lid.

5.1.4.2.1 Prior to removing the cask secondary lid, the inspection tag attached to the primary or secondary lid shall be reviewed to verify none of the maintenance, inspection or testing activities have passed the due dates recorded on the tag. If no tag is present, or if any dates have expired, or will expire prior to the cask reaching the destination where it will be unloaded, Energy*Solutions* CMF shall be contacted prior to proceeding.

Note: **Contact Energy*Solutions* CMF for further directions if no inspection tag is present, or if any of the due dates on the inspection tag have expired or will expire prior to unloading the cask.**

5.1.4.2.2 Remove the security seals. Properly dispose of removed seals.

Caution: **Use of impact wrenches to remove cask lid bolts is limited to breaking initial torque on the bolt. Once the bolt is free to rotate, stop using impact wrench. Final removal of lid bolts is to be done by hand.**

5.1.4.2.3 Loosen and remove the twelve (12) 2-inch bolts from the secondary lid. Do not leave bolts in lid during removal.

Note: **Pneumatic or hydraulic torque wrenches (non-impacting) may be used to remove the bolts.**

5.1.4.2.4 Attach crane hook to secondary lid lifting lugs, using appropriate lifting hardware.

Note: **The cables used to lift the secondary lid must have a true angle of not less than 45° with respect to the horizontal.**

Caution: **Care should be taken during handling operation to prevent damage to cask sealing surfaces.**

5.1.4.2.5 Slowly remove secondary lid from cask and place it on absorbent material or plastic sheeting, if required.

Warning: **Treat the underside of the lid, the inside surfaces of cask, and any bolts or seals removed as potentially radiologically contaminated.**

5.1.4.2.6 Visually inspect the secondary lid bolts for defects and obtain replacement bolts from Energy*Solutions* CMF for any lid bolts that show cracking or other visual defects. Lubricate bolt threads, if required.

5.1.4.2.7 Visually inspect lid bolt holes for damage, defects and accumulation of debris. Remove debris, if required. Contact Energy*Solutions* CMF for any bolt holes that show signs of cracking or visual signs of distress.

5.1.4.2.8 Visually inspect and clean the seal seating surfaces.

5.1.4.3 Process liner as necessary, and cap using standard capping devices.

5.1.4.4 Perform two independent physical verifications of the liner's closure system to ensure that it is properly closed and secured. Record the compliance of this step in Attachment 7.1, Step 1.

Note: **This requirement is waived for uniformly distributed resins, filters, and for solidified wastes with no dimension less than 1 cm.**

5.1.4.5 Replace secondary lid.

5.1.4.5.1 Attach crane and lifting sling to lifting lugs on secondary lid.

Note: **The cables used to lift the secondary lid must have a true angle of not less than 45° with respect to the horizontal.**

5.1.4.5.2 The secondary lid seals shall be visually inspected for serviceability ensuring that they are in the proper position and free of cracks, tears, cuts or discontinuities which may prevent them from sealing properly. The seal seating surface shall be visually inspected to ensure that they are free of damage, debris, gravel, or any foreign matter, which might damage the seals or prevent the seals from properly sealing. If any defects are detected, that may prevent the seals from forming a seal contact Energy*Solutions* CMF. Refer to the provisions of Step 4.4.2 for leak test requirements. Inspect and clean the seal seating surfaces. A very thin coat of vacuum grease may be applied to the sealing surface of the seal prior to installing and torquing the lid. Inspect the air test annulus and leak test port to assure that they are free of foreign materials.

Warning: **Treat all debris removed from the bottom surface of the lid as potentially radiologically contaminated.**

Caution: **Care should be taken during handling operations to prevent damage to cask sealing surfaces.**

5.1.4.5.3 Place secondary lid on cask using alignment marks and/or alignment pins.

5.1.4.5.4 Visually inspect secondary cask lid bolts for defects and obtain replacement bolts from Energy*Solutions* CMF for any bolts that show cracking or other visual defects. Lubricate bolt threads, if required.

Caution: **The use of impact wrenches for the installation of cask lid bolts is not permitted.**

5.1.4.5.5 Replace and hand tighten the twelve (12) 2-inch bolts.

5.1.4.5.6 Torque all secondary lid bolts to 250 ± 25 ft.-lbs. (lubricated), using a star pattern. It is recommended that the bolts be torqued a second time to 250 ± 25 ft, lbs., repeating the star pattern.

Note: **Pneumatic or hydraulic torque wrenches (non-impacting) may be used to install the bolts.**

5.1.4.5.7 Re-torque all secondary lid bolts to 500 ± 50 ft.-lbs. (lubricated), using a star pattern. It is recommended that the bolts be torqued a second time to 500 ± 50 ft. lbs., repeating the star pattern.

5.1.4.5.8 Check torque on all secondary lid bolts, at least once, using a circular pattern to 500 ± 50 ft.-lbs. Do not leave bolts in lid during removal.

5.1.4.5.9 Torque the vent port socket head cap screw to 20 ± 2-ft. lbs.

Note: **If the vent port socket head cap screw is removed, the vent port seal shall be inspected, if damaged contact Energy*Solutions* CMF. Prior to installation, the vent port seal shall be installed on the vent port socket head cap screw; and a thin layer of anti-seize should be applied to the vent port socket head cap screw threads.**

5.1.4.5.10 Leak test of the cask primary lid, secondary lid, and vent port seals is required per Reference 3.3 and Step 4.4.2 for an 8-120B Type B shipment.

5.1.4.5.11 Ensure all three test port set screw plugs are in place.

5.1.4.5.12 If required by site procedures, install the optional security seal on the secondary lid bolts.

5.1.4.5.13 Ensure that all dirt/clay/debris is removed from the cask lids prior to installation of the cask impact limiters.

5.1.4.5 Replace secondary lid thermal shield and upper impact limiter. Follow Steps 5.1.2.7 through 5.1.2.7.8.

5.1.5 Inspect the cask tie-down cables for tightness. Tighten if necessary.

5.1.6 Before the loaded cask leaves the shipper's facility, the following shall be confirmed:

5.1.6.1 Trailer placarding and cask labeling and marking meet D.O.T. specifications in References 3.1 and 3.2 as applicable.

5.1.6.2 That exterior radiation levels do not exceed 200 millirem per hour (2 mSv/h) on contact, 10 millirem per hour (0.1 mSv/h) at 2 meters, and 2 millirem per hour (0.02 mSv/h) in the tractor cab, in accordance with 49 CFR 173.441 and 10 CFR 71.47 (see References 3.2 and 3.5).

5.1.6.3 That cask external removable contamination does not exceed Site Release Limits, 49 CFR 173.443 and 10 CFR 71.87, as applicable (see Reference 3.2 and 3.5).

5.1.6.4 Cask primary lid, secondary lid, and vent port seals have been pre-shipment leak tested in accordance with Reference 3.3.

5.1.6.5 Cask lid bolts and vent port socket head cap screw are properly torqued.

5.1.6.6 That the cask lids and impact limiters are sealed with security seals.

5.1.6.7 That all lifting lugs are removed or properly covered for transport.

5.1.6.8 Inspect the accessible exterior surfaces of the package for damage (e.g., large dents, gouges and/or tears in the impact limiter skin or thermal shielding.) Contact Energy*Solutions* CMF if damage is identified.

5.1.6.9 Two independent physical verifications of the secondary container's closure system have been performed as part of the package loading operations to ensure that it is properly closed and secured. Record the compliance of this step in Attachment 7.1, Step 1.

Note: **This requirement is waived for uniformly distributed resins, filters, and for solidified wastes with no dimension less than 1 cm.**

5.1.6.10 The periodic leak test of the primary lid, secondary lid, and vent port plug seals has been performed in the prior 12-month period. For a shipment of powdered radioactive materials (i.e., powdered solids), confirm that the most recent periodic leak test demonstrated leaktight status.

5.1.7 Complete the USER CHECK-OFF SHEET (Attachment 7.1) or equivalent sheet and send a copy with the shipment.

5.2 **Unloading Procedure.**

Note: **Verify compliance to Step 4.3.8.**

Note: **If it is necessary to remove the cask from the trailer, refer to Section 5.3 of this procedure.**

Warning: **All personnel handling a filled liner or filled drums shall observe established site radiation protection procedures**

5.2.1 Move the unopened package to an appropriate level unloading area; and position the unloading crane at an optimum distance to facilitate offloading the cask and minimizing operator exposure.

5.2.2 Remove upper impact limiter and secondary lid thermal shield.

Note: **Position cask and trailer on a level surface (visual determination) to facilitate impact limiter and lid removal.**

5.2.2.1 Perform an external examination of the unopened package. Record any significant observations.

5.2.2.2 Remove the impact limiter security seals. Properly dispose of removed seals.

5.2.2.3 Remove impact limiter lifting lug covers.

5.2.2.4 Loosen ratchet binders securing impact limiter.

5.2.2.5 Remove holding pin and bolt from upper end of ratchet binder. Retain bolts and holding pins for reinstallation.

Note: **Do not lose the ratchet binder holding pins.**

5.2.2.6 Attach crane to lifting lugs on upper impact limiter using appropriate lifting gear.

5.2.2.7 Ensure alignment marks are on impact limiter and cask body.

5.2.2.8 Lift off impact limiter.

Caution: **To prevent damage to the impact limiter, place impact limiter carefully in set-down area.**

5.2.2.9 Remove the retaining device from each of the three retaining pins and remove the retaining pins from the secondary lid lift lugs.

5.2.2.10 Using suitable lifting equipment, inspect for damage, and remove the secondary lid thermal shield. Contact Energy*Solutions* CMF if damage is present. Care should be taken to prevent damage to the thermal shield during handling and storage.

5.2.3 Remove primary cask lid.

Warning: **Treat the underside of the lids, the inside surfaces of the cask, and any bolts or seals removed as potentially radiologically contaminated.**

5.2.3.1 Remove the optional security seals from the primary lids bolts, if installed. Properly dispose of removed seals.

Caution: **Use of impact wrenches to remove cask lid bolts is limited to breaking initial torque on the bolt. Once the bolt is free to rotate, stop using impact wrench. Final removal of lid bolts is to be done by hand.**

5.2.3.2 Loosen and remove the twenty (20) 2-inch hex head bolts from the primary cask lid, using a star pattern. Do not leave bolts in lid during removal. Retain them for reinstallation.

Note: **Pneumatic or hydraulic torque wrenches (non-impacting) may be used to remove the bolts.**

5.2.3.3 Attach crane hook to lifting lugs on primary cask lid using appropriate lifting hardware.

Note: **The cables used to lift the primary lid must have a true angle not less than 45° with respect to the horizontal.**

Caution: **Use care during handling operations to prevent damage to cask sealing surfaces.**

5.2.3.4 Slowly raise the cask lid to clear cask and set the lid down on absorbent material or plastic sheeting, if required.

Warning: **Treat the underside of the lid, the inside surfaces of cask, and any bolts or seals removed as potentially radiologically contaminated.**

5.2.3.5 Visually inspect the cask lid bolts for defects and obtain replacement bolts from Energy*Solutions* CMF for any lid bolts that show cracking or other visual defects. Lubricate bolt threads, if required.

5.2.3.6 Visually inspect lid bolt holes for damage, defects and accumulation of debris. Remove debris, if required. Contact Energy*Solutions* CMF for any bolt holes that show signs of cracking or visual signs of distress.

5.2.3.7 Visually inspect and clean the seal seating surfaces.

5.2.4 The Health Physics Technician shall conduct a radiation survey to determine offloading precautions.

5.2.5 If directed by the Health Physics Technician, vacate all personnel from the immediate area except for the crane operator and rigger. The rigger shall stand in clear view of the crane operator or have proper communications with crane operator.

5.2.6 Prepare to remove contents of the cask.

Note: **The cask may contain a filled liner or pallets. If the cask contains pallets, follow the procedure for unloading pallets, Step 5.2.8 and skip Step 5.2.7.**

5.2.7 Procedure for Unloading a Liner

Caution: **Care should be taken during handling operations to prevent damage to cask sealing surfaces.**

5.2.7.1 Attach crane hook to the cables or grapple ring on the liner.

5.2.7.2 Lift liner straight up out of cask and allow any liquid to drip off into the cask.

5.2.7.3 Place the liner in position for disposal or future handling.

5.2.8 Procedure for Unloading Pallets

Caution: **Confirm that the safety hook (if installed) on the pallet sling remains attached to the lifting ring.**

Caution: **Care should be taken during handling operations to prevent damage to cask sealing surfaces.**

5.2.8.1 Attach crane hook to the pallet lifting ring.

5.2.8.2 Lift pallet straight up out of cask.

5.2.8.3 Position the pallet for disposal or future handling.

5.2.8.4 Empty the pallet.

Warning: **Treat all materials removed from the pallet as potentially radiologically contaminated.**

5.2.8.5 Recover pallet for reuse. Clean and decontaminate the pallet, if necessary. Detach the crane hook.

5.2.8.6 Repeat Steps 5.2.8 through 5.2.8.5 to remove and empty the other pallet from the cask.

5.2.9 The Health Physics Technician shall survey the interior of the cask for radiation and contamination levels. Decontaminate if acceptable levels (as per Site procedures) are exceeded.

Warning: **Treat any liquid in the cask or used in decontamination process as potentially radiologically contaminated.**

Warning: **Radioactively contaminated liquids may be pumped out or removed by use of an absorbent material. Removal of any material from inside the cask shall be performed under the supervision of qualified Health Physics personnel with the necessary H.P. monitoring and radiological health safety precautions and safeguards.**

5.2.10 Visually inspect the inside of the cask for damage, foreign materials, or liquid accumulation. If the interior surfaces of the cask are damaged, remove the cask from service and report any noted defects to Energy*Solutions* CMF before proceeding with cask operations. Contact Health Physics Department for instructions on removal of any liquids or foreign materials from the cask cavity.

Caution: **Care should be taken during liner handling operations to prevent damage to cask sealing surfaces.**

5.2.11 Place a new liner in the cask, if required. The liner cables should be taped on the liner to ensure the cables do not interfere with installing the HIC lid. Reload the pallets into the cask, if required.

Note: **Load only one pallet at a time.**

Warning: **Treat any material removed from the bottom of the liner or pallets as potentially radiologically contaminated.**

5.2.11.1 Attach crane hook to slings on liner, the grapple ring on the liner, or to the lifting ring on the pallet and slowly lift the liner or pallet. Clean the bottom of the liner or pallet before placing it into the cask.

Caution: **<u>Do not</u> damage the seal seating surfaces, the sides of the cask, or inner walls.**

5.2.11.2 Carefully lower the liner or pallet into the cask and detach the crane hook.

5.2.11.3 Repeat Steps 5.2.11 and 5.2.11.2 to place other pallet into cask.

5.2.12 Replace primary lid.

Note: **The secondary lid torque must be checked prior to shipment per Steps 5.1.4.5.5 through 5.1.4.5.8.**

5.2.12.1 Attach the crane hook to the three (3) lifting lugs on the primary lid.

Note: **The cables used to lift the primary lid must have a true angle of not less than 45° with respect to the horizontal.**

5.2.12.2 The primary lid seals shall be visually inspected for serviceability ensuring that they are in the proper position and free of cracks, tears, cuts or discontinuities which may prevent them from sealing properly. The seal seating surface shall be visually inspected to ensure that they are free of damage, debris, gravel, or any foreign matter, which might damage the seals or prevent the seals from properly sealing. If any defects are detected, that may prevent the seals from forming a seal, contact Energy*Solutions* CMF. Inspect and clean the seal seating surfaces. A very thin coat of vacuum grease may be applied to the sealing surface of the seal prior to installing and torqueing the lid. Inspect the air test annulus and leak test port to assure that they are free of foreign materials.

Warning: **Treat all debris removed from the bottom surface of the lid as potentially radiologically contaminated.**

5.2.12.3 Clean the bottom surface of the lid and inspect lid bolt holes for damage and accumulation of debris. Remove debris, if required.

5.2.12.4 Visually inspect and clean seal seating surfaces for any damage or material that will prevent seals from forming a seal. If inspection is satisfactory a very thin coat of vacuum grease may be applied. Contact Energy*Solutions* CMF if any damage, nicks, gauges or anything that might interfere with the seal sealing properly.

Caution: **Care should be taken during handling operations to prevent damage to cask sealing surfaces.**

5.2.12.5 Visually inspect the cask lid bolts for defects and obtain replacement for any bolts that show cracking or other visual defects. Lubricate bolt threads, if required and Visually inspect lid bolt holes for damage, defects and accumulation of debris. Remove debris, if required. Contact Energy*Solutions*

CMF for any bolt holes that show signs of cracking or visual signs of distress.

Note: **To more easily seat primary lid; after positioning lid within guide pins approximately 1 inch above cask body, start threading each of the 20 bolts by hand. Once all bolts have been started, clear the area and slowly place the lid onto the cask body.**

5.2.12.6 Lift the primary lid and lower onto the cask and position using alignment marks and alignment pins.

5.2.12.7 Replace and hand tighten the twenty (20) 2-inch primary lid bolts.

Note: **Tighten all the bolts hand-tight before starting the torque sequence.**

Caution: **The use of impact wrenches for the installation of cask lid bolts is not permitted.**

5.2.12.8 Torque all primary lid bolts to 250 ± 25 ft.-lbs. (lubricated), using a star pattern. It is recommended that the bolts be torqued a second time to 250 ± 25 ft. lbs., repeating the star pattern.

Note: **Pneumatic or hydraulic torque wrenches (non-impacting) may be used to install the bolts.**

5.2.12.9 Re-torque all primary lid bolts to 500 ± 50 ft.-lbs. (lubricated), using a star pattern. It is recommended that the bolts be torqued a second time to 500 ± 50 ft. lbs., repeating the star pattern.

5.2.12.10 Check torque on all primary lid bolts, at least once, using a circular pattern to 500 ± 50 ft.-lbs. If any bolts move, go back to Step 5.2.12.9.

5.2.12.11 Torque the vent port socket head cap screw to 20 ± 2-ft. lbs.

Note: **If the vent port socket head cap screw is removed, the vent port seal shall be inspected, if damaged contact Energy*Solutions* CMF. Prior to installation, the vent port seal shall be installed on the vent port socket head cap screw; and a thin layer of anti-seize should be applied to the vent port socket head cap screw threads.**

5.2.12.12 If required by site procedures, install the optional security seal on the primary lid bolts.

5.2.12.13 Ensure that all dirt/clay/debris is removed from the cask lids prior to installation of the cask impact limiter.

5.2.13 Replace secondary lid thermal shield and upper impact limiter.

Warning: **Ensure inner surfaces of impact limiter are below external package limits as specified in Reference 3.2 and/or site release limits. Also, this should include any enclosed surfaces of external cask body.**

5.2.13.1 Using suitable lifting equipment, lift, inspect for damage and install the secondary lid thermal shield. Contact Energy*Solutions* CMF if damage is present. In case required, it shall be verified that the secondary lid thermal shield swivel hoist ring is torqued to 14 ± 2 ft.-lbs.

5.2.13.2 Install the three secondary lid thermal shield retaining pins into the secondary lid lift lugs and insert the retaining device into the retaining pins.

5.2.13.3 Attach the crane hook to the lifting lugs on the impact limiter; lift it, and inspect for damage.

5.2.13.4 Position the impact limiter on cask using alignment marks on the cask body and impact limiter and detach the crane hook.

Note: **Visually inspect ratchet binder bolts for any signs of cracking or other visual defects. Replace any defective bolts or pins.**

5.2.13.5 Replace the top bolts in the ratchet binders. Insert holding pins.

Note: **Tools, wrenches, pipes ect. are not permitted to be used on any cask ratchet binder. Using these tools will cause damage to ratchet binders.**

5.2.13.6 Tighten the ratchet binders hand tight and return ratchet handles to storage position leaving flip block in the lock position.

5.2.13.7 Place security seals on the impact limiter.

5.2.13.8 Install impact limiter lifting lug covers.

5.2.14 Inspect the cask tie-down cables for tightness. Tighten if necessary.

5.2.15 The Health Physics Technician shall survey all exterior surfaces of the cask for contamination and radiation levels. Decontaminate, as required, to meet the limits set in Site radiation and contamination release procedures and Reference 3.2.

5.2.16 Before the empty cask leaves the shipper's facility, the following shall be confirmed:

5.2.16.1 Cask verified to be empty of radioactive waste. For foreign material exclusion concerns, cask internals must also be verified clean and clear of all non-radioactive debris.

5.2.16.2 Cask internal and external removable contamination does not exceed Site Release Limits, 49 CFR 173.428, 49 CFR 173.443, and 10 CFR 71.87, as applicable (see References 3.2 and 3.5).

5.2.16.3 The cask lid bolts and vent port socket head cap screw are properly torqued.

5.2.16.4 Trailer placarding and cask labeling and marking meet D.O.T. specifications in References 3.1 and 3.2 as applicable.

5.2.16.5 That radiation levels conform to requirements as established in Site radiation and contamination release procedures, 49 CFR 173.441 and, and 10 CFR 71.47, as applicable (see References 3.2 and 3.5).

5.2.16.6 That the cask lids and impact limiters are sealed with security seals.

5.2.16.7 That all lifting lugs are removed or properly covered for transport.

5.3 **Removing the Cask from the Trailer**

Note: **Removal of cask from trailer is usually not necessary. Authorization to remove cask from trailer must be granted on a case by case basis. If removal is necessary, authorization may be obtained from Energy*Solutions* CMF.**

5.3.1 Locate the trailer.

5.3.1.1 Position the trailer and cask on a level surface within reach and safe load limit of the crane.

5.3.1.2 Be sure that the trailer is leveled by verifying with a leveling tool. Use the trailer landing gear or airbags to move the trailer up or down.

Warning: **The cask tie-down ratchet binders/turnbuckles have stored energy. Be sure to isolate the eye of the connecting wire rope so that it is not wound up, creating more stored energy that wen release can cause severe injury. Please contact EnergySolutions BLF if needing assistance with removing cask tie-downs.**

5.3.2 Prepare the cask for removal from the trailer.

5.3.2.1 Loosen the cask tie-down cables. Unscrew the shackles from all four of the cask tie-down lugs.

5.3.2.2 Inspect the cask tie-down system. Set the cask tie-downs in a safe location.

5.3.2.3 Using a 5/8" allen wrench, remove the set screw plugs from the cask lift pads.

5.3.2.4 Clean and inspect the cask lift pad lugs.

5.3.2.5 Be aware that the cask must be set back into place using the alignment marks on the bottom impact limiter and cask body.

5.3.2.6 Remove upper impact limiter and secondary lid thermal shield. Follow Steps 5.1.2.1 through 5.1.2.2.2.

5.3.2.7 Check torque on the primary and secondary lid bolts and ensure all bolts are torqued to 500 ± 50 ft.-lbs., using a star pattern.

5.3.2.8 Remove cask lifting lugs from storage rack on trailer.

5.3.2.9 Visually inspect the cask lift lug bolts for defects and obtain replacement bolts from Energy*Solutions* CMF for any bolts that show cracking or other visual defects. Lubricate bolt threads, if required.

5.3.2.10 Visually inspect lid bolt holes for damage, defects and accumulation of debris. Remove debris, if required. Contact CMF for any bolt holes that show signs of cracking or visual signs of distress

5.3.2.11 Install lifting lugs on cask using a 2" socket and torque bolts to 200 ± 20 ft.-lbs. (lubricated).

5.3.2.12 Connect lifting equipment to the two (2) or four (4) cask lifting lugs.

Note: **Adequate lifting and handling equipment is the responsibility of and will be provided by the user.**

Caution: **Do not use primary lid or secondary lid lifting lugs to lift cask.**

Note: **The cables used to lift the cask must have a true angle of not less than 60° with respect to the horizontal.**

5.3.2.13 Lift cask out of bottom impact limiter, using suitable lifting equipment.

Note: **Empty weight of the cask with lids is approximately 51,550 pounds. Maximum expected weight of loaded cask can be up to approximately 65,700 pounds.**

5.3.2.14 Position the cask on a firm, level supported area.

5.3.2.15 Remove the cask lifting equipment, if required, and proceed with cask use.

5.4 **Reinstalling the Cask on Trailer**

5.4.1 Locate the trailer.

5.4.1.1 Position the trailer within reach and safe load limits of the crane.

5.4.1.2 Be sure that the trailer is leveled by verifying with a leveling tool. Use the trailer landing gear or airbags to move the trailer up or down

5.4.2 Prepare cask for reinstallation on trailer.

5.4.2.1 Verify that all lid bolts on the primary lid are torqued to 500 ± 50 ft.-lbs..

5.4.2.2 Reinstall the two (2) or four (4) cask lifting lugs per Steps 5.3.2.3 - 5.3.2.11, where applicable.

5.4.3 Connect lifting equipment to the two cask lifting lugs.

Note: **The cables used to lift the cask must have a true angle of not less than 60° with respect to the horizontal.**

Caution: Do not lift cask by lifting lugs on the primary or secondary lids.

Caution: Be sure the lifting equipment is adequate to lift the cask. The empty weight of cask with lids and thermal shield is approximately 51,550 pounds. Maximum expected weight of a loaded cask is approximately 65,700 pounds.

5.4.4 Prepare mounting surfaces on bottom impact limiter and cask.

Warning: Ensure inner surfaces of impact limiter are below external package limits as specified in Reference 3.2 and/or site release limits. Also, this should include any enclosed surfaces of external cask body.

5.4.4.1 Wipe clean the inside surface of the bottom impact limiter.

5.4.4.2 Verify the interior of the bottom impact limiter is free of debris and has no obvious damage (e.g., rust, holes, gouges, cracks, etc.). Notify Energy*Solutions* CMF if damage is observed.

5.4.4.3 Lift the cask.

5.4.4.4 Inspect and clean the bottom surface of the cask.

5.4.4.5 Verify exterior cask bottom and lower impact limiter surfaces has no obvious damage (e.g., rust, holes, gouges, cracks, etc.). Notify Energy*Solutions* CMF if damage is observed.

5.4.5 Position and slowly lower the cask inside the bottom impact limiter using the alignment mark that was noticed when the cask was removed from the bottom impact limiter.

Caution: Lower cask into bottom impact limiter very slowly to prevent any damage.

5.4.6 Install security seal between lower impact limiter and cask body.

5.4.7 Unbolt and remove cask lifting lugs from the cask and mount the cask lifting lugs on the storage rack on the trailer. Install and securely tighten the bolts.

5.4.8 Replace the cask tie-down cables and tighten.

5.4.9 Replace the secondary lid thermal shield and upper impact limiter. Follow Steps 5.1.2.7 through 5.1.2.7.8.

5.4.10 Return to proper point in handling procedure and proceed with preparing the cask for transport.

5.5. **Preparation of Empty Packaging for Transportation**

Note: The procedural steps for preparing empty packaging for transportation at the unloading facility are included in Section 5.2. The procedure described in this section is intended to be used when an empty package is prepared for transportation at a location other than an unloading facility.

Note: After completing Step 5.5.7, verify that nothing is obstructing the viewing of cask information. Tape, magnets, or any other objects may NOT be placed over the cask CoC number, Model/Serial number, name plate information, Type-B, tri-foil, etc.

Note: If shipping the cask radioactive empty, UN2908, pre-shipment leak testing is not required.

5.5.1 Confirm that the cask cavity is empty of radioactive waste contents, to the extent practicable. For foreign material exclusion concerns, cask internals must also be verified clean and clear of all non-radioactive debris.

5.5.2 Survey the cask interior to confirm that the removable contamination does not exceed the limits of 49 CFR 173.428(d). Decontaminate the cask interior as necessary to satisfy the removable contamination does not exceed the limits of 49 CFR 173.428(d).

5.5.3 Replace primary lid.

Note: The secondary lid torque must be checked prior to shipment per Steps 5.1.4.5.5 through 5.1.4.5.8.

5.5.3.1 Attach the crane hook to the three (3) lifting lugs on the primary lid.

Note: The cables used to lift the primary lid must have a true angle of not less than 45° with respect to the horizontal.

5.5.3.2 The primary lid seals shall be visually inspected for serviceability ensuring that they are in the proper position and free of cracks, tears, cuts or discontinuities which may prevent them from sealing properly. The seal seating surface shall be visually inspected to ensure that they are free of damage, debris, gravel, or any foreign matter, which might damage the seals or prevent the seals from properly sealing. If any defects are detected, that may prevent the seals from forming a seal, contact Energy*Solutions* CMF. Inspect and clean the seal

seating surfaces. A very thin coat of vacuum grease may be applied to the sealing surface of the seal prior to installing and torqueing the lid. Inspect the air test annulus and leak test port to assure that they are free of foreign materials.

Warning: Treat all debris removed from the bottom surface of the lid as potentially radiologically contaminated.

5.5.3.3 Clean the bottom surface of the lid and inspect lid bolt holes for damage and accumulation of debris. Remove debris, if required.

5.5.3.4 Visually inspect and clean seal seating surfaces for any damage or material that will prevent seals from forming a seal. If inspection is satisfactory a very thin coat of vacuum grease may be applied. Contact Energy*Solutions* CMF if any damage, nicks, gauges or anything that might interfere with the seals sealing properly.

Caution: Care should be taken during handling operations to prevent damage to cask sealing surfaces.

5.5.3.5 Visually inspect the cask lid bolts for defects and obtain replacement for any bolts that show cracking or other visual defects. Lubricate bolt threads, if required and Visually inspect lid bolt holes for damage, defects and accumulation of debris. Remove debris, if required. Contact Energy*Solutions* CMF for any bolt holes that show signs of cracking or visual signs of distress.

5.5.3.6 Lift the primary lid and lower onto the cask and position using alignment marks and alignment pins.

Note: To more easily seat primary lid; after positioning lid within guide pins approximately 1 inch above cask body, start threading each of the 20 bolts by hand. Once all bolts have been started, clear the area and slowly place the lid onto the cask body.

5.5.3.7 Replace and hand tighten the twenty (20) 2-inch primary lid bolts.

Note: Tighten all the bolts hand-tight before starting the torque sequence.

Caution: The use of impact wrenches for the installation of cask lid bolts is not permitted.

5.5.3.8 Torque all primary lid bolts to 250 ± 25 ft.-lbs. (lubricated), using a star pattern. It is recommended that the bolts be torqued a second time to 250 ± 25 ft. lbs., repeating the star pattern.

Note: **Pneumatic or hydraulic torque wrenches (non-impacting) may be used to install the bolts.**

5.5.3.9 Re-torque all primary lid bolts to 500 ± 50 ft.-lbs. (lubricated), using a star pattern. It is recommended that the bolts be torqued a second time to 500 ± 50 ft. lbs., repeating the star pattern.

5.5.3.10 Check torque on all primary lid bolts, at least once, using a circular pattern to 500 ± 50 ft.-lbs. If any bolts move, go back to Step 5.5.1.9.

5.5.3.11 Torque the vent port socket head cap screw to 20 ± 2-ft. lbs.

Note: **If the vent port socket head cap screw is removed, the vent port seal shall be inspected. If the vent port seal is damaged contact Energy*Solutions* CMF. Prior to installation, the vent port seal shall be installed on the vent port socket head cap screw; and a thin layer of anti-seize should be applied to the vent port socket head cap screw threads.**

5.5.3.12 If required by site procedures, install the optional security seal on the primary lid bolts.

5.5.3.13 Ensure that all dirt/clay/debris is removed from the cask lids prior to installation of the cask impact limiter.

5.5.4 Replace secondary lid thermal shield and upper impact limiter.

Warning: **Ensure inner surfaces of impact limiter are below external package limits as specified in Reference 3.2 and/or site release limits. Also, this should include any enclosed surfaces of external cask body.**

5.5.4.1 Using suitable lifting equipment, lift, inspect for damage and install the secondary lid thermal shield. Contact Energy*Solutions* CMF if damage is present. In case required, it shall be verified that the secondary lid thermal shield swivel hoist ring is torqued to 14 ± 2 ft.-lbs

5.5.4.2 Install the three secondary lid thermal shield retaining pins into the secondary lid lift lugs and insert the retaining device into the retaining pins.

5.5.4.3 Attach the crane hook to the lifting lugs on the impact limiter; lift it, and inspect for damage.

5.5.4.4 Position the impact limiter on cask using alignment marks on the cask body and impact limiter and detach the crane hook.

5.5.4.5 Replace the top bolts in the ratchet binders. Insert holding pins.

Note: **Visually inspect ratchet binder bolts for any signs of cracking or other visual defects. Replace any defective bolts or pins.**

5.5.4.6 Tighten the ratchet binders hand tight and return ratchet handles to storage position leaving flip block in the lock position.

Note: **Tools, wrenches, pipes etc. are not permitted to be used on any cask ratchet binder. Using these tools will cause damage to ratchet binders.**

5.5.4.7 Place security seals on the impact limiter.

5.5.4.8 Install impact limiter lifting lug covers.

5.5.5 Inspect the cask tie-down cables for tightness. Tighten if necessary.

5.5.6 The Health Physics Technician shall survey all exterior surfaces of the cask for contamination and radiation levels. Decontaminate, as required, to meet the limits set in Site radiation and contamination release procedures and Reference 3.2.

5.5.7 Before the empty cask leaves the shipper's facility, the following shall be confirmed:

5.5.7.1 Cask verified to be empty of radioactive waste. For foreign material exclusion concerns, cask internals must also be verified clean and clear of all non-radioactive debris.

5.5.7.2 Cask internal and external removable contamination does not exceed Site Release Limits, 49 CFR 173.428, 49 CFR 173.443, and 10 CFR 71.87, as applicable (see References 3.2 and 3.5).

5.5.7.3 The cask lid bolts and vent port socket head cap screw are properly torqued.

5.5.7.4 Trailer placarding and cask labeling and marking meet D.O.T. specifications in References 3.1 and 3.2 as applicable.

5.5.7.5 That radiation levels conform to requirements as established in Site radiation and contamination release procedures, 49 CFR 173.441 and, and 10 CFR 71.47, as applicable (see References 3.2 and 3.5).

5.5.7.6 That the cask lids and impact limiters are sealed with security seals.

5.5.7.7 That all lifting lugs are removed or properly covered for transport.

6.0 RECORDS AND REPORTS

The following reports shall accompany all loaded shipments and be maintained in accordance with Reference 3.4 or other facility applicable records requirements.

6.1 Shipping papers per 49 CFR Part 172 (see Reference 3.1) - prepared and certified by the shipper

6.2 Vehicle Radiation Survey - prepared and certified by the shipper.

6.3 User Check-Off Sheet or equivalent form - prepared and signed by the shipper (see Attachment 7.1).

6.4 Prior Notification Forms (if required).

6.5 State Permit Forms (if required).

6.6 Statement that pre-shipment leak test of cask has been completed.

7.0 ATTACHMENTS

7.1 User Check-Off Sheet

Trailer CKB17084

Attachment 7.1
USER CHECK-OFF SHEET

Date 5-29-19 Shipment Number 19-077 Waste Identification 638712-1

Operator(s) Zach Green / Jamie Lulloff HP Technician(s) Jim Meyer

Cask ID/Serial Number 8-120B-7

Shipper Gene LaClair Driver Ralph Hudson / Rich Ford

Time of arrival on site 0700 Time of departure from site 1030 5/30/19

PLEASE INITIAL WHEN COMPLETED	OPERATOR (O)	SHIPPER (S)
1) Two independent physical verifications of secondary container's closure system, if required.		
2) Check interior of cask, bolts and bolt holes for foreign material / water		
3) Primary and secondary lid seals /seating surfaces are inspected (when applicable)		
4) Vent port STAT-O-SEAL and Cap Screw are inspected (when applicable)	TB	
5) Primary and Secondary lid bolts torqued Torque wrench data: Serial # MCTC-002 Calibration Date ____ Calibration Due Date 9-14-19		
6) Vent Port Cap Screw torqued Torque wrench data: Serial # MCTW-076 Calibration Date 5-22-19 Calibration Due Date 5-22-20	TB	
7) Secondary Lid thermal shield replaced		
8) Impact limiter ratchet binders replaced, hand tighten and left in the lock position		
9) For an 8-120B cask shipment, both Primary and Secondary Lids and Vent Port seals have been pre-shipment leak tested per Reference 3.3.	TB	
10) All 3 test port set screw plugs replaced/hand tightened and vent port socket head cap screw with seal replaced/torqued Torque wrench data: Serial # MCTW-076 Calibration Date 5-22-19 Calibration Due Date 5-22-20	TB	
11) If cask removed from lower impact limiter; follow Steps 5.4.4.2 through 5.4.4.5. and forward bottom of cask/lower impact survey to Energy*Solutions* CMF.	N/A	N/A
12) Upper impact limiter to cask body security seal installed. Seal # 0571895		
13) Other Security Seals on Secondary and Primary lid, Cask Body to Lower Impact, Upper Impact Man Way and Trailer Tool Box Installed or Verified in place.		
14) Impact limiter lifting lug covers replaced		
15) Cask tie-downs hand tighten, inspected and taunted		
16) Cask labels and marking adhered correctly and legible.		

PLEASE COMPLETE AND INITIAL	SHIPPER/SUPERVISOR (S)	HEALTH PHYSICS TECH (HP)	
17) Cask payload (including shoring)	Max. 12,250 lbs.	Actual 5750	Initials
18) Decay heat (if applicable)	Max. 200 W	Actual 0.347	Initials
19) Gamma - ____ at 2 meters from trailer		(HP)	(S)
20) Gamma - 15 at cask surface (Top)		(HP)	(S)
21) Gamma - ____ in tractor cab		(HP)	(S)
22) Smearable beta-gamma (d/m/100 cm^2) ____		(HP)	(S)
23) Smearable alpha (d/m/100 cm^2) ____		(HP)	(S)

I hereby certify that the above statements are correct and the cask has been loaded and tested in accordance with approved procedures.

Operators: Jamie Lulloff, Zach Green, Troy Beasley / Energy Solutions

Health Physics Tech(s): Jim Meyer, Doug Swanson

Supervisors/Shipper(s): Gene LaClair

2.4 Energy*Solutions* C-110-E-0007, Rev.24, 8-120B Shipping Cask

2.5 Leak Testing Specialists, LLC: PQRT No: PCMT-PRESSURE DECAY-ES-8-120B-04-2017, Revision 3622-01, Procedure Qualification Record Package (PQRP) for pressure decay leak test, pre-shipment leak test of 8-120B cask closures.

2.6 ASTM E2930-13, Standard Practice for Pressure Decay Leak Test Method.

2.7 Energy*Solutions*, ES-QA-PR-006, Qualification and Certification of Nondestructive Testing Personnel (Written Practice), effective revision

2.8 ASNT - Recommended Practice No. SNT-TC-1A (Personal Qualification and Certification in Nondestructive Testing) 2006, 2011 and 2016 Editions

2.9 Energy*Solutions* CS-QA-WI-002, Measuring and Test Equipment Calibration, effective revision

3. PERSONNEL

3.1 Energy*Solutions* personnel who perform and/or evaluate leak tests shall be qualified and certified as Level II PCMT, Level II Limited PCMT (certified for 8-120B cask PCMT), or Level III, LT in accordance with Reference 2.7.

3.2 Trainees and Level I PCMT operators can work under the direct supervision of a Level II PCMT, Level II Limited PCMT (certified for 8-120B cask PCMT) or Level III individual.

3.3 Employees of organizations other than Energy*Solutions* who perform and/or evaluate leak tests shall be qualified and certified as Level II PCMT, Level II-Limited PCMT (certified for 8-120B cask PCMT), or Level III, LT in accordance with Reference 2.8 based on the requirement provided in Section 8.8 of Reference 2.2.

3.4 Operations and/or maintenance personnel are responsible for preparing a cask for testing using Reference 2.1 and providing handling support during a pre-shipment leak test.

4. DEFINITIONS

4.1 Terms:

4.1.1 *Set Screw Plug* — 1-1/2" set screw used as a cover to plug all 3 test ports (primary/secondary lid and vent ports); Reference 2.4, Item 34.

4.1.2 *Socket Head Cap Screw* — 1/2" socket head cap screw (together with STAT-O-SEAL) used to plug vent port; Reference 2.4, Item 27.

4.1.3 *Lid Bolts* — 2" hex head bolt used to fasten primary and secondary lids to cask body; Reference 2.4, Item 39.

4.1.4 *Vent Port Seal* — STAT-O-SEAL to seal vent port; Reference 2.4, Item 26.

4.1.5 *Lid Seals* — Inner and outer O-rings used to seal primary and secondary lids; Reference 2.4, Items 22 thru 25.

4.1.6 *Manifold Gasket* — Gasket placed on the bottom 8-120B cask manifold test/vent port connector before installation (See Attachment D, Item 9).

4.1.7 CL – Calibrated Air Flow Leak Standard (Calibrated Leak)

4.2 Symbols and Abbreviations

Symbol	Units	Description
$P_{ambient}$	Psia	The ambient air pressure in the area of the test
$T_{surface}$	°C	Temperature of the primary or secondary lid surface (measured within 3 inches from test manifold)
$T_{ambient}$	°C	The ambient air temperature in the area of the test
CL_{Temp}	°C	Temperature of CL
$T_{Calibrated\ Leak}$	atm cc/sec __% /°C	Certified calibrated leak leakage rate with temperature correction factor
T_{Press}	min or sec	The minimum pressure stability verification time from Table 1
$T_{Min\ Dwell}$	min or sec	The minimum test dwell time duration from Table 2
$P_{Initial\ Prelim\ Cal}$	Psig	Initial pressure for a preliminary system calibration
$P_{Final\ Prelim\ Cal}$	Psig	Final pressure for a preliminary system calibration
$P_{Initial\ Final\ Cal}$	Psig	Initial pressure for a final system calibration
$P_{Final\ Final\ Cal}$	Psig	Final pressure for a final system calibration
$T_{Fin\ Dwell}$	min or sec	Finalized dwell time (longer duration of $T_{Min\ Dwell}$ or 5 (five) increments of pressure resolution
$T_{Li\ start}$	°C	Temperature of the primary or secondary lid surface (measured within 3 inches from test manifold) at the beginning of the Leak Detection Test
$T_{Li\ end}$	°C	Temperature of the primary or secondary lid surface (measured within 3 inches from test manifold) at the end of the Leak Detection Test

5. TOOLS, MATERIALS AND EQUIPMENT

5.1 Equipment

Note: All M&TE equipment listed in this section is managed by Energy*Solutions* per Reference 2.9[2].

5.1.1 A manually powered air pump or clean dry air supply or bottled nitrogen.

5.1.2 Calibrated Leak

5.1.2.1 **LACO model CM52H-41008AO/1/17-2 or equivalent** as determined by Energy*Solutions* Level III, LT. (Other manufacturers and models of calibrated standard leak may be added to this procedure following Level III review of supplier and validation of test temperature limitation).

5.1.2.2 Have a NIST traceable calibration that has been performed within the preceding one year (12 months).

5.1.2.3 Be a stainless steel or other non-fragile, corrosion resistant material.

5.1.2.4 Be a non-reservoir (open end) leak. Have a calibrated air or nitrogen leakage rate that is less than the equivalent of 8.75 E-04 atm-cc/sec at an upstream pressure of at least two atmospheres absolute, and downstream pressure of one atmosphere[3].

5.1.3 Pressure Gauge

5.1.3.1 **The Ashcroft DG 25, -14.7 to 30 psig** compound pressure gauge with resolution of 0.01 psig has been qualified (Reference 2.5) for this procedure.

5.1.3.2 The gauge shall have a NIST traceable calibration[4].

5.1.4 Temperature Measuring Device

5.1.4.1 Calibrated Temperature Measuring Device (Thermometer) with resolution of 0.1°C or smaller and current calibration traceable to a NIST standard is required.

5.1.5 Timer

5.1.5.1 Stopwatch, timer or other time keeping device. The stopwatch or other time keeping device which is used for the determination and control of the minimum test dwell times shall have a current calibration certificate or verification completed.

5.1.6 Test manifold

5.1.6.1 Test Manifold with fittings, valves, and tubing with appropriate end connection and manifold gasket to connect to 8-120B cask lid test port (see Attachment D, Items 8 and 9).

5.2 Materials

5.2.1 Cleaning Agent (solvents)

5.2.1.1 If needed for permanent cask equipment, cleaning agents shall be supplied and shall be Acetone, Isopropanol, or other solvent permitted by Energy*Solutions*.

5.2.2 Seal lubricant

5.2.2.1 Where needed for seal installation, approved by Energy*Solutions* light coat of O-ring lubricant (Parker Super-O-Lube) can be used.

5.2.3 Fasteners lubricant

5.2.3.1 Moly-Z, Neolube, or anti-seize or equivalent as permitted by Energy*Solutions*.

5.3 Tools

Note: Tools are covered in Reference 2.1 and provided in this document for information only.

5.3.1 Sockets and wrenches

5.3.1.1 3/8" allen wrench by 3/8" drive socket

5.3.1.2 3/4" allen wrench

5.3.2 Calibrated 0-75 ft.-lb. and 0-600 ft-lb. torque wrench, or equivalent, with appropriate adapters.

ENERGYSOLUTIONS

TR-TP-008

Pre-Shipment Leak Test for Model 8-120B Cask NRC Certificate of Compliance 9168, Rev. 24

Revision 1

Authored By:	Signature on File Trey Beasley, Cask Lead Technician	12/18/2018 Date
Reviewed By:	Signature on File Michael Frassica, Cask Engineer	12/18/2018 Date
Reviewed By:	Signature on File Richard Byars, Director of QA	12/18/2018 Date
Approved By:	Signature on File Aleksandr Gelfond, Cask Licensing Manager and ASNT NDT Level III in LT	12/18/2018 Date

[ ] Non-Proprietary
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[ ] Restricted Information

[ ] New
[ ] Title Change
[X] Revision
[ ] Rewrite

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RECORD OF REVISIONS

Revision	Revision Title Description and Reason for Change
0	Initial issue
1	• Revision of Table 1 to provide minimum acceptable volumes for primary and secondary lids based on 8-120B cask mock up pre-shipment leak test trials. Rational for a change is provided in endnote 9 of Attachment E • Revision of Attachment B – revise acceptable minimum volumes (see above) + editorial changes of the form • Editorial changes in Section 8 • Revision of Attachment E: Endnote 9

Table of Contents

1. SCOPE

1.1 Purpose

1.1.1 This procedure delineates the requirements for performing pre-shipment leakage rate testing (pre-shipment leak tests) on the Model 8-120B shipping cask containment system in compliance with References 2.2 and 2.3. These tests are established to show that the Model 8-120B cask has been assembled correctly. This procedure covers a pressure decay leak test technique.

1.2 Applicability

1.2.1 This procedure establishes the method for a pre-shipment leak testing of the Model 8-120B shipping cask used under Reference 2.3.

1.2.2 This procedure is applicable to a pre-shipment leak test of the following closures:

1.2.2.1 Primary and secondary lids O-ring containment boundary seals.

1.2.2.2 Vent port plug closure seal (STAT-O-SEAL).

1.2.3 This procedure is issued only for a pre-shipment leak test of 8-120B cask closures to sensitivity equal or larger (more sensitive) than 1×10^{-3} ref-cm^3/sec of air as described in Reference 2.2.

1.2.4 Procedure Qualification Testing to support this procedure was performed and documented in Reference 2.5.

1.2.5 This procedure shall be used when environment, equipment and cask lid metal temperatures are between 25 (-4 °C) to 140 degrees Fahrenheit (60°C) inclusive[1].

2. REFERENCES

2.1 TR-OP-035, Handling Procedure for Transport Cask Model 8-120B cask, Certificate of Compliance Number 9168, effective revision.

2.2 ANSI N14.5-2014, American National Standard for Radioactive Materials-Leakage Tests on Packages for Shipment.

2.3 NRC Certificate of Compliance for Radioactive Materials Package, Certificate Number 9168, Rev. 24 for package Identification Number USA/9168/B(U)-96

6. TEST PREPARATION

6.1 Prerequisites

6.1.1 If shipping the cask as a Type-B package, the primary/secondary lids and vent port seals must be leak tested prior to every 8-120B cask shipment, whether or not lid/ lid bolts or the vent port socket head cap screw have been removed.

6.1.2 This procedure must be used with the latest revision of the 8-120B cask handling procedure, TR-OP-035 (Reference 2.1).

6.1.3 Cleanliness — Cleanliness requirements for these closures are addressed in References 2.1 and 2.2.

6.1.4 The cask shall be examined visually for integrity, condition of seals, and sealing surfaces.

6.1.5 Prior to performing pre-shipment leak tests, the user should conduct the following inspections (with ***exception*** listed below) regardless of whether primary and/or secondary lid is required to be removed/replaced during cask handling operations.

6.1.5.1 Visually inspect the accessible seals and seal seating surfaces of the primary and secondary lids. Ensure that these surfaces are free of debris, dirt and any other potential contaminants. If the seal surfaces have to be cleaned use a lint free cloth with moderate amount of isopropyl alcohol or acetone and, if necessary, apply a very light (thin) coat of vacuum grease (for example, Parker Super-O-Lube) on seal's exposed surfaces. Do not attempt to remove seals from their respective dovetail grooves located on a cask lid.

6.1.5.2 Inspect primary/secondary lid test ports to ensure that they are not blocked and are free of dirt and/or grease. Clean lid test ports, as necessary.

6.1.5.3 Visually inspect the vent test port for any obstructions, and clean the port as necessary (The vent port socket head cap screw should only be loosened or removed to relieve internal cask pressure in order to lift lids or to investigate vent port test failures).

Exception: **If during loading process Energy*Solutions* optional tamper seal connecting two adjacent lid bolts on primary or secondary lid closure remain unbroken (primary or secondary lid and its bolts have not been removed during handling operations), the closure with un-tampered seal does not need to be removed for inspection of seals and sealing surfaces, but verification of required lid bolt torque and pre-shipment leak test is required to verify proper cask assembly.**

6.1.6 Inspect pre-shipment leakage rate testing hardware and M&TE equipment for damages.

6.1.7 Record essential information in CASK LEAK TEST INFORMATION AND EQUIPMENT sections of Attachment B.

6.1.8 Measure and record essential information associated with ambient temperature ($T_{ambient}$), temperature of lid surface ($T_{surface}$), temperature of calibrated leak (CL_{temp}) in MEASUREMENTS section of Attachment B. Determine ambient pressure ($P_{ambient}$)[5] and record it in MEASUREMENTS Section.

6.2 Test Considerations

6.2.1 Before performing pre-shipment leak tests, the closure and the test hardware shall be allowed to attain a stable temperature. Consideration shall be given to measures that will minimize the effect of temperature variation during execution of this procedure.

6.2.1.1 The test hardware should be co-located with the cask closures for at least two hours preceding the leak test and preferably for a full work shift.

6.2.1.2 During the co-location for attaining temperature stabilization, the test hardware may not be insulated.

6.2.1.3 When preparing to test, insulation of the test hardware should be considered.

6.2.1.4 The test hardware and object shall be shielded for drafts from sources that would cause temperature variation of the test hardware.

6.2.1.5 The test hardware and object shall be shielded from unnecessary radiant heat sources such as near location of high heat intensity lights.

6.2.2 If any of the containment seals (primary/secondary lid or vent port) need to be replaced for any reason, the cask shall be unloaded and sent to Energy*Solutions* maintenance facility for seal replacement and performance of mandatory maintenance/periodic leak test.

6.2.3 Ensure that the cask body/lids and leak test manifolds attain the same temperature. Due to high thermal inertia of the cask, it may be required to thermally balance cask components, manifolds and external environment.

6.2.4 Depending on the environmental conditions and specific geometry of cask closures, pressure stabilization timeframes may vary.

6.2.5 There is no specific requirement associated with sequence for leak testing of cask closures (primary/secondary lids and vent port); however, for ALARA purposes such sequences shall be considered. For example, if cask is loaded with payload and primary/secondary lid has been removed, it is recommended that the leak test of vent port and secondary lid is completed first.

7. DETAILED PROCEDURE FOR PRE-SHIPMENT LEAK TESTS

Note: **Pre-shipment leak test installation configuration for primary and secondary lid is provided in Section 7.2. Pre-shipment leak test installation configuration for vent port is provided in Section 7.3.**

7.1 Pre-Shipment Leak Test Considerations

7.1.1 DO NOT over-tighten the test manifold when connecting it to the test ports. If it is over-tightened, manifold adapter, or test port sealing surfaces may be damaged.

7.1.2 Review the troubleshooting guide listed in Attachment C prior to performing the pre-shipment leak tests.

7.1.3 Pre-shipment leak test installation configuration for primary/secondary lid seals is described in Section 7.2 (See Figure 1 of Attachment A).

7.1.4 Pre-shipment leak test installation configuration for vent port seal is described in Section 7.3 (See Figure 2 of Attachment A).

7.1.5 After completion of Section 7.2 or 7.3 (depending on the test sequence), technician shall proceed to Section 7.4.

7.2 Pre-Shipment Leak Test Installation Configuration for 8-120B Cask Primary and Secondary Lid Seals

7.2.1 Ensure that the cask is assembled in accordance with References 2.1 and 2.3.

7.2.2 Verify that cask lid bolts are properly torqued to values listed in Reference 2.1.

7.2.3 Using a 3/4-inch allen wrench, remove set screw plug from the primary/secondary lid test port. Retain for reinstallation.

7.2.4 Verify that the primary/secondary lid test port is free of any debris/foreign material. Remove any debris /foreign material found in the primary/secondary lid test port, as necessary.

Note: Over tightening of the test manifold sleeve nut can cause damage to the test manifold gasket, the primary/secondary lid test port threads or/and the primary/secondary lid port sealing surface. To prevent damage, use caution and proceed slowly to ensure that the test manifold sleeve nut is not over tightened.

7.2.5 Ensure that the Test Manifold gasket is in good condition and lubricated. Replace if necessary. Attach the Test Manifold to the primary or secondary lid test port by placing the Test Manifold stinger down into test port. Next, hand tighten the Test Manifold sleeve nut until it is snug. If needed, a wrench may be used to tighten the test manifold sleeve nut. Figure 1 in Attachment A shows assembled configuration for pre-shipment leak test for the 8-120B cask primary and secondary lid seals.

7.3 Pre-Shipment Leak Test Installation Configuration For 8-120B Cask Vent Port Seal

7.3.1 Verify that that the cask is assembled in accordance with References 2.1 and 2.3.

7.3.2 Using a 3/4-inch allen wrench, remove the set screw plug from the vent test port. Retain for reinstallation.

7.3.3 Verify that the vent test port is free of any debris/foreign material. Remove any debris /foreign material found in the vent test port, as necessary.

7.3.4 Using a 3/8" allen wrench by 3/8" drive socket, verify the torque on the vent port socket head cap screw to be 20 ft-lbs (+/- 2 ft-lbs.).

Note: Over tightening of the test manifold sleeve nut can cause damage to the test manifold gasket, the vent test port threads or/and vent port sealing surface. To prevent damage, use caution and proceed slowly to ensure that the test manifold sleeve nut is not over tightened.

7.3.5 Ensure that the test manifold gasket is in good condition and lubricated. Replace if necessary. Attach the Test Manifold to vent port test port by placing the manifold stinger down into the vent port. Next, hand tighten the manifold sleeve nut until it is snug. If needed, a wrench may be used to tighten the manifold sleeve nut. Figure 2 in Attachment A shows assembled configuration for a pre-shipment leak test for the 8-120B cask vent port seal.

7.4 Test Volume Determination[7]

Note: The test volume verification is necessary to ensure that the test volume is not obstructed. Refer to Figure 1 of Attachment A for the test diagram. The test volume is determined using guidance from Reference 2.6. Due to simple geometry to of the vent port, verification of vent port test volume is not required.

7.4.1 Test Sequence

7.4.1.1 Check position of valves: V1- Open, V2- Open and V_{CL} - Open.

7.4.1.2 Close V_{CL} and energize the pressure gauge. Tare (or zero) the gauge.

7.4.1.3 Connect Manual Air Pump via quick disconnect and pressurize the system to be between 17-18 psig.

7.4.1.4 Close V1 and disconnect the manual pump. Allow the pressure to stabilize within 30 seconds.

7.4.1.5 Record the pressure P_1 in absolute pressure (psia) in Section 1 of Attachment B.

7.4.1.6 Close V2 and Open V1 to release the air. Verify that the pressure is released using the gauge.

7.4.1.7 Close V1, Open V2 and record final pressure reading P_2 in absolute pressure (psia) in Section 1 of Attachment B.

7.4.2 Calculate Test Volume:

7.4.2.1 Test Volume (V_t) = $V1 * ((P_2 - P_{ambient})/(P_1 - P_2)) - V_2$. Where V_1 =8 cc, V_2 =5 cc[3] and $P_{ambient}$ = Ambient Pressure (for example, 14.7 psia for a sea level).

Note: All pressure readings shall be converted to absolute pressure (psia). Test volumes shall be converted to cubic centimeters (cc).

7.4.2.2 Calculate Test Volume in cubic centimeters (cc) and record in Section 6.1 of Attachment B.

Table 1: Acceptable test volumes for Primary/Secondary Lids[7]

Component	Measure Volume (cc)
Primary Lid	Volume >60 cc
Secondary Lid	Volume >25 cc

7.4.2.3 If the test volume is acceptable (larger than minimum volumes as indicated on Table 1), proceed with recording of this information in Section 6 of Attachment B.

7.4.2.4 If the test volume is not acceptable, inspect and resolve obstructions in the test volume and repeat the test sequence.

7.4.2.5 Open V1 (release air pressure) and V_{CL}

7.5 Pressure Stabilization[10]

7.5.1 Check position of valves: V1- Open, V2- Open and V_{CL} - Open

7.5.2 Connect manual air pump to the manifold quick disconnect.

7.5.3 Pressurize the volume to 18-20 psi above the $P_{ambient}$, but not more than 20 psi above the $P_{ambient}$ (i.e. 18 to 20 psig, or $P_{ambient}$ plus 18 to 20 psia).

7.5.4 Close V1 and disconnect manual pump

7.5.5 Close V_{CL}.

7.5.6 Allow the pressure to stabilize. Monitor the pressure for the time increment equal to at least the time indicated in Table 2 below[11].

Table 2: Minimum Pressure Stability Verification Time (T_{press})

Component	Time (min)
Primary Lid	9
Secondary Lid	4
Vent Port	2

Note: An initial decay in pressure is expected as the adiabatic heat is dissipated, and as the added air distributes across the metal to

metal interfaces and into any small virtual leaks in the closure being tested.

Note: A persistent, continuous, or substantial pressure loss may be indicative of either a test system leak, or possibly a leak across the closure being tested.

Note: The addition of air to bring the pressure back up to the minimum initial pressure of 18 to 20 psi above ambient is permitted during the pressure stabilization of the closure as long as criteria below is met.

7.5.7 Upon observation of adequate pressure stabilization (shall be within ± 0.01 psi change) since the start of pressure stability verification time duration shown in Table 2 above, proceed to the following step.

7.5.8 Initial the leak test report to document that the pressure stability has been verified (Section 2 of Attachment B).

7.5.9 Do not release air from the system. Verify that the pressure remains high enough to complete further test sequence (at least 17.5 psig, or 17.5 psia above $P_{ambient}$). If the indicated pressure is less than 17.5 psig, repeat steps above.

7.6 Preliminary System Calibration and Test Dwell Time Determination

7.6.1 Ensure that valves are positioned as follows with air supply disconnected from the manifold: V1- Close, V2- Open and V_{CT} - Close, Open V_{CL} valve. The pressure shall remain above 17 psig.

7.6.2 Record the initial pressure $P_{Initial\ Pre\text{-}Cal}$ (in Section 3 of Attachment B) at elapsed time 0:00 and start the timer.

7.6.3 Record the longer of the following as $T_{Test\ Dwell}$

7.6.3.1 Elapsed time required to observe 5 increments of pressure decay (5 x 0.01 – 0.05 psi), or

7.6.3.2 The minimum test dwell time ($T_{Min\ Dwell}$) from Table 3 below[12].

7.6.4 Record the end pressure at the end of test dwell time as $P_{Final\ Pre\text{-}Cal}$ in preliminary system calibration section (Section 3 of Attachment B).

Notes: For the Primary and Secondary lid closures: record the pressure indication at intervals of 1 minute until a time interval at least equal to the minimum test dwell time

shown in Table 3 and there has been a change in pressure equal to at least 5 divisions of pressure resolution. E.g. if pressure resolution is 0.01 psi, then 5 divisions equal 0.05 psi.

Note: For the Vent Plug port closure, record the pressure indication at intervals of 15 seconds until a time interval at least equal to the minimum test dwell time shown in Table 3, and until there has been a change in pressure equal to at least 0.05 psi (5 scale divisions of 0.01 psi each). A missed interval recording is not a cause to restart the timing.

Table 3: Minimum test dwell time for preliminary system calibration ($T_{Min\ Dwell}$)[13]

Component	Time (min)
Primary Lid	9
Secondary Lid	4
Vent Port	2

7.7 Leakage Detection (LD)

7.7.1 Ensure that the pressure is at least 16.8 psig, or 16.8 psia above $P_{ambient}$ and valves are positioned as follows with air supply disconnected from the manifold: V1- Close, V2- Open and V_{CT} - Open.

7.7.2 Close V_{CT}

7.7.3 Allow the pressure to stabilize for at least 10 seconds.

7.7.4 Measure and record temperature of the primary or secondary lid base material surface (within 3 inches from the test manifold) as T_{lid_start}[14]

7.7.5 Re-set timer. Start timer. Record the indicated pressure at intervals of 30 seconds or 1 minute (for lid closures) or 15 seconds (for vent port closures) for an elapsed time at least equal to the $T_{Test\ Dwell}$ for each closure as shown in Section 4 of Attachment B.

7.7.6 Upon completion of an elapsed time measure and record the temperature T_{lid_end}.

7.7.7 Perform an evaluation as follows:

7.7.7.1 Pressure: A change in the indicated pressure of ± 1 x the smallest increment of resolution of the pressure gauge

(± 0.01 psig) is a non-relevant signal, and may be treated as no change in signal.

7.7.7.2 Temperature: A change in temperature between T_{lid_start} and T_{lid_end} of ± 1 x the smallest increment of resolution of the thermometer (± 0.1 °C) is a non-relevant signal, and may be treated as no change in signal. In addition, it is acceptable for the temperature of the lid (primary or secondary, as applicable) to decrease up to 0.3 °C[11]. Any increase of temperature of a lid between T_{lid_start} and T_{lid_end} beyond non-relevant signal (+0.1 °C) is not acceptable.

7.7.8 Proceed to Final System Calibration if both of the following conditions are met:

7.7.8.1 No relevant change in signal for pressure based on Section 7.7.7.1 above.

7.7.8.2 No relevant change in signal for temperature between T_{lid_start} and T_{lid_end} (± 0.1 °C) or maximum of 0.3 °C temperature decrease between T_{lid_start} and T_{lid_end}.

7.7.9 If there is a relevant change in signal during duration of Final Test Dwell Time ($T_{Test\ Dwell}$) for pressure and/or temperature, then further evaluation or time extension may be performed (as long as pressure stay above 16.5 psig) before proceeding to Final System Calibration. In such case, at the end of each Test Dwell Time increment the operator shall perform an evaluation to determine if there has been a relevant signal change (both pressure/temperature) during the discrete Test Dwell Time observations.

7.7.10 If there is a continuing relevant change in pressure or/and temperature, then the closure of the package is not sufficiently thermally stable for a reliable leak test. Among the possible corrective measures to achieve adequate thermal stability:

7.7.10.1 Delay the test to allow the package to reach thermal stability.

7.7.10.2 Add insulation or active temperature control.

7.7.10.3 Other thermal isolation/stabilization measures may be necessary.

7.7.11 If there is a clear indication of leakage, the test sequence may be terminated in order to proceed immediately to leak location measures and leak remediation.

7.8 Final System Calibration

7.8.1 Ensure that the pressure is at least 16.0 psig, or 16.0 psia above $P_{ambient}$ and valves are positioned as follows with air supply disconnected from the manifold: V1- Close, V2- Open and V_{CL}- Close.

7.8.2 Open V_{C1}.

7.8.3 Re-set the timer.

7.8.4 Record the indicated pressure $P_{Final\ Cal}$ at elapsed time 0:00 and start the timer.

7.8.5 Record the pressure indication at 30 second to one-minute intervals for lid closures, or 15 seconds for the vent port closure for a period of time at least equal to the $T_{Test\ Dwell}$ (as shown in Section 5 of Attachment B). Record the end pressure $P_{Final\ End\ Cal}$ once timer is stopped.

7.8.6 Proceed to Section 8 below.

8. EVALUATION AND DISPOSITION

8.1 Test Volume Measurements

8.1.1 Verify that the test volume measurement calculated in Section 7.4 of this procedure meets Acceptance Criteria listed in Section 6 of Attachment B. Record result in Section 6 of Attachment B.

8.2 Pressure Stabilization

8.2.1 Verify that pressure stabilization for a closure is adequate.

8.3 Leak Test Detection

8.3.1 Indicate in Section 6 of Attachment B whether the test is acceptable or unacceptable based on the following criteria:

8.3.1.1 Acceptable:

8.3.1.1.1 Pressure: A change in the indicated pressure of ± 1 x - the smallest increment of resolution of the pressure gauge (± 0.01 psig).

8.3.1.1.2 Temperature: A change in temperature between T_{lid_start} and T_{lid_end} of ± 1 x - the smallest increment of resolution of the thermometer (± 0.1 C). In addition, it is acceptable for the temperature of the lid(s) to decrease up to 0.3°C during duration of $T_{Fin\ Dwell}$. Any increase of temperature between T_{lid_start} and T_{lid_end} beyond non-relevant (+0.1 °C) signal is not acceptable.

8.3.1.2 Unacceptable:

8.3.1.2.1 Pressure: A change in the indicated pressure beyond of ± 1 x - the smallest increment of resolution of the pressure gauge (± 0.01 psig).

8.3.1.2.2 Temperature: A change (increase in temperature) between T_{lid_start} and T_{lid_end} beyond + 1 x - the smallest increment of resolution of the thermometer (+0.1 C) and decrease of temperature beyond 0.3°C during duration of $T_{Fin\ Dwell}$.

8.4 Test Quality Factor

8.4.1 Preliminary Calibration Rate of Change

8.4.1.1 Calculate the Preliminary Calibration Rate of Change in psi per minute observed during the Preliminary Calibration using values for the Initial Pressure ($P_{Initial\ Pre\text{-}Cal}$), and Final Pressure ($P_{Final\ Pre\text{-}Cal}$) that are separated in time by a duration equal to $T_{Fin\ Dwell}$ using the following equation:

$$\text{Preliminary Cal. Rate of Change} = (P_{Initial\ Pre\text{-}Cal} - P_{Final\ Pre\text{-}Cal}) / (T_{Fin\ Dwell})$$

8.4.1.2 Record result in Section 6.2 of Attachment B.

8.4.2 Final Calibration Rate of Change

8.4.2.1 Calculate the Final Calibration Rate of Change in psi per minute during the Final Calibration using values for the Initial Pressure ($P_{Initial\ Fin\text{-}Cal}$), and Final Pressure ($P_{Final\ Fin\text{-}Cal}$) that are separated in time by a duration equal to $T_{Fin\ Dwell}$ using the following equation:

$$\text{Final Cal. Rate of Change} = (P_{Initial\ Fin\text{-}Cal} - P_{Final\ Fin\text{-}Cal}) / (T_{Fin\ Dwell})$$

8.4.2.2 Record result in Section 6.3 of Attachment B.

8.4.3 Test quality factor (TQF)

8.4.3.1 Determine Test quality factor (TQF) using the following equation and record in Section 6.4 of Attachment B.

Test Quality Factor (TQF) = Preliminary Cal. Rate of Change/ Final Cal. Rate of Change

8.4.3.2 Indicate in Section 6 of Attachment B whether the TQF is adequate.

8.4.3.3 The TQF is required to be between 0.77 and 1.4 inclusive.

8.4.3.3.1 Adequate: $0.77 \leq TQF \leq 1.4$

8.4.3.3.2 Not Adequate: $TQF < 0.77$, or $1.4 < TQF$

8.5 Disposition

8.5.1 Prior to completion report for each testing closure, verify the following:

8.5.1.1 Volume verification check is Adequate.

8.5.1.2 Pressure stabilization check is Adequate.

8.5.1.3 Acceptable for Relevant Pressure Change (i.e. no relevant change in pressure) during leak detection test.

8.5.1.4 Acceptable for Relevant Temperature Change (i.e. no relevant change in pressure) during leak detection test.

8.5.1.5 TQF is Adequate.

8.5.1.6 Test demonstrated adequate assembly of the closure.

9. DOCUMENTATION

9.1 Complete, check, and sign the Pre-Shipment Leak Test Report for each closure. See Attachment B for a report format. Test records from this procedure shall be stored and maintained per EnergySolutions applicable procedures.

10. DISSASEMBLY OF TEST MANIFOLD

10.1 After successfully completing the required pre-shipment leak test of the tested closure remove the Test Manifold and all associated parts, treating all

parts as potentially contaminated. Ensure that no debris or other foreign material is left inside the test port cavity. Inspect the set screw plug to ensure that there are no defects (i.e. cracks, deformed or stripped threads, etc.).

10.2 Clean the test port set screw plug of all debris, and reinstall it the primary/secondary lid or vent port (per Reference 2.1).

11. ATTACHMENTS

11.1 Attachment A: Test Manifold Configurations

11.2 Attachment B: 8-120B Cask Leak Test Report

11.3 Attachment C: Troubleshooting Guide and Diagnostic

11.4 Attachment D: Manifold Assembly Components

11.5 Attachment E: Endnotes

ATTACHMENT A: TEST MANIFOLD CONFIGURATIONS (PAGE 1 OF 2)

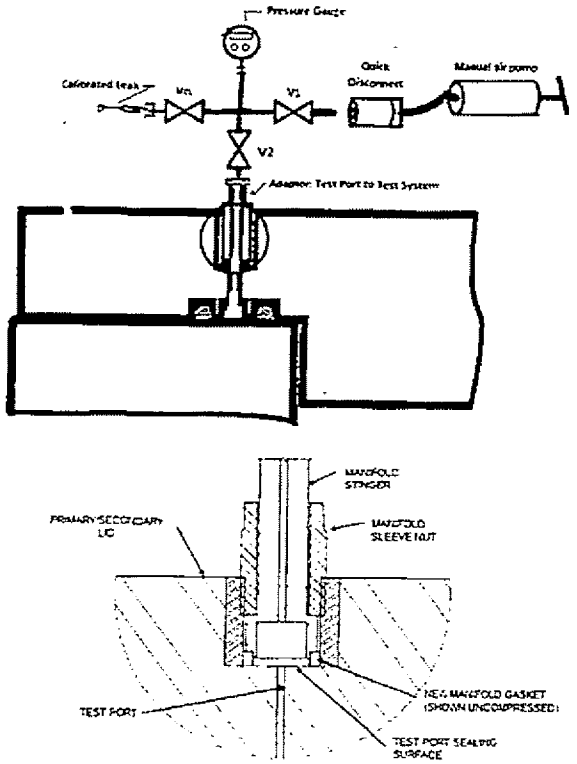

Figure 1: Assembled configuration for a pre-shipment leak test of the primary/secondary lid seals

ATTACHMENT A: TEST MANIFOLD CONFIGURATIONS (PAGE 2 OF 2)

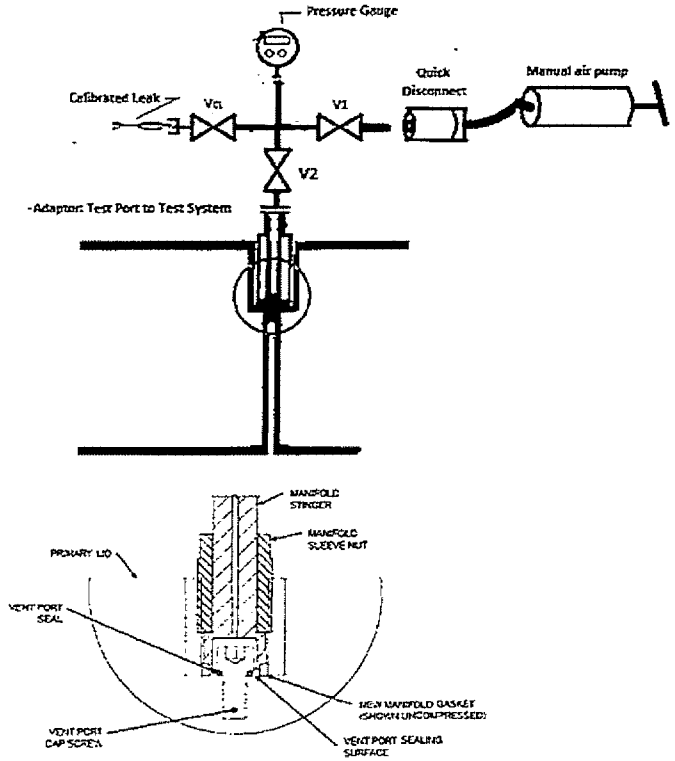

Figure 2: Assembled configuration for a pre-shiment leak test of the vent port seal

ATTACHMENT B: 8-120B CASK LEAK TEST REPORT

EnergySolutions				8-120B Cask Pre-Shipment Leak Test Report			
EnergySolutions Report #				Date:		Page __ of __	
CASK AND LEAK TEST INFORMATION							
Client:			Released by (Name/Title):				
Location:							
Cask #	8-120B- __						
Component							
EQUIPMENT							
Pressure Gauge S/N		Cal. Date		Cal Due Date			
Thermometer S/N		Cal. Date		Cal Due Date			
Timer S/N		Cal. Date		Cal Due Date			
Calibrated Leak S/N		Cal. Date		Cal Due Date			
$T_{Cal\ Leak\ °C}$	____E-0__atm.cc/sec Air (or N2) @ ___°C __%°C			Temp. of the CL (CL_{temp})			
Lid Surface Temp. ($T_{surface}$) °C		Ambient Air Temp. ($T_{ambient}$) °C		Ambient Air Pres. ($P_{ambient}$) PSIA			

1. VOLUME MEASUREMENT (SECTION 7.4)

P_1_____psia P_2_____psia Not Applicable (circle for a vent port leak test)

2. PRESSURE STABILIZATION VERIFICATION (SECTION 7.5)

Minimum Pressure Stabilization Time (T_{Press}) from Table 2 of Procedure_____

Pressure Stabilization Verified :_____ (Initial)

3. PRELIMINARY SYSTEM CALIBRATION AND TEST DWELL TIME (SECTION 7.6)

Elapsed Time mm:ss	Pressure (psig)	Elapsed Time mm:ss	Pressure (psig)	Elapsed Time mm:ss	Pressure (psig)	Elapsed Time mm:ss	Pressure (psig)
00:00							

Final Test Dwell Time ($T_{Fin\ Dwell}$) =_____ $P_{Initial\ Pressure}$ = _____psig $P_{Final\ Pressure}$ =_____psig

4. LEAK DETECTION (SECTION 7.7)

Elapsed Time mm:ss	Pressure (psig)	Elapsed Time mm:ss	Pressure (psig)	Elapsed Time mm:ss	Pressure (psig)	Elapsed Time mm:ss	Pressure (psig)
00:00							

Final Test Dwell Time ($T_{Fin\ Dwell}$)= _____ T_{ld_start}_____°C T_{ld_end}_____°C

	8-120B Cask Pre-Shipment Leak Test Report	
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5. FINAL SYSTEM CALIBRATION (SECTION 7.8)

Elapsed Time (mm:ss)	Pressure (psig)	Elapsed Time (mm:ss)	Pressure (psig)	Elapsed Time (mm:ss)	Pressure (psig)	Elapsed Time (mm:ss)	Pressure (psig)
00:00							

Final Test Dwell Time ($T_{Fin\ Dwell}$) = _____ $P_{Initial\ Fin\ Cal}$ = _____ psig $P_{Final\ Fin\ Cal}$ = _____ psig

6. EVALUATION AND DISPOSITION (SECTION 8)

6.1 Test Volume (V_T) = $V_1 \times ((P_2 - P_{ambient})/(P_1 - P_2)) - V_2$, where V_1 = 8 cc and V_2 = 5 cc

Test Volume (V_T) = _____ cc

6.2 Preliminary Cal. Rate of Change = ($P_{Initial\ Pre\ Cal} - P_{Final\ Pre\ Cal}$) / ($T_{Fin\ Dwell}$) = _____ psig / min or sec

6.3 Final Cal. Rate of Change = ($P_{Initial\ Fin\ Cal} - P_{Final\ Fin\ Cal}$) / ($T_{Fin\ Dwell}$) = _____ psig / min or sec

6.4 Test Quality Factor (TQF) = Preliminary Cal. Rate of Change / Final Cal. Rate of Change = _____

#	Parameter	Acceptance Criteria	Result	Conclusion
1	Volume Verification	V_T >60 cc for primary lid V_T > 25 cc for secondary lid N/A for a vent port leak test		
2	Pressure stabilization	Within +/-0.01 psig pressure change within min. duration established in Table 2 (PSIG)		
3	No relevant change in pressure during LD	Within +/-0.01 psig pressure change (PSIG)		
4	No relevant change in temperature during LD	Within temperature range of - 0.3 °C to + 0.1 °C		
5	Test Quality Factor	0.77 ≤ TQF ≤ 1.4		
6	Does the test demonstrated adequate assembly of the closure		YES / NO (Circle one)	

Notes:

Leak Test Technician (Name/Title/Certification Level) Date

Optional: Report Reviewer (Name/Title/Certification Level) Date

ATTACHMENT C: TROUBLESHOOTING GUIDE AND DIAGNOSTIC

Listed below are some suggestions for performing a pre-shipment leak test on the 8-120B cask.

Following these suggestions should help achieve a successful pre-shipment leak test.

Handling of the cask components and inspection of seals:

1. Use extreme care when removing and/or replacing the cask lids (primary or secondary) to prevent damage to the O-ring seals.
2. Ensure that the O-ring seal sealing surfaces are clean. Acetone (or an equivalent cleaning solution such as isopropyl alcohol) may be used to clean the O-ring seal sealing surfaces.
3. Inspect the O-ring seals and ensure that they are in good condition and properly installed.
5. If necessary, the O-ring seals should be lubricated with a small amount (thin coat) of O-ring lubricant such as Parker Super O-Lube or equivalent as needed.
6. Ensure that the test port and the connection line to the Test Manifold are free of any foreign material. A small diameter wire should be pushed through the test port line. This will ensure that the line does not have any internal blockage that could restrict airflow to the annulus.
7. Ensure that the threads of the test port are clean and free of any foreign material.
8. The cask lids must be torqued in accordance with the cask handling procedure (Reference 2.1). This torqueing sequence ensures the lids are evenly seated and tightened. Ensure that Vent Port Hex Head Cap Screw is properly torqued to the values listed in the Reference 2.1.

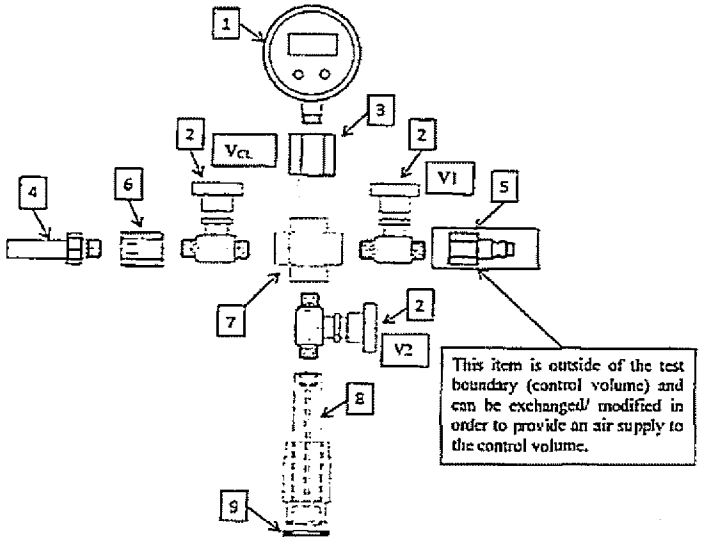
The following table discusses a few common causes that prevent adequate demonstration of correct closure assembly and suggestions that may be considered to remedy the situation.

Diagnostic Suggestions and Troubleshooting Line Condition Potential Causes and Remediation

#	Condition	Potential Causes	Remediation
1	The volume verification does not show as "Adequate"	A. Testing error. B. Grease or other obstruction of the test adaptor, the connection of the test adaptor to the port, or the closure conductance channel. C. There is a real or virtual leak (of the test hardware, or the closure).	A. Repeat the leak test. B. Disassemble, inspect, clean and re-assemble the test connection, the adaptor, and possible the cask closure. C. Investigate and resolve the source of the issue.
2	Inadequate Pressure Stabilization	A. A leak in the test hardware. B. A leak in the package closure C. Thermal/Pressure unbalance	A. Test to verify hardware leak tightness/leak location. B. Disassemble closure for cleaning and inspection. C. Extend the length of time for pressure stabilization

#	Condition	Potential Causes	Remediation
3	Pressure increased more than +1 division during Leak Detection	A. Typically caused by thermal instability.	A. Perform the thermal stability verification (measure temperature of lid base material) before re-testing. Remediate sources of heating.
4	Inadequate Thermal Stability during Leak Detection test (temperature measurements of the lid are outside of acceptable range)	A. Cask Body/Lid and Leak Manifold temperature are not stable. B. External temperature effects.	A. Ensure that the cask body/lid and leak test manifolds attain the same temperature. Ensure that the cask body/lid and leak test manifolds attain the same temperature. Due to high thermal inertia of the cask, it may be required to thermally balance cask components, manifolds and external environment. B. Delay the test to allow the package to reach thermal stability. Add insulation or active temperature control. Other thermal isolation or stabilization measures may be necessary.
5	Pressure decreased more the -1 division during Leak Detection.	A. A leak in the test hardware B. A leak in the package closure. C. Inadequate pressure stabilization. D. Thermal instability. E. Partial plugging of the closure conductance path creating a virtual leak in the system.	A. Test to verify hardware leak tightness/leak location (using bubble leak test) B. Disassemble closure for cleaning and inspection. C. Extend the length of time for pressure stabilization D. Repeat the thermal stability verification. E. Disassemble, inspect, clean re-assemble the closure.
6	TOF value is not within the requirement.	A. Inadequate thermal instability. B. Inadequate pressure stabilization. C. Instrument instability. D. Timing error. E. Failure of calibrated leak	A. Repeat the thermal stability verification, remediate sources of thermal instability. B. Extend the length of time for pressure stabilization. C. Verify instrument with other similar instrument. D. Verify Timing. E. Calibrated leak may be plugged/failed.

ATTACHMENT D: MANIFOLD ASSEMBLY COMPONENTS



#	Vendor	Part #	Description	QTY
1	Ashcroft	DG25 5 LL 02 L 30#AV	DG-25 Digital Compound Gauge -14.7 to 30 psig	1
2	Swagelok	SS-4H2	Stainless Steel Bellows Sealed Valve, Welded, 55 Series, 7/16 in. 4NPT	2
3	McMaster	48935K36	Straight Adapter, 1/4 NPT Female/Male, Stainless 316	1
4	LACO	CA15214-1800AD7/17-2	Calibrated air leak (7.4-7.5 x10^-4 cm^3/sec from 17 psig to zero)	2
5	McMaster	6534K56	Quick Disconnect, ¼ Zinc-Plated Steel Plug, 1/4 NPT Female End	1
6	McMaster	4844K312	Straight Connector, 1/4 NPT Female, 304 Stainless	1
7	McMaster	4464K312	Cross Connector, 1/4 NPT Female, 304 Stainless	1
8	Custom	N/A	8-120B cask manifold test/vent port connector (volume 5 cc)	1
9	N/A		Gasket, OD 1.391" x ID 1" x .07" Thick, Neoprene or Equivalent	1

NOTES:

1. Control Volumes: The volume between V1- V2-V_{CL} – Pressure gauge < 8cc. The volume of Item 8 < 5 cc. Use of alternative assembly parts is not allowed without documented review of Level III in LT.
2. Test manifold may be enclosed in insulation (protective box) to minimize environmental impact of the manifold/pressure gauge during the pre-shipment leak test.

ATTACHMENT E: ENDNOTES

Note: Endnotes are provided for information only

[1] Operating Temperature Limitation. The manufacturers operating temperature for the Ashcroft DG-25 pressure gauge is -4F to 140F. The manufacturer's catalog operating temperature for the LACO calibrated leak is 32F to 150F, however, manufacturer of calibrated leaks confirmed that air leak shall work at lower temperatures as long as it can be verified that the leak is not plugged due to condensation of water vapors. Energy*Solutions* will establish an administrative measure to ensure that leak are not plugged (by condensation) when they are used at temperatures below 32F. Therefore, Energy*Solutions* sets the minimum temperature for the test to be 25F (or -4C).

[2] If the test is performed by third party or using the equipment by third party, procedures associated with control of M&TE equipment shall be reviewed/approved by Energy*Solutions*.

[3] The maximum leakage rate of the calibrated leak was selected in order to accommodate the test temperature range of 25F (-4C) to 140 F (60C) and still comply with leak rate criteria of 10E-3 atm*cc/sec. Most preferable leakage rate for CL is between 8 to 8.75 E-04 atm-cc/sec.

[4] Compound gauge calibration points may be reported on positive pressure scale (0-30 psig). This is because the pre-shipment leak test does not use a negative pressure gauge scale reading for the preliminary, final system calibrations and actual leak test.

[5] For the purpose of this procedure, atmospheric pressure (psia) is not essential variable and is used for verification of the test volume. Atmospheric pressure can be determined based on elevation of the test location (see below) or by other means.

Elevation (ft)	Atmospheric Pressure (psia)
0	14.696
500	14.43
1000	14.16
1500	13.91
2000	13.66
2500	13.41
3000	13.17
3500	12.93
4000	12.69
4500	12.46
5000	12.23
6000	11.78
7000	11.35
8000	10.91
9000	10.5

[6] Test Manifold including pressure gauge and calibrated leak may be enclosed in insulation (protective box) to minimize environmental impact of the manifold/pressure gauge during the pre-shipment leak test.

[7] Verification of the test volume is necessary to ensure that there is no obstruction/blockage in the test system.

[8] V1 is a volume between Valves V1, V2, V_{C1} and pressure gauge. V2 is the volume between the test port and V2 valve (manifold volume).

[9] Table 1 provides a range of acceptable volumes (in form of min volume required). During mock up leak test trials on several 8-120B casks, it has determined that the test volumes may vary significantly, primarily, due to virtual leaks present in cask lid seal closure features. This procedure has compensation mechanism for larger volumes associated with potential "virtual leaks". In such case, potential increase in a volume size will result in increased dwell time. A solution for volume verification that does not meet the criteria will typically be caused by a blockage in the pressurized volume. The most obvious cause would be an improper application of vacuum grease (O-ring lubricant).

[10] Due to specifics of the 8-120B packaging closures (susceptible to virtual leaks), pressure stabilization verification is required.

[11] In certain cases, pressure stabilization duration may range from a few minutes up to several hours.

[12] The use of a leak test dwell time that is the longer of the time required for a specified number of divisions of pressure change, and the fixed minimum leak test dwell time, inherently compensates the pressure decay test for altitude and ambient pressure differences that occur with altitude.

[13] Minimum test dwell time was derived from Reference 2.5. The fixed time period for minimum test dwell time shown in Table 4 corresponds to the observed time required to generate a 5 division (5 x 0.01 psi) pressure drop during procedure qualification testing when there was no leak in the test article.

[14] Due to large thermal inertia of cask components, the temperature of the primary or secondary lid provides an accurate estimation of the air flow temperature in the test manifold.

[15] It is acceptable for the temperature of the lid(s) to decrease up to 0.3 °C during the leak detection as long as pressure reading on the pressure gauge remains within acceptance criteria (± 0.01 psig)

[16] This field is optional

ATTACHMENT B: 8-120B CASK LEAK TEST REPORT

ENERGYSOLUTIONS				8-120B Cask Pre-Shipment Leak Test Report			
EnergySolutions Report #	105915 (003)			Date: 5/29/19		Page 1 of 2	
CASK AND LEAK TEST INFORMATION							
Client:	Point Beach		Released by (Name/Title):	Site Waste Supervisor			
Location:	WI						
Cask #	8-120B- 7						
Component	Vent port						
EQUIPMENT							
Pressure Gauge S/N	TGC-3000-020	Cal. Date	11/2/18	Cal Due Date	11/2/19		
Thermometer S/N	THR - 002	Cal. Date	9/19/18	Cal Due Date	9/19/19		
Timer S/N	ES-TW-011	Cal. Date	2/17/18	Cal Due Date	12/17/18		
Calibrated Leak S/N	163530M-001	Cal. Date	10/29/18	Cal Due Date	10/29/19		
$T_{Cal\ Leak}$ °C	7.7 E-04 atm.cc/sec Air (or N2) @ 23.8°C 7.6%/°C			Temp. of the CL (CL_{Temp})	21.7		
Lid Surface Temp. ($T_{surface}$) °C	20.9	Ambient Air Temp. ($T_{ambient}$) °C	20.8	Ambient Air Pres. ($P_{ambient}$) PSIA	14.6		

1. VOLUME MEASUREMENT (SECTION 7.4)

P_1 N/A psia P_2 N/A psia (Not Applicable) (circle for a vent port leak test)

2. PRESSURE STABILIZATION VERIFICATION (SECTION 7.5)

Minimum Pressure Stabilization Time (T_{Pstss}) from Table 2 of Procedure 2 min

Pressure Stabilization Verified : TB (Initial)

3. PRELIMINARY SYSTEM CALIBRATION AND TEST DWELL TIME (SECTION 7.6)

Elapsed Time mm:ss	Pressure (psig)	Elapsed Time mm:ss	Pressure (psig)	Elapsed Time mm:ss	Pressure (psig)	Elapsed Time mm:ss	Pressure (psig)
00:00	17.99	60	17.95	120	17.92		
15	17.98	75	17.94				
30	17.97	90	17.93				
45	17.96	105	17.92				

Final Test Dwell Time ($T_{Fin\ Dwell}$) = 2min $P_{Initial\ Pre\text{-}Cal}$ = 17.99 psig $P_{Final\ Pre\text{-}Cal}$ = 17.91 psig

4. LEAK DETECTION (SECTION 7.7)

Elapsed Time mm:ss	Pressure (psig)	Elapsed Time mm:ss	Pressure (psig)	Elapsed Time mm:ss	Pressure (psig)	Elapsed Time mm:ss	Pressure (psig)
00:00	17.97	60	17.97	120	17.97		
15	17.97	75	17.97				
30	17.97	90	17.97				
45	17.97	105	17.97				

Final Test Dwell Time ($T_{Fin\ Dwell}$) = 2min T_{ld_start} 20.8°C T_{ld_end} 20.8°C

EnergySolutions	8-120B Cask Pre-Shipment Leak Test Report	
EnergySolutions Report # 105915 (003)	Date: 5/29/18	Page 2 of 2

5. FINAL SYSTEM CALIBRATION (SECTION 7.8)

Elapsed Time mm:ss	Pressure (psig)	Elapsed Time mm:ss	Pressure (psig)	Elapsed Time mm:ss	Pressure (psig)	Elapsed Time mm:ss	Pressure (psig)
00:00	17.91	60	17.88	120	17.84		
15	17.70	75	17.87				
30	17.90	90	17.86				
45	17.89	105	17.85				

Final Test Dwell Time ($T_{Fin\ Dwell}$) = 2 min $P_{Initial\ Fin\ Cal}$ 17.91 psig $P_{Final\ Fin\ Cal}$ 17.82 psig

6. EVALUATION AND DISPOSITION (SECTION 8)

6.1 Test Volume (V_t) = $V_1 \times ((P_2 - P_{ambient})/(P_1 - P_2)) - V_2$, where V_1=8 cc and V_2=5 cc

Test Volume (V_t) = N/A cc

6.2 Preliminary Cal. Rate of Change = ($P_{Initial\ Pre\ Cal} - P_{Final\ Pre\ Cal}$) / ($T_{Fin\ Dwell}$) = .024 psig (min) or sec

6.3 Final Cal. Rate of Change = ($P_{Initial\ Fin\ Cal} - P_{Final\ Fin\ Cal}$) / ($T_{Fin\ Dwell}$) = .035 psig/(min) or sec

6.4 Test Quality Factor (TQF) = Preliminary Cal. Rate of Change/ Final Cal. Rate of Change = 1

#	Parameter	Acceptance Criteria	Result	Conclusion
1	Volume Verification	V_t>60 cc for primary lid V_t> 25 cc for secondary lid (N/A for a vent port leak test)	N/A	N/A
2	Pressure stabilization	Within +/-0.01 psig pressure change within min. duration established in Table 2 (PSIG)	No Change	PASS
3	No relevant change in pressure during LD	Within +/-0.01 psig pressure change (PSIG)	No Change	PASS
4	No relevant change in temperature during LD	Within temperature range of – 0.3 °C to + 0.1 °C	No change	PASS
5	Test Quality Factor	0.77 ≤ TQF ≤ 1.4	1	PASS
6	Does the test demonstrated adequate assembly of the closure		(YES) NO (Circle one)	

Notes:

Trey Seagey Lead LT Plant Level III (CI) 5/29/18
Leak Test Technician (Name/Title/Certification Level) Date

Gene LaClair / Site Waste Supervisor N/A 5-29-19
Optional: Report Reviewer (Name/Title/Certification Level)[16] Date

ATTACHMENT B: 8-120B CASK LEAK TEST REPORT

ENERGYSOLUTIONS				8-120B Cask Pre-Shipment Leak Test Report			
EnergySolutions Report #	165915 (001)			Date: 5/29/19		Page 1 of 2	
CASK AND LEAK TEST INFORMATION							
Client:	Point Beach		Released by (Name/Title):	Site Waste Supervisor			
Location:	W1						
Cask #	8-120B- 7						
Component	Primary Lid						
EQUIPMENT							
Pressure Gauge S/N	T6C-30-D-020	Cal. Date	11/2/18	Cal Due Date	11/2/19		
Thermometer S/N	THR-002	Cal. Date	9/19/18	Cal Due Date	9/19/19		
Timer S/N	ES-TW-011	Cal. Date	12/17/18	Cal Due Date	12/17/19		
Calibrated Leak S/N	16353/SH-008	Cal. Date	10/29/18	Cal Due Date	10/29/19		
$T_{cal\ leak}$ °C	7.7E-04 atm.cc/sec Air (or N2) @ 23.8 °C, 0 °C			Temp. of the CL (CL_{Temp})	21.9		
Lid Surface Temp. ($T_{surface}$) °C	20.3	Ambient Air Temp. ($T_{ambient}$) °C	21.6	Ambient Air Pres. ($P_{ambient}$) PSIA	14.6		

1. VOLUME MEASUREMENT (SECTION 7.4)

P_1 32.12 psia P_2 31.03 psia Not Applicable (circle for a vent port leak test)

2. PRESSURE STABILIZATION VERIFICATION (SECTION 7.5)

Minimum Pressure Stabilization Time (T_{Press}) from Table 2 of Procedure 9 min

Pressure Stabilization Verified : TS (Initial)

3. PRELIMINARY SYSTEM CALIBRATION AND TEST DWELL TIME (SECTION 7.6)

Elapsed Time (mm):ss	Pressure (psig)	Elapsed Time (mm):ss	Pressure (psig)	Elapsed Time (mm):ss	Pressure (psig)	Elapsed Time mm:ss	Pressure (psig)
00:00	18.02	4	17.99	8	17.96		
1	18.02	5	17.98	9	17.96		
2	18.01	6	17.98				
3	18.00	7	17.97				

Final Test Dwell Time ($T_{Fin\ Dwell}$) = 9 min $P_{Initial\ Pre\text{-}Cal}$ = 18.02 psig $P_{Final\ Pre\text{-}Cal}$ = 17.96 psig

4. LEAK DETECTION (SECTION 7.7)

Elapsed Time (mm):ss	Pressure (psig)	Elapsed Time (mm):ss	Pressure (psig)	Elapsed Time (mm):ss	Pressure (psig)	Elapsed Time mm:ss	Pressure (psig)
00:00	17.97	4	17.96	8	17.96		
1	17.97	5	17.96	9	17.96		
2	17.96	6	17.96				
3	17.96	7	17.96				

Final Test Dwell Time ($T_{Fin\ Dwell}$)= 9 min T_{ld_start} 20.3 °C T_{ld_end} 20.2 °C

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5. FINAL SYSTEM CALIBRATION (SECTION 7.8)

Elapsed Time (mm)ss	Pressure (psig)	Elapsed Time (mm)ss	Pressure (psig)	Elapsed Time (mm)ss	Pressure (psig)	Elapsed Time mm:ss	Pressure (psig)
00:00	17.94	4	17.91	8	17.88		
1	17.93	5	17.90	9	17.87		
2	17.93	6	17.90				
3	17.92	7	17.89				

Final Test Dwell Time ($T_{Fin\ Dwell}$) = 9 min $P_{Initial\ Fin\text{-}Cal}$ 17.94 psig $P_{Final\ Fin\text{-}Cal}$ 17.87 psig

6. EVALUATION AND DISPOSITION (SECTION 8)

6.1 Test Volume (V_{11}) = $V_1 x ((P_2 - P_{ambient})/(P_1 - P_2)) - V_2$, where V_1=8 cc and V_2=5 cc

Test Volume (V_{11}) = 138.3 cc

6.2 Preliminary Cal. Rate of Change = ($P_{Initial\ Pre\text{-}Cal} - P_{Final\ Pre\text{-}Cal}$) / ($T_{Fin\ Dwell}$) = .006 psig/(min) or sec

6.3 Final Cal. Rate of Change = ($P_{Initial\ Fin\text{-}Cal} - P_{Final\ Fin\text{-}Cal}$) / ($T_{Fin\ Dwell}$) = .007 psig/(min) or sec

6.4 Test Quality Factor (TQF) = Preliminary Cal. Rate of Change/ Final Cal. Rate of Change = .86

#	Parameter	Acceptance Criteria	Result	Conclusion
1	Volume Verification	V_1>60 cc for primary lid V_1> 25 cc for secondary lid N/A for a vent port leak test	138.3	PASS
2	Pressure stabilization	Within +/-0.01 psig pressure change within min. duration established in Table 2 (PSIG)	-.01	PASS
3	No relevant change in pressure during LD	Within +/-0.01 psig pressure change (PSIG)	-.01	PASS
4	No relevant change in temperature during LD	Within temperature range of – 0.3 °C to + 0.1 °C	-.1	PASS
5	Test Quality Factor	0.77 ≤ TQF ≤ 1.4	.86	PASS
6	Does the test demonstrated adequate assembly of the closure		(YES) / NO (Circle one)	

Notes:

TREY BEASLEY LT lead, PCMT Level II (L) 5/29/19
Leak Test Technician (Name/Title/Certification Level) Date

[signature] / Site Waste Supervisor / N A 5/29/19
Optional: Report Reviewer (Name/Title/Certification Level)[16] Date

ATTACHMENT B: 8-120B CASK LEAK TEST REPORT

ENERGYSOLUTIONS — 8-120B Cask Pre-Shipment Leak Test Report

EnergySolutions Report # 105715 (002)	Date: 5/29/19	Page 1 of 2

CASK AND LEAK TEST INFORMATION

Client:	Point Beach	Released by (Name/Title):	[signature] Site Waste Supervisor
Location:	WI		
Cask #	8-120B- 7		
Component	Secondary Lid		

EQUIPMENT

Pressure Gauge S/N	TGC-30-D-020	Cal. Date	11/2/18	Cal Due Date	11/2/19
Thermometer S/N	THR-002	Cal. Date	9/19/18	Cal Due Date	9/19/19
Timer S/N	ES-TW-011	Cal. Date	12/17/18	Cal Due Date	12/17/19
Calibrated Leak S/N	163526SH-005	Cal. Date	10/24/18	Cal Due Date	10/24/19
$T_{Cal\ Inst\ °C}$	7.7E-04 atm.cc/sec Air (or N2) @ 22 °C ± 6%/°C			Temp. of the CL (CL_{Temp})	22.0
Lid Surface Temp. ($T_{surface}$) °C	20.9	Ambient Air Temp. ($T_{ambient}$) °C	21.6	Ambient Air Pres. ($P_{ambient}$) PSIA	14.6

1. VOLUME MEASUREMENT (SECTION 7.4)

P_1 34.43 psia P_2 31.59 psia Not Applicable (circle for a vent port leak test)

2. PRESSURE STABILIZATION VERIFICATION (SECTION 7.5)

Minimum Pressure Stabilization Time (T_{Press}) from Table 2 of Procedure 4 min

Pressure Stabilization Verified : TS (Initial)

3. PRELIMINARY SYSTEM CALIBRATION AND TEST DWELL TIME (SECTION 7.6)

Elapsed Time (mm)ss	Pressure (psig)	Elapsed Time (mm)ss	Pressure (psig)	Elapsed Time mm:ss	Pressure (psig)	Elapsed Time mm:ss	Pressure (psig)
00:00	17.62	4	17.57				
1	17.61						
2	17.59						
3	17.58						

Final Test Dwell Time ($T_{Fin\ Dwell}$) = 4 min $P_{Initial\ Pre-Cal}$ = 17.62 psig $P_{Final\ Pre-Cal}$ = 17.57 psig

4. LEAK DETECTION (SECTION 7.7)

Elapsed Time (mm)ss	Pressure (psig)	Elapsed Time (mm)ss	Pressure (psig)	Elapsed Time mm:ss	Pressure (psig)	Elapsed Time mm:ss	Pressure (psig)
00:00	17.60	4	17.61				
1	17.61						
2	17.61						
3	17.61						

Final Test Dwell Time ($T_{Fin\ Dwell}$) = ~~20-16~~ 4 min $T_{ld\ start}$ 20.8 °C $T_{ld\ end}$ 20.9 °C

ENERGYSOLUTIONS	8-120B Cask Pre-Shipment Leak Test Report	
EnergySolutions Report # 105915 (002)	Date: 5/29/19	Page 2 of 2

5. FINAL SYSTEM CALIBRATION (SECTION 7.8)

Elapsed Time (min)/ss	Pressure (psig)	Elapsed Time (min)/ss	Pressure (psig)	Elapsed Time mm:ss	Pressure (psig)	Elapsed Time mm:ss	Pressure (psig)
00:00	17.60	4	17.55				
1	17.58						
2	17.57						
3	17.56						

Final Test Dwell Time ($T_{Fin\ Dwell}$) = 4 min $P_{Initial\ Fin\text{-}Cal}$ 17.60 psig $P_{Final\ Fin\text{-}Cal}$ 17.55 psig

6. EVALUATION AND DISPOSITION (SECTION 8)

6.1 Test Volume (V_1) = $V_1 \times ((P_2 - P_{Atmosphere})/(P_1 - P_2)) - V_2$, where V_1=8 cc and V_2=5 cc

Test Volume (V_1) = 42.9 cc

6.2 Preliminary Cal. Rate of Change = ($P_{Initial\ Pre\text{-}Cal} - P_{Final\ Pre\text{-}Cal}$) / ($T_{Fin\ Dwell}$) = .012 psig/(min) or sec

6.3 Final Cal. Rate of Change = ($P_{Initial\ Fin\text{-}Cal} - P_{Final\ Fin\ Cal}$) / ($T_{Fin\ Dwell}$) = .012 psig/(min) or sec

6.4 Test Quality Factor (TQF) = Preliminary Cal. Rate of Change/ Final Cal. Rate of Change = 1

#	Parameter	Acceptance Criteria	Result	Conclusion
1	Volume Verification	V_1>60 cc for primary lid (V_1> 25 cc for secondary lid) N/A for a vent port leak test	42.9	PASS
2	Pressure stabilization	Within +/-0.01 psig pressure change within min. duration established in Table 2 (PSIG)	no change	PASS
3	No relevant change in pressure during LD	Within +/-0.01 psig pressure change (PSIG)	+.01	PASS
4	No relevant change in temperature during LD	Within temperature range of - 0.3 °C to + 0.1 °C	+.1	PASS
5	Test Quality Factor	0.77 ≤ TQF ≤ 1.4	1	PASS
6	Does the test demonstrated adequate assembly of the closure	(YES) / NO (Circle one)		

Notes:

Trey Brearley LT Leak Port Level II (2) 5/29/19
Leak Test Technician (Name/Title/Certification Level) Date

Optional: Report Reviewer (Name/Title/Certification Level)[16] Date

RDW 16.17

RADWASTE RELATED COMPLEX LIFT PROCEDURE

DOCUMENT TYPE: Technical

CLASSIFICATION: Safety Related

REVISION: 0

EFFECTIVE DATE: July 5, 2011

REVIEWER: Qualified Reviewer

APPROVAL AUTHORITY: Department Manager

PROCEDURE OWNER (title): Group Head

OWNER GROUP: Radiation Protection

Verified Current Copy: _____ 5/29/19 0700
Signature Date Time

List pages used for Partial Performance	Controlling Work Document Numbers	

TABLE OF CONTENTS

1.0 PURPOSE

1.1 This procedure provides guidance for lifts involving the handling of shielded shipping casks or radioactive materials greater than or equal to 2000 pounds.

1.2 This procedure provides instructions for the removal, installation, and transfer of radioactive waste/material and associated shielding components in the Primary Auxiliary Building (PAB) Truck Bay using the installed PAB Crane (Z-015). The only exception is the filter HIC located in the storage area on El. 46' of the PAB.

1.3 This procedure is to be used in conjunction with vendor cask handling procedures, radwaste shipping procedures, rigging and material handling guidelines, and SLP 4, Auxiliary Building Main Crane. The shipping procedure used depends on preliminary disposal characterization and dose rates found on disposal liner during the loading evolution

2.0 PREREQUISITES

2.1 Tools

- Crane availability, either the main or auxiliary hook can be used for these evolutions.
- No special lifting devices are required for these lifts.

2.2 Supplies

- Shackles rated for all lifting evolutions
- Slings (wire or nylon) rated for all lifting evolutions
- Torque wrenches, sockets per vendor cask handling procedure

2.3 External Organization Support

- Qualified Crane operator, riggers, and Rigger-in-Charge
- Spotters as required

3.0 PRECAUTIONS AND LIMITATIONS

3.1 Z-015 is deemed single failure proof with the bridge crane capacities listed here:

Maximum Lifted Loads: Main hook = 250 tons/2.2 = 56.8 tons = 113,600 pounds

Aux hook = 20 tons/2.2 = 9.1 tons = 18,180 pounds

3.2 When lifting the load(s):

- Two point pick using two slings should be used for liners with baskets (i.e., 8/120 Liner).
- Three point pick **SHALL** be used for rigging cask lids, impact limiters, and round concrete shield lid.
- Four point pick using two slings shall be used for square concrete shield lid.
- Four point pick for seavans or oblong lids (i.e., resin steel liner).
- Other as determined by routine lifting practices.

3.3 When lifting the cask lid, the inner lid lifting point is not rated for lifting both the inner secondary and outer primary lid.

3.4 Avoid side loading of crane to the extent practical during all movements.

3.5 Observe radiation protection procedures when handling any radioactive material.

3.6 Adhere to standard safety practices when lifting heavy packages or using cranes. Ensure the equipment is rated for the expected weight of the items being handled.

3.7 Improper handling of radioactive material can result in personnel contamination, radioactive material uptake, and unplanned personnel exposure.

3.8 Rapidly changing dose rates can occur during equipment/liners transfers.

3.9 During the performance of radiation surveys, personnel may be subjected to radiological hazards including high radiation areas, contaminated areas, and airborne radioactivity areas.

3.10 Personnel shall wear prescribed protective clothing, dosimetry devices, and other protective equipment as required.

3.11 Rigger-in-Charge, RP Supervision, or designee may N/A steps that are not applicable.

3.12 Performance of this procedure may be performed partially in parallel, or out of order when authorized by RP Supervision or designee.

INITIALS

4.0 INITIAL CONDITIONS

4.1 Visually inspect the dedicated lifting lugs and surrounding areas where the lugs are attached. Contact engineering if signs of degradation and/or cracks are observed.

5.0 PROCEDURE

5.1 Removing Cask Impact Limiter from Type B Shipping Cask

NOTE: **Type B shipping cask impact limiters typically weigh approximately 5,500 pounds.**

NOTE: **The PAB Truck Bay, is not an "Heavy Loads" area and NUREG-0612 is NOT applicable. Refer to SLP 4, Auxiliary Building Main Crane.**

5.1.1 Impact limiter weight based on cask handling procedure 5500 lbs.

5.1.2 Remove ratchet binders securing the top impact limiter.

5.1.3 Remove the three lifting eye shipping covers and inspect the eyes for excessive wear prior to attaching shackles and slings.

5.1.4 Rig lid for lift using the three lifting eyes. The lifted load used to size the rigging **SHALL** be 2.2 times the actual load. The safety factor (3 for yield, 5 for ultimate) is applied towards the 2.2 times the actual load.

5.1.5 List slings being used for lifting cask impact limiter.

Slings NS 654, 1943, 1945

NOTE: **When performing a lift, check levelness of lift to ensure binding does not occur. If needed, set down load and adjust rigging to ensure a level lift. If needed, utilize wire rope slings to minimize stretch of nylon slings.**

5.1.6 Raise impact limiter slowly and ensure lid is level.

5.1.7 Continue raising impact limiter high enough to ensure travel path is clear and relocate lid to designated laydown area inside the PAB Truck Bay.

INITIALS

5.2 Removing Cask Primary Lid with Secondary Lid Installed

NOTE: Shipping cask lids vary in weight. The weights listed below are the combined weight of the primary and secondary lids unless noted otherwise.

CNS 8-120A	**7,000 pounds**
CNS 8-120B	**7,080 pounds**
CNS 14/210 and 14/215	**7,700 pounds**
CNS 14-195H	**6,300 pounds**
CNS 14-190H	**8,800 pounds**
CNS 14-170 Series II	**6,500 pounds**
CNS 14-170 Series III	**6,540 pounds**

NOTE: The PAB Truck Bay is not an "Heavy Loads" area and NUREG-0612 is NOT applicable. Refer to SLP 4.

5.2.1 Combined primary and secondary lid weight based on cask handling manual 7080 lbs.

5.2.2 Remove the three lifting eye shipping covers if applicable, and inspect the eyes for excessive wear prior to attaching shackles and slings.

CAUTION

When lifting the cask lid, use the three installed lifting eyes on the top of the primary (outer) lid with appropriate slings and shackles to ensure lifting capacity of 2.2 times the load is maintained.

The secondary lid (i.e., inner cask lid with one lifting eye) is NOT designed to lift the entire lid.

5.2.3 Rig lid for lift using the three lifting eyes. The lifted load used to size the rigging **SHALL** be 2.2 times the actual load. The safety factor (3 for yield, 5 for ultimate) is applied towards the 2.2 times the actual load.

5.2.4 List slings being used for lifting cask lid.

Slings NS-654, 1943, 1945

INITIALS

NOTE: When performing a lift, check levelness of lift to ensure binding does not occur. If needed, set down load and adjust rigging to ensure a level lift. If needed, utilize wire rope slings to minimize stretch of nylon slings.

5.2.5 Raise cask lid slowly and ensure lid is level.

5.2.6 Raise cask lid high enough to ensure travel path is clear and relocate lid to designated laydown area inside the PAB Truck Bay.

5.3 Removing Concrete (square) Shield Lid From Shield Body

NOTE: Square concrete shield lid with handrails weighs 11,000 pounds with concrete plug installed.

NOTE: The PAB Truck Bay is NOT an "Heavy Loads" area and NUREG-0612 is NOT applicable. Refer to SLP 4.

CAUTION

When lifting the concrete shield lid, use the four installed lifting points with appropriate slings and shackles to ensure lifting capacity of 2.2 times the load is maintained.

5.3.1 Rig lid for lift using the four lifting points. The lifted load used to size the rigging **SHALL** be 2.2 times the actual load. The safety factor (3 for yield, 5 for ultimate) is applied towards the 2.2 times the actual load.

5.3.2 List slings being used for lifting concrete shield lid.

Slings 16-040343, 16-040344, 16-040280, 16-040337

NOTE: When performing a lift, check levelness of lift to ensure binding does not occur. If needed, set down load and adjust rigging to ensure a level lift. If needed, utilize wire rope slings to minimize stretch of nylon slings.

5.3.3 Raise concrete shield slowly and ensure lid is level.

5.3.4 Raise concrete shield high enough to ensure travel path is clear and relocate lid to designated laydown area inside the PAB Truck Bay.

INITIALS

5.4 Removing Concrete (round OSSC) Shield Lid From Shield Body

NOTE: Round concrete shield lid weighs approximately 10,750 pounds with inner concrete plug installed.

NOTE: The PAB Truck Bay is NOT an "Heavy Loads" area and NUREG-0612 is NOT applicable. Refer to SLP 4.

CAUTION

When lifting the concrete shield lid, use the three installed lifting lugs with appropriate slings and shackles to ensure lifting capacity of 2.2 times the load is maintained.

5.4.1 Rig lid for lift using the three lifting lugs. The lifted load used to size the rigging SHALL be 2.2 times the actual load. The safety factor (3 for yield, 5 for ultimate) is applied towards the 2.2 times the actual load. N/A

5.4.2 List slings being used for lifting concrete shield lid.

Slings N/A N/A

NOTE: When performing a lift, check levelness of lift to ensure binding does not occur. If needed, set down load and adjust rigging to ensure a level lift. If needed, utilize wire rope slings to minimize stretch of nylon slings.

5.4.3 Raise concrete shield slowly and ensure lid is level. N/A

5.4.4 Raise concrete shield high enough to ensure travel path is clear and relocate lid to designated laydown area inside the PAB Truck Bay. N/A

INITIALS

5-25-19

5.5 Relocate loaded resin liner (CNS 8-120 ~~Poly~~ Liner) from concrete shield to shipping cask or container. Liners other than the CNS 8-120 Poly Liner require a completed rigging evaluation including review by Engineering personnel.

NOTE: Shipping liners can vary in weight depending on media (i.e., resin, charcoal, other)

Resins weighs from 45 to 53 pounds/cubic foot

Activated Carbon weighs approximately 33 pounds/cubic foot

INDEPENDENT VERIFICATION

Calculated weight has been verified to be accurate

5.5.1 Calculate the weight of liner with contents

Weight of Empty Liner 1250
Weight of resin 53 lbs/ft^3 x 100 = 5300
Weight of carbon 33 lbs/ft^{3}x 0 = 0

Total Weight of liner with contents = 6550 lbs

6550
2TG
IV

INITIALS

NOTE: **The PAB Truck Bay is NOT an "Heavy Loads" area and NUREG-0612 is NOT applicable. Refer to SLP 4.**

CAUTION

The lifting basket and its associated lugs have been structurally evaluated by Energy Solutions.

The device has been designed for a load of 10,000 pounds.

At this load, the device has a safety factor of 3 against yield and 5 against ultimate stress.

The HIC lifts will all occur in the PAB Truck Bay.

The basket slings provided with the HIC were load tested to 3.8 tons and have a capacity of 1.9 ton (3,800 pounds) at factors of safety of 3 and 5.

Two slings each in a basket configuration are provided with the HIC. There are four rigging points on the HIC, each sling attached to 2 shackles that are 3 feet apart, resulting in a lift angle of approximately 53 degrees.

This is an acceptable configuration.

5.5.2 Rig liner for lift using the four lifting points. The lifted load used to size the rigging **SHALL** be 2.2 times the actual load. The safety factor (3 for yield, 5 for ultimate) is applied towards the 2.2 times the actual load.

5.5.3 List slings being used for lift.

Slings 303-4056

NOTE: **When performing a lift, check levelness of lift to ensure binding does not occur. If needed, set down load and adjust rigging to ensure a level lift. If needed, utilize wire rope slings to minimize stretch of nylon slings.**

5.5.4 Raise liner slowly and ensure it is level.

INITIALS

CAUTION

Radioactive Waste liners can have dose rates up to and exceeding 50 rem/hour.

Determine methods to minimize dose during the transfer.

Methods to be considered include the use of cameras, radios, shielding, distance, and minimizing time in exposed areas.

All unnecessary personnel to vacate the PAB Truck Bay as directed by RP personnel with the understanding the Rigger-in-Charge of the lift will determine communication and spotting requirements.

5.5.5 Raise liner lid high enough to ensure travel path is clear and relocate liner to shipping cask.

5.5.6 Remove rigging from liner using ALARA practices.

5.5.7 Ensure slings on liner will **NOT** interfere with cask lid installation.

5.6 Δ Relocate filter HIC (CNS 8-120 Poly Liner) from the PAB El. 46' storage area to the PAB Truck Bay concrete shield or shipping cask container. Liners other than the CNS 8-120 Poly Liner require a completed rigging evaluation including review by Engineering personnel.

INITIALS

NOTE: Shipping liners can vary in weight.

CAUTION

The lifting basket and its associated lugs have been structurally evaluated by Energy Solutions.

The device has been designed for a load of 10,000 pounds. At this load, the device has a safety factor of 3 against yield and 5 against ultimate stress.

The basket slings provided with the HIC were load tested to 3.8 tons and have a capacity of 1.9 ton (3,800 pounds) at factors of safety of 3 and 5.

Two slings each in a basket configuration are provided with the HIC. There are four rigging points on the HIC, each sling attached to 2 shackles that are 3 feet apart, resulting in a lift angle of approximately 53 degrees.

Since factors of safety are insufficient for the move over the Spent Fuel Pool using the single failure proof crane the rated load of the basket and its lifting lugs must be divided by 2.2.

Thus, the allowable load for this configuration is 10,000 pounds/2.2 = 4,545 pounds.

To be conservative, this weight limit is 4,500 pounds.

5.6.1 Weigh the liner with contents.

Weight of Liner N/A pounds. N/A

5.6.2 Verify the loaded liner is less than 4,500 pounds. N/A

5.6.3 Rig liner for lift using the four rigging points. The lifted load used to size the rigging SHALL be 2.2 times the actual load. The safety factor (3 for yield, 5 for ultimate) is applied towards the 2.2 times the actual load. N/A

5.6.4 List slings being used for lift.

Slings N/A N/A

NOTE: When performing a lift, check levelness of lift to ensure binding does not occur. If needed, set down load and adjust rigging to ensure a level lift. If needed, utilize wire rope slings to minimize stretch of nylon slings.

5.6.5 Raise liner slowly and ensure it is level. N/A

INITIALS

CAUTION

Radioactive Waste liners can have dose rates up to and exceeding 50 rem/hour.

Determine methods to minimize dose during the transfer. Methods to be considered include the use of cameras, radios, minimizing time in exposed areas, shielding, and maximizing distance.

All unnecessary personnel to vacate the PAB Truck Bay as directed by RP personnel with the understanding the Rigger-in-Charge of the lift will determine communication and spotting requirements.

5.6.6 Raise liner high enough to ensure travel path is clear and relocate liner to shipping cask. N/A

5.6.7 Remove rigging from liner using ALARA practices. N/A

5.6.8 Ensure slings on liner will **NOT** interfere with cask lid installation. N/A

INITIALS

5.7 Replace Cask Primary Lid with Secondary Lid Installed

NOTE: Shipping cask lids vary in weight. The weights listed below are the combined weight of the primary and secondary lids unless noted otherwise.

CNS 8-120A	**7,000 pounds**
CNS 8-120B	**7,080 pounds**
CNS 14/210 and 14/215	**7,700 pounds**
CNS 14-195H	**6,300 pounds**
CNS 14-190H	**8,800 pounds**
CNS 14-170 Series II	**6,500 pounds**
CNS 14-170 Series III	**6,540 pounds**
TCT Lid	**3,500 pounds**

NOTE: The PAB Truck Bay is NOT an "Heavy Loads" area and NUREG-0612 is NOT applicable. Refer to SLP 4.

CAUTION

When lifting the cask lid, use the three installed lifting eyes on the top of the primary (outer) lid. Rig with appropriate slings and shackles to ensure lifting capacity of 2.2 times the load is maintained.

5.7.1 Rig lid for lift using the three lifting eyes. The lifted load used to size the rigging **SHALL** be 2.2 times the actual load. The safety factor (3 for yield, 5 for ultimate) is applied towards the 2.2 times the actual load.

5.7.2 List slings being used for lifting cask impact limiter.

Slings NS-654, 1943, 1945

NOTE: When performing a lift, check levelness of lift to ensure binding does not occur. If needed, set down load and adjust rigging to ensure a level lift. If needed, utilize wire rope slings to minimize stretch of nylon slings.

5.7.3 Raise primary lid slowly and ensure lid is level.

INITIALS

5.7.4 Raise lid high enough to ensure travel path is clear and relocate lid to cask using alignment pins and markings.

5.8 Replacing Cask Impact Limiter from Type B Shipping Cask

NOTE: Type B shipping cask impact limiters typically weigh approximately 5,500 pounds.

NOTE: The PAB Truck Bay is NOT an "Heavy Loads" area and NUREG-0612 is NOT applicable. Refer to SLP 4.

CAUTION

When lifting the impact limiter, use the three installed lifting eyes with appropriate slings and shackles to ensure lifting capacity of 2.2 times the load is maintained.

5.8.1 Rig lid for lift using the three lifting eyes. The lifted load used to size the rigging **SHALL** be 2.2 times the actual load. The safety factor (3 for yield, 5 for ultimate) is applied towards the 2.2 times the actual load.

5.8.2 List slings being used for lifting cask impact limiter.

Slings 16-040343, 16-040344, 16-040280, 16-040337

NOTE: When performing a lift, check levelness of lift to ensure binding does not occur. If needed, set down load and adjust rigging to ensure a level lift. If needed, utilize wire rope slings to minimize stretch of nylon slings.

5.8.3 Raise impact limiter slowly and ensure level.

5.8.4 Raise impact limiter high enough to ensure travel path is clear and relocate to cask utilizing the alignment marks on cask body.

5.8.5 Remove rigging from impact limiter lifting eyes.

5.8.6 Replace impact limiter lifting eye shipping covers with covers and pins provided.

5.8.7 Reconnect impact limiter ratchet binders securing the top and bottom impact limiters.

INITIALS

5.9 Replacing Concrete (square) Shield Lid on Shield Body

NOTE: Square concrete shield lid with handrails weighs 11,000 pounds with concrete plug installed.

NOTE: The PAB Truck Bay is not an "Heavy Loads" area and NUREG-0612 is NOT applicable. Refer to SLP 4.

CAUTION

When lifting the concrete shield lid, use the four installed lifting points with appropriate slings and shackles to ensure lifting capacity of 2.2 times the load is maintained.

5.9.1 Rig lid for lift using the four lifting eyes. The lifted load used to size the rigging **SHALL** be 2.2 times the actual load. The safety factor (3 for yield, 5 for ultimate) is applied towards the 2.2 times the actual load.

5.9.2 List slings being used for lifting concrete shield lid.

Slings 16-040343, 16-040344, 16-040280, 16-040337

NOTE: When performing a lift, check levelness of lift to ensure binding does not occur. If needed, set down load and adjust rigging to ensure a level lift. If needed, utilize wire rope slings to minimize stretch of nylon slings.

5.9.3 Raise concrete shield slowly and ensure lid is level.

5.9.4 Raise the concrete shield high enough to ensure travel path is clear and relocate lid to shield base inside truck bay.

INITIALS

5.10 Replacing Concrete (round OSSI) Shield Lid on Shield Body

NOTE: Round concrete shield lid weighs approximately 10,750 pounds with concrete plug installed.

NOTE: The PAB Truck Bay is NOT an "Heavy Loads" area and NUREG-0612 is NOT applicable. Refer to SLP 4.

CAUTION

When lifting the concrete shield lid, use the three installed lifting lugs with appropriate slings and shackles to ensure lifting capacity of 2.2 times the load is maintained.

5.10.1 Rig lid for lift using the three lifting lugs. The lifted load used to size the rigging **SHALL** be 2.2 times the actual load. The safety factor (3 for yield, 5 for ultimate) is applied towards the 2.2 times the actual load. N/A

5.10.2 List slings being used for lifting concrete shield lid. N/A

Slings N/A N/A

NOTE: When performing a lift, check levelness of lift to ensure binding does not occur. If needed, set down load and adjust rigging to ensure a level lift. If needed, utilize wire rope slings to minimize stretch of nylon slings.

5.10.3 Raise concrete shield slowly and ensure lid is level. N/A

5.10.4 Raise the concrete shield high enough to ensure travel path is clear and relocate lid to shield base inside PAB Truck Bay. N/A

6.0 REFERENCES

6.1 MA-AA-110-1000, Rigging Handbook and Inspection Guideline

6.2 MA-AA-212-1000, Rigging and Material Handling Guideline

6.3 SLP 4, Auxiliary Building Main Crane

6.4 SLP 5, Use of Wire Rope Slings

6.5 SLP 6, Wire Rope Sling Sizing

6.6 SLP 7, Use of Synthetic Webbing Slings

6.7 SLP 8, Synthetic Webbing Sling Sizing

6.8 SLP 9, Sling Selection

6.9 NUREG-0612, Control of Heavy Loads at Nuclear Power Plants

6.10 NEI 08-05, Industry Initiation on Control of Heavy Loads

6.11 Technical 382, Cask Handling Procedure for U.S. DOT Specification 7A, Type A Transportation Cask

6.12 14/210 and 14-215H Cask Book

6.13 CNS 14-170II Cask Book

6.14 CNS 14-170III Cask Book

6.15 CNS 14-190H Cask Book

6.16 CNS 14-195H Cask Book

6.17 CNS 21-300 Cask Book

6.18 CNS 8-120A Cask Book

6.19 CNS 8-120B Cask Book

RIGGING LIFT PLAN
(Page 1 of 4)

WO or Equip. ID._____

Description of object to be lifted

Cask Impact Limiter 5500 Lbs.

1. Lift Preparation - Refer to MA-AA-212-1000, Section 4.4, Attachment 8 and Attachment 13 for guidance.

1A. Lift Identification

Check all that apply. If none apply then check ☐ Level 1 Lift

- ☐ Heavy Load
- ☐ Complex Lift
- ☒ ≥5000 lbs.
- ☐ < 25 feet from High Power Lines
- ☐ Special Heavy Lift, per DAEC ACP1408.3 (Mark Section 1B as N/A)

1B. Lift Oversight and Controls: ☐ N/A

IF lift is a HEAVY LOAD, THEN refer to Site Specific NUREG 0612 requirements & MA-AA-212-1000 guidance:

Check all that apply - Refer to MA-AA-212-1000, Attachment 8 for guidance:

- ☐ Site Specific NUREG 0612 Form/Engineering Evaluation, as applicable
- ☐ Rigging Evaluation (MA-AA-212-1000-F01)
- ☐ Rigging Lift Plan (MA-AA-212-1000-F02)
- ☐ Rigger-In-Charge ☐ Rigger 1 ☐ Rigger 2 ☑ RDW 16.17

2. Weight of the load

If the answer to any of these questions is "yes", fill in the weight and proceed to section 3. If all of the answers to these questions are "no", then the lift cannot proceed without a Rigging Evaluation, MA-AA-212-1000-F01.

(i) Is the weight of the load marked on it? ☐ Yes ☒ No

(ii) Is the weight of the load shown on a drawing / procedure ☒ Yes ☐ No

If Yes, Record drawing / procedure number: RDW 16.17

(iii) Can the weight of the load be accurately calculated? ☐ Yes ☐ No ☒ N/A

(attach written indication of weight)

(iv) Can a test lift be made with a load-weighing device? ☐ Yes ☐ No ☒ N/A

Weight of the Load = _____ (lbs / tons Circle one)

3. Nature of the Load

If the answer to any of these questions are "no" for questions 3i thru 3v, then consult a Rigging Evaluator / Engineer for a Rigging Evaluation

(i) Is the center of gravity of the load known, or easily identified? ☒ Yes ☐ No

(ii) Can the rigging be adjusted to accommodate an uncertain center of gravity or known imbalance? ☐ Yes ☐ No ☒ N/A

NOTE: Side loading of any crane shall not be permitted unless properly evaluated

(iii) Can the lifting hook be positioned over the center of gravity of the load ☒ Yes ☐ No

(iv) Can the load be lifted without side loading the crane? ☒ Yes ☐ No

(v) Are movable parts (such as doors, arms, trolleys, etc.) secured to prevent any movement / load shift during the lift? ☐ Yes ☐ No ☒ N/A

(vi) Are softeners required? ☐ Yes ☒ No

RIGGING LIFT PLAN
(Page 2 of 4)

4. Capacity of the Crane and Rigging

If the answer to any of these questions is "no" or unknown for 4i through 4ix, then the lift may not proceed until the discrepancy is resolved. If performing a Special Heavy Lift per DAEC ACP1408.3 step (ii) is N/A, and section 5 of this form shall be completed.

(i) Capacity of the crane or hoist intended to be used. 25 T

(ii) Are the capacities of ALL the rigging components, in their intended configuration, greater than the weight of the load?	☒ Yes	☐ No	
(iii) Is the capacity of the crane(s) / hoist(s) greater than the weight of the load	☒ Yes	☐ No	
(iv) Are all of the rigging components inspected and qualified?	☒ Yes	☐ No	
(v) For mobile cranes, is the ground stable enough for landing outriggers?	☐ Yes	☐ No	☒ N/A
(vi) Are concrete lift inserts of sufficient capacity for the load?	☐ Yes	☐ No	☒ N/A
(vii) Do concrete lift inserts require testing?	☐ Yes	☐ No	☒ N/A
(viii) Does the area where the load is to be set have sufficient capacity to support the load?	☒ Yes	☐ No	
(ix) Has the (mobile or overhead) crane had a periodic inspection within the last year?	☒ Yes	~~☐ No~~ 5-25-17	
(x) Are any Rigging Engineer inspections required of lifting equipment?	☐ Yes	☒ No	
(xi) For Mobile Cranes review lift for use of appropriate devices (guide pins, extended all thread rods) to limit load drift/swing due to boom deflection when using mobile crane for lifting large motors/pumps.	☐ Yes	☐ No	☒ N/A

5. Special Heavy Lifts, per DAEC ACP1408.3 ☒ N/A

(i) Is the pre-lift crane inspection complete? ☒ Yes ☐ No

LIFT MAY NOT PROCEED UNTIL PRE-LIFT INSPECTION IS COMPLETE

(ii) Record the distances:

A. Height to be lifted. 3'

B. Total distance to be travelled with the load lifted 20'

(iii) Is the post-lift crane inspection complete? ☐ Yes ☐ No

THE CRANE CANNOT BE USED AGAIN UNTIL THE POST-LIFT CRANE INSPECTION IS COMPLETE

RIGGING LIFT PLAN
(Page 3 of 4)

6. Crane Operator, Communications, Load Path, and Environmental Concerns

(i) Are the prior to use checks on the crane or hoist complete?	☒ Yes	☐ No	☐ N/A
(ii) Is the crane operator qualified to operate the crane?	☒ Yes	☐ No	☐ N/A
(iii) Is the signalman designated and uniquely marked?	☒ Yes	☐ No	☐ N/A
(iv) What is the primary method of communication between the crane operator and the signalman?	☒ Voice	☐ Radio	☐ Hand Signals
(v) Are effective barricades in place on roads or walkways to alert personnel of the lift?	☒ Yes	☐ No	☐ N/A
(vi) Is the intended load path over offices, shops or other work locations	☐ Yes	☒ No	☐ N/A
(vii) Is the intended load path over live equipment (electrical, steam, pressurized fluids)?	☐ Yes	☒ No	☐ N/A
(viii) Are there weather hazards (wind, rain, snow, cold) that may adversely effect the completion of the lift?	☐ Yes	☒ No	☐ N/A
(ix) Are there personnel in the load path?	☐ Yes	☒ No	☐ N/A

If the answer to any of (vi) thru (ix) is "yes", describe how the effect of conditions will be eliminated, controlled, or reduced:

(x) For mobile cranes, is the crane required to be grounded?	☐ Yes	☐ No	☒ N/A
(xi) Is the cribbing material properly staged and inspected?	☐ Yes	☐ No	☒ N/A
(xii) Are tag lines being used?	☐ Yes	☒ No	☐ N/A
(xiii) For Mobile Cranes verify wind speed is less than allowed by the crane data.	☐ Yes	☐ No	N/A

Record wind speed at time of lift: N/A.

Comments – Enter any additional comments or sketches for this lift below:

RIGGING LIFT PLAN
(Page 4 of 4)

Signatures
Task Supervisor or Rigger-in-Charge _____ Date 5/2
Crane Operator _____ Date 5-29-19
Rigger / Signalman James Tullo _____ Date 5/29/19
(*SEABROOK USE ONLY, if required, per MS0534.38 for NUREG lifts)
*Department Head or Manager _____ Date _____

RIGGING LIFT PLAN
(Page 1 of 4)

WO or Equip. ID._____

Description of object to be lifted

Resin Liner 6550 Lbs

1. Lift Preparation - Refer to MA-AA-212-1000, Section 4.4, Attachment 8 and Attachment 13 for guidance.

1A. Lift Identification

Check all that apply. If none apply then check ☐ Level 1 Lift

- ☐ Heavy Load
- ☐ Complex Lift
- ☒ ≥5000 lbs.
- ☐ < 25 feet from High Power Lines
- ☐ Special Heavy Lift, per DAEC ACP1408.3 (Mark Section 1B as N/A)

1B. Lift Oversight and Controls: ☐ N/A

IF lift is a HEAVY LOAD, THEN refer to Site Specific NUREG 0612 requirements & MA-AA-212-1000 guidance:

Check all that apply - Refer to MA-AA-212-1000, Attachment 8 for guidance:

- ☐ Site Specific NUREG 0612 Form/Engineering Evaluation, as applicable
- ☐ Rigging Evaluation (MA-AA-212-1000-F01)
- ☐ Rigging Lift Plan (MA-AA-212-1000-F02)
- ☐ Rigger-In-Charge ☐ Rigger 1 ☐ Rigger 2 [X] RDW 16.17

2. Weight of the load

If the answer to any of these questions is "yes", fill in the weight and proceed to section 3. If all of the answers to these questions are "no", then the lift cannot proceed without a Rigging Evaluation, MA-AA-212-1000-F01.

(i) Is the weight of the load marked on it? ☐ Yes ☒ No

(ii) Is the weight of the load shown on a drawing / procedure ☒ Yes ☐ No

If Yes, Record drawing / procedure number: RDW 16.17

(iii) Can the weight of the load be accurately calculated? ☒ Yes ☐ No ☐ N/A

(attach written indication of weight)

(iv) Can a test lift be made with a load-weighing device? ☐ Yes ☐ No ☒ N/A

Weight of the Load = _____ (lbs / tons Circle one)

3. Nature of the Load

If the answer to any of these questions are "no" for questions 3i thru 3v, then consult a Rigging Evaluator / Engineer for a Rigging Evaluation

(i) Is the center of gravity of the load known, or easily identified? ☒ Yes ☐ No

(ii) Can the rigging be adjusted to accommodate an uncertain center of gravity or known imbalance? ☐ Yes ☐ No ☒ N/A

NOTE: Side loading of any crane shall not be permitted unless properly evaluated

(iii) Can the lifting hook be positioned over the center of gravity of the load? ☒ Yes ☐ No

(iv) Can the load be lifted without side loading the crane? ☒ Yes ☐ No

(v) Are movable parts (such as doors, arms, trolleys, etc.) secured to prevent any movement / load shift during the lift? ☐ Yes ☐ No ☒ N/A

(vi) Are softeners required? ☐ Yes ☒ No

RIGGING LIFT PLAN
(Page 2 of 4)

4. Capacity of the Crane and Rigging

If the answer to any of these questions is "no" or unknown for 4i through 4ix, then the lift may not proceed until the discrepancy is resolved. If performing a Special Heavy Lift per DAEC ACP1408.3 step (ii) is N/A, and section 5 of this form shall be completed.

(i) Capacity of the crane or hoist intended to be used. 25 T

(ii) Are the capacities of ALL the rigging components, in their intended configuration, greater than the weight of the load?	☒ Yes	☐ No	
(iii) Is the capacity of the crane(s) / hoist(s) greater than the weight of the load	☒ Yes	☐ No	
(iv) Are all of the rigging components inspected and qualified?	☒ Yes	☐ No	
(v) For mobile cranes, is the ground stable enough for landing outriggers?	☐ Yes	☐ No	☒ N/A
(vi) Are concrete lift inserts of sufficient capacity for the load?	☐ Yes	☐ No	☒ N/A
(vii) Do concrete lift inserts require testing?	☐ Yes	☐ No	☒ N/A
(viii) Does the area where the load is to be set have sufficient capacity to support the load?	☒ Yes	☐ No	
(ix) Has the (mobile or overhead) crane had a periodic inspection within the last year?	☒ Yes	☐ No	
(x) Are any Rigging Engineer inspections required of lifting equipment?	☐ Yes	☒ No	
(xi) For Mobile Cranes review lift for use of appropriate devices (guide pins, extended all thread rods) to limit load drift/swing due to boom deflection when using mobile crane for lifting large motors/pumps.	☐ Yes	☐ No	☒ N/A

5. Special Heavy Lifts, per DAEC ACP1408.3 ☒ N/A

(i) Is the pre-lift crane inspection complete? ☐ Yes ☐ No

LIFT MAY NOT PROCEED UNTIL PRE-LIFT INSPECTION IS COMPLETE

(ii) Record the distances:

A. Height to be lifted. _____

B. Total distance to be travelled with the load lifted _____

(iii) Is the post-lift crane inspection complete? ☐ Yes ☐ No

THE CRANE CANNOT BE USED AGAIN UNTIL THE POST-LIFT CRANE INSPECTION IS COMPLETE

RIGGING LIFT PLAN
(Page 3 of 4)

6. Crane Operator, Communications, Load Path, and Environmental Concerns

(i) Are the prior to use checks on the crane or hoist complete?	☒ Yes	☐ No	☐ N/A
(ii) Is the crane operator qualified to operate the crane?	☒ Yes	☐ No	☐ N/A
(iii) Is the signalman designated and uniquely marked?	☒ Yes	☐ No	☐ N/A
(iv) What is the primary method of communication between the crane operator and the signalman?	☒ Voice	☐ Radio	☐ Hand Signals
(v) Are effective barricades in place on roads or walkways to alert personnel of the lift?	☒ Yes	☐ No	☐ N/A
(vi) Is the intended load path over offices, shops or other work locations	☐ Yes	☒ No	☐ N/A
(vii) Is the intended load path over live equipment (electrical, steam, pressurized fluids)?	☐ Yes	☒ No	☐ N/A
(viii) Are there weather hazards (wind, rain, snow, cold) that may adversely effect the completion of the lift?	☐ Yes	☒ No	☐ N/A
(ix) Are there personnel in the load path?	☐ Yes	☒ No	☐ N/A

If the answer to any of (vi) thru (ix) is "yes", describe how the effect of conditions will be eliminated, controlled, or reduced:

(x) For mobile cranes, is the crane required to be grounded?	☐ Yes	☐ No	☒ N/A
(xi) Is the cribbing material properly staged and inspected?	☐ Yes	☐ No	☒ N/A
(xii) Are tag lines being used?	☐ Yes	☐ No	☐ N/A
(xiii) For Mobile Cranes verify wind speed is less than allowed by the crane data.	☐ Yes	☐ No	☒ N/A

Record wind speed at time of lift: N/A.

Comments – Enter any additional comments or sketches for this lift below:

RIGGING LIFT PLAN
(Page 4 of 4)

Signatures

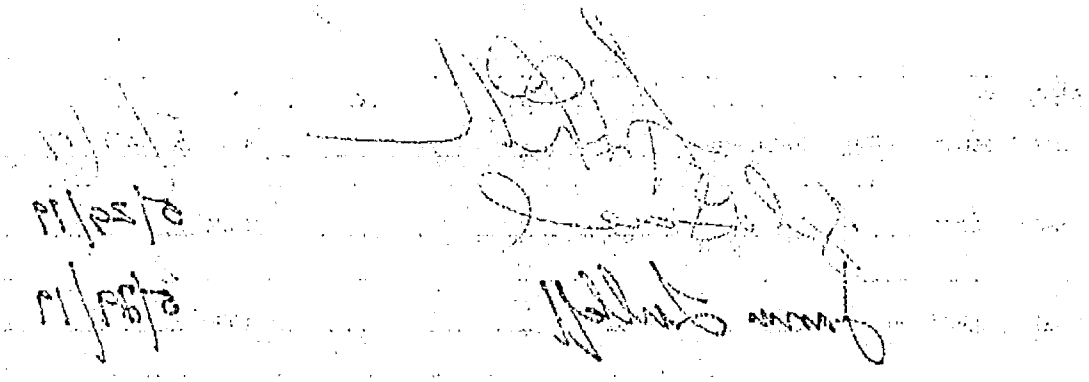
Task Supervisor or Rigger-in-Charge _____ Date 5/29/19

Crane Operator _____ Date 5/29/19

Rigger / Signalman _____ Date 5/29/19

(*SEABROOK USE ONLY, if required, per MS0534.38 for NUREG lifts)

*Department Head or Manager _____ Date _____



RIGGING LIFT PLAN
(Page 1 of 4)

WO or Equip. ID._____

Description of object to be lifted

Cask Lid w/ Secondary Lid. 7080 Lbs

1. Lift Preparation - Refer to MA-AA-212-1000, Section 4.4, Attachment 8 and Attachment 13 for guidance.

1A. Lift Identification

Check all that apply. If none apply then check ☐ Level 1 Lift

- ☐ Heavy Load
- ☐ Complex Lift
- ☒ ≥5000 lbs.
- ☐ < 25 feet from High Power Lines
- ☐ Special Heavy Lift, per DAEC ACP1408.3 (Mark Section 1B as N/A)

1B. Lift Oversight and Controls: ☐ N/A

IF lift is a HEAVY LOAD, THEN refer to Site Specific NUREG 0612 requirements & MA-AA-212-1000 guidance:

Check all that apply - Refer to MA-AA-212-1000, Attachment 8 for guidance:

- ☐ Site Specific NUREG 0612 Form/Engineering Evaluation, as applicable
- ☐ Rigging Evaluation (MA-AA-212-1000-F01)
- ☐ Rigging Lift Plan (MA-AA-212-1000-F02)
- ☐ Rigger-In-Charge ☐ Rigger 1 ☐ Rigger 2 ☒ RDW 16.17

2. Weight of the load

If the answer to any of these questions is "yes", fill in the weight and proceed to section 3. If all of the answers to these questions are "no", then the lift cannot proceed without a Rigging Evaluation, MA-AA-212-1000-F01.

(i) Is the weight of the load marked on it? ☐ Yes ☒ No

(ii) Is the weight of the load shown on a drawing / procedure ☒ Yes ☐ No

If Yes, Record drawing / procedure number: RDW 16.17

(iii) Can the weight of the load be accurately calculated? ☐ Yes ☐ No ☒ N/A

(attach written indication of weight)

(iv) Can a test lift be made with a load-weighing device? ☐ Yes ☐ No ☒ N/A

Weight of the Load = _____ (lbs / tons Circle one)

3. Nature of the Load

If the answer to any of these questions are "no" for questions 3i thru 3v, then consult a Rigging Evaluator / Engineer for a Rigging Evaluation

(i) Is the center of gravity of the load known, or easily identified? ☒ Yes ☐ No

(ii) Can the rigging be adjusted to accommodate an uncertain center of gravity or known imbalance? ☐ Yes ☐ No ☒ N/A

NOTE: Side loading of any crane shall not be permitted unless properly evaluated

(iii) Can the lifting hook be positioned over the center of gravity of the load ☒ Yes ☐ No

(iv) Can the load be lifted without side loading the crane? ☒ Yes ☐ No

(v) Are movable parts (such as doors, arms, trolleys, etc.) secured to prevent any movement / load shift during the lift? ☐ Yes ☐ No ☒ N/A

(vi) Are softeners required? ☐ Yes ☒ No

RIGGING LIFT PLAN
(Page 2 of 4)

4. Capacity of the Crane and Rigging

If the answer to any of these questions is "no" or unknown for 4i through 4ix, then the lift may not proceed until the discrepancy is resolved. If performing a Special Heavy Lift per DAEC ACP1408.3 step (ii) is N/A, and section 5 of this form shall be completed.

(i) Capacity of the crane or hoist intended to be used. 25 T

(ii) Are the capacities of ALL the rigging components, in their intended configuration, greater than the weight of the load?	☒ Yes	☐ No	
(iii) Is the capacity of the crane(s) / hoist(s) greater than the weight of the load	☒ Yes	☐ No	
(iv) Are all of the rigging components inspected and qualified?	☒ Yes	☐ No	
(v) For mobile cranes, is the ground stable enough for landing outriggers?	☐ Yes	☐ No	☒ N/A
(vi) Are concrete lift inserts of sufficient capacity for the load?	☐ Yes	☐ No	☒ N/A
(vii) Do concrete lift inserts require testing?	☐ Yes	☐ No	☒ N/A
(viii) Does the area where the load is to be set have sufficient capacity to support the load?	☐ Yes	☐ No	
(ix) Has the (mobile or overhead) crane had a periodic inspection within the last year?	☒ Yes	☐ No	
(x) Are any Rigging Engineer inspections required of lifting equipment?	☐ Yes	☒ No	
(xi) For Mobile Cranes review lift for use of appropriate devices (guide pins, extended all thread rods) to limit load drift/swing due to boom deflection when using mobile crane for lifting large motors/pumps.	☐ Yes	☐ No	☒ N/A

5. Special Heavy Lifts, per DAEC ACP1408.3 ☒ N/A

(i) Is the pre-lift crane inspection complete? ☐ Yes ☐ No

LIFT MAY NOT PROCEED UNTIL PRE-LIFT INSPECTION IS COMPLETE

(ii) Record the distances:

A. Height to be lifted. _____

B. Total distance to be travelled with the load lifted _____

(iii) Is the post-lift crane inspection complete? ☐ Yes ☐ No

THE CRANE CANNOT BE USED AGAIN UNTIL THE POST-LIFT CRANE INSPECTION IS COMPLETE

RIGGING LIFT PLAN
(Page 3 of 4)

6. Crane Operator, Communications, Load Path, and Environmental Concerns

(i) Are the prior to use checks on the crane or hoist complete?	☒ Yes	☐ No	☐ N/A
(ii) Is the crane operator qualified to operate the crane?	☒ Yes	☐ No	☐ N/A
(iii) Is the signalman designated and uniquely marked?	☒ Yes	☐ No	☐ N/A
(iv) What is the primary method of communication between the crane operator and the signalman?	☒ Voice	☐ Radio	☐ Hand Signals
(v) Are effective barricades in place on roads or walkways to alert personnel of the lift?	☒ Yes	☐ No	☐ N/A
(vi) Is the intended load path over offices, shops or other work locations	☐ Yes	☒ No	☐ N/A
(vii) Is the intended load path over live equipment (electrical, steam, pressurized fluids)?	☐ Yes	☒ No	☐ N/A
(viii) Are there weather hazards (wind, rain, snow, cold) that may adversely effect the completion of the lift?	☐ Yes	☒ No	☐ N/A
(ix) Are there personnel in the load path?	☐ Yes	☒ No	☐ N/A

If the answer to any of (vi) thru (ix) is "yes", describe how the effect of conditions will be eliminated, controlled, or reduced:

(x) For mobile cranes, is the crane required to be grounded?	☐ Yes	☐ No	☒ N/A
(xi) Is the cribbing material properly staged and inspected?	☐ Yes	☐ No	☒ N/A
(xii) Are tag lines being used?	☐ Yes	☐ No	☐ N/A
(xiii) For Mobile Cranes verify wind speed is less than allowed by the crane data.	☐ Yes	☐ No	N/A

Record wind speed at time of lift: _____.

Comments – Enter any additional comments or sketches for this lift below:

RIGGING LIFT PLAN
(Page 4 of 4)

Signatures
Task Supervisor or Rigger-in-Charge _____ Date 5-29-19
Crane Operator _____ Date 5-29-19
Rigger / Signalman _____ Date 5-29-19
(*SEABROOK USE ONLY, if required, per MS0534.38 for NUREG lifts)
*Department Head or Manager _____ Date _____

9-25-7

[illegible]

RIGGING LIFT PLAN
(Page 1 of 4)

WO or Equip. ID._____

Description of object to be lifted

Square Shied Lid 11,000 Lbs

1. Lift Preparation - Refer to MA-AA-212-1000, Section 4.4, Attachment 8 and Attachment 13 for guidance.

1A. Lift Identification

Check all that apply. If none apply then check ☐ Level 1 Lift

- ☐ Heavy Load
- ☐ Complex Lift
- ☒ ≥5000 lbs.
- ☐ < 25 feet from High Power Lines
- ☐ Special Heavy Lift, per DAEC ACP1408.3 (Mark Section 1B as N/A)

1B. Lift Oversight and Controls: ☐ N/A

IF lift is a HEAVY LOAD, THEN refer to Site Specific NUREG 0612 requirements & MA-AA-212-1000 guidance:

Check all that apply - Refer to MA-AA-212-1000, Attachment 8 for guidance:

- ☐ Site Specific NUREG 0612 Form/Engineering Evaluation, as applicable
- ☐ Rigging Evaluation (MA-AA-212-1000-F01)
- ☐ Rigging Lift Plan (MA-AA-212-1000-F02)
- ☐ Rigger-In-Charge ☐ Rigger 1 ☐ Rigger 2 ☒ RDW 16.17

2. Weight of the load

If the answer to any of these questions is "yes", fill in the weight and proceed to section 3. If all of the answers to these questions are "no", then the lift cannot proceed without a Rigging Evaluation,

MA-AA-212-1000-F01.(i) Is the weight of the load marked on it?	☐ Yes	☒ No	
(ii) Is the weight of the load shown on a drawing / procedure	☒ Yes	☐ No	
If Yes, Record drawing / procedure number: RDW 16.17			
(iii) Can the weight of the load be accurately calculated? (attach written indication of weight)	☐ Yes	☐ No	☒ N/A
(iv) Can a test lift be made with a load-weighing device?	☐ Yes	☐ No	☒ N/A

Weight of the Load = _____ (lbs / tons Circle one)

3. Nature of the Load

If the answer to any of these questions are "no" for questions 3i thru 3v, then consult a Rigging Evaluator / Engineer for a Rigging Evaluation

(i) Is the center of gravity of the load known, or easily identified?	☒ Yes	☐ No	
(ii) Can the rigging be adjusted to accommodate an uncertain center of gravity or known imbalance?	☐ Yes	☐ No	☒ N/A
NOTE: Side loading of any crane shall not be permitted unless properly evaluated			
(iii) Can the lifting hook be positioned over the center of gravity of the load	☒ Yes	☐ No	
(iv) Can the load be lifted without side loading the crane?	☒ Yes	☐ No	
(v) Are movable parts (such as doors, arms, trolleys, etc.) secured to prevent any movement / load shift during the lift?	☐ Yes	☐ No	☒ N/A
(vi) Are softeners required?	☐ Yes	☒ No	

RIGGING LIFT PLAN
(Page 2 of 4)

4. Capacity of the Crane and Rigging

If the answer to any of these questions is "no" or unknown for 4i through 4ix, then the lift may not proceed until the discrepancy is resolved. If performing a Special Heavy Lift per DAEC ACP1408.3 step (ii) is N/A, and section 5 of this form shall be completed.

(i) Capacity of the crane or hoist intended to be used. 25T			
(ii) Are the capacities of ALL the rigging components, in their intended configuration, greater than the weight of the load?	☒ Yes	☐ No	
(iii) Is the capacity of the crane(s) / hoist(s) greater than the weight of the load	☒ Yes	☐ No	
(iv) Are all of the rigging components inspected and qualified?	☒ Yes	☐ No	
(v) For mobile cranes, is the ground stable enough for landing outriggers?	☐ Yes	☐ No	☒ N/A
(vi) Are concrete lift inserts of sufficient capacity for the load?	☐ Yes	☐ No	☒ N/A
(vii) Do concrete lift inserts require testing?	☐ Yes	☐ No	☒ N/A
(viii) Does the area where the load is to be set have sufficient capacity to support the load?	☐ Yes	☐ No	
(ix) Has the (mobile or overhead) crane had a periodic inspection within the last year?	☒ Yes	☐ No	
(x) Are any Rigging Engineer inspections required of lifting equipment?	☐ Yes	☒ No	
(xi) For Mobile Cranes review lift for use of appropriate devices (guide pins, extended all thread rods) to limit load drift/swing due to boom deflection when using mobile crane for lifting large motors/pumps.	☐ Yes	☐ No	☒ N/A

5. Special Heavy Lifts, per DAEC ACP1408.3 ☒ N/A

(i) Is the pre-lift crane inspection complete? ☐ Yes ☐ No

LIFT MAY NOT PROCEED UNTIL PRE-LIFT INSPECTION IS COMPLETE

(ii) Record the distances:

A. Height to be lifted. _____

B. Total distance to be travelled with the load lifted _____

(iii) Is the post-lift crane inspection complete? ☐ Yes ☐ No

THE CRANE CANNOT BE USED AGAIN UNTIL THE POST-LIFT CRANE INSPECTION IS COMPLETE

RIGGING LIFT PLAN
(Page 3 of 4)

6. Crane Operator, Communications, Load Path, and Environmental Concerns

(i) Are the prior to use checks on the crane or hoist complete?	☒ Yes	☐ No	☐ N/A
(ii) Is the crane operator qualified to operate the crane?	☒ Yes	☐ No	☐ N/A
(iii) Is the signalman designated and uniquely marked?	☒ Yes	☐ No	☐ N/A
(iv) What is the primary method of communication between the crane operator and the signalman?	☒ Voice	☐ Radio	☐ Hand Signals
(v) Are effective barricades in place on roads or walkways to alert personnel of the lift?	☒ Yes	☐ No	☐ N/A
(vi) Is the intended load path over offices, shops or other work locations	☐ Yes	☒ No	☐ N/A
(vii) Is the intended load path over live equipment (electrical, steam, pressurized fluids)?	☐ Yes	☒ No	☐ N/A
(viii) Are there weather hazards (wind, rain, snow, cold) that may adversely effect the completion of the lift?	☐ Yes	☒ No	☐ N/A
(ix) Are there personnel in the load path?	☐ Yes	☒ No	☐ N/A

If the answer to any of (vi) thru (ix) is "yes", describe how the effect of conditions will be eliminated, controlled, or reduced:

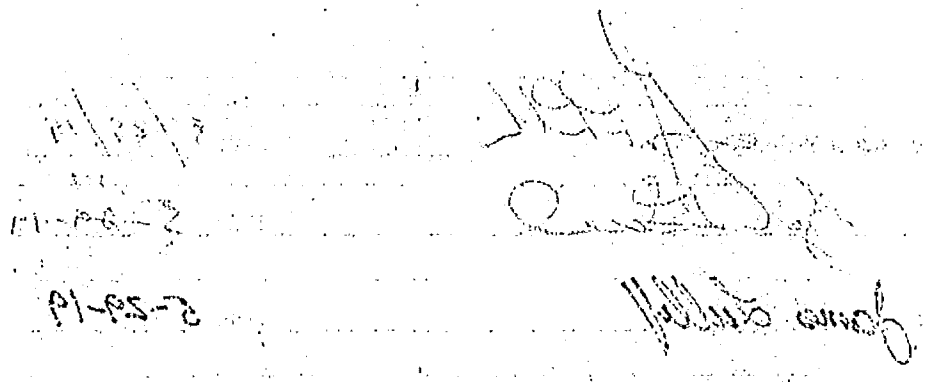
(x) For mobile cranes, is the crane required to be grounded?	☐ Yes	☐ No	☒ N/A
(xi) Is the cribbing material properly staged and inspected?	☐ Yes	☐ No	☒ N/A
(xii) Are tag lines being used?	☐ Yes	☐ No	☐ N/A
(xiii) For Mobile Cranes verify wind speed is less than allowed by the crane data.	☐ Yes	☐ No	

Record wind speed at time of lift: N/A.

Comments – Enter any additional comments or sketches for this lift below:

RIGGING LIFT PLAN
(Page 4 of 4)

Signatures
Task Supervisor or Rigger-in-Charge _____ Date 5/29/19
Crane Operator _____ Date 5-29-19
Rigger / Signalman James Lullo _____ Date 5-29-19
(*SEABROOK USE ONLY, if required, per MS0534.38 for NUREG lifts)
*Department Head or Manager _____ Date _____



Attachment 4

Microshield V8 Outputs

MicroShield 8.03
rscs (8.03-0000)

Date	By	Checked

Filename	Run Date	Run Time	Duration
contact 1m model.msd	August 19, 2020	13:09:17	00:00:01

Project Info

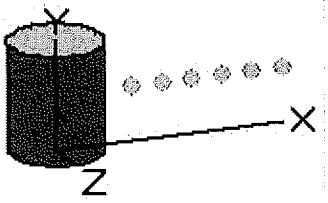
Case Title	Case 1
Description	Case 1
Geometry	7 - Cylinder Volume - Side Shields

Source Dimensions

Height	184.15 cm (6 ft 0.5 in)
Radius	77.788 cm (2 ft 6.6 in)

Dose Points

A	X	Y	Z
#1	128.092 cm (4 ft 2.4 in)	92.075 cm (3 ft 0.3 in)	0.0 cm (0 in)
#2	178.092 cm (5 ft 10.1 in)	92.075 cm (3 ft 0.3 in)	0.0 cm (0 in)
#3	228.092 cm (7 ft 5.8 in)	92.075 cm (3 ft 0.3 in)	0.0 cm (0 in)
#4	278.092 cm (9 ft 1.5 in)	92.075 cm (3 ft 0.3 in)	0.0 cm (0 in)
#5	328.092 cm (10 ft 9.2 in)	92.075 cm (3 ft 0.3 in)	0.0 cm (0 in)
#6	378.092 cm (12 ft 4.9 in)	92.075 cm (3 ft 0.3 in)	0.0 cm (0 in)



Shields

Shield N	Dimension	Material	Density
Source	3.50e+06 cm³	polystyrene	0.72
Transition		Air	0.00122
Air Gap		Air	0.00122
Wall Clad	.304 cm	Carbon	7.85

Source Input: Grouping Method - Actual Photon Energies

Nuclide	Ci	Bq	μCi/cm³	Bq/cm³
Am-241	1.0000e+000	3.7000e+010	2.8566e-001	1.0570e+004

Buildup: The material reference is Source
Integration Parameters

Radial	10
Circumferential	10
Y Direction (axial)	20

Results - Dose Point # 1 - (128.092,92.075,0) cm

Energy (MeV)	Activity (Photons/sec)	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.0139	1.580e+10	1.435e+00	3.110e+00	1.564e-01	3.389e-01
0.0263	8.880e+08	2.094e+00	1.179e+01	3.074e-02	1.730e-01

0.0332	3.922e+07	1.687e-01	1.530e+00	1.242e-03	1.126e-02
0.0595	1.328e+10	1.529e+02	3.294e+03	3.067e-01	6.608e+00
0.0692	6.635e+07	9.436e-01	2.100e+01	1.621e-03	3.607e-02
Totals	**3.008e+10**	**1.575e+02**	**3.331e+03**	**4.967e-01**	**7.167e+00**

Results - Dose Point # 2 - (178.092,92.075,0) cm

Energy (MeV)	Activity (Photons/sec)	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.0139	1.580e+10	8.558e-01	1.847e+00	9.329e-02	2.013e-01
0.0263	8.880e+08	1.138e+00	6.168e+00	1.670e-02	9.054e-02
0.0332	3.922e+07	9.063e-02	8.004e-01	6.669e-04	5.890e-03
0.0595	1.328e+10	8.151e+01	1.749e+03	1.635e-01	3.508e+00
0.0692	6.635e+07	5.027e-01	1.113e+01	8.635e-04	1.912e-02
Totals	**3.008e+10**	**8.410e+01**	**1.769e+03**	**2.750e-01**	**3.825e+00**

Results - Dose Point # 3 - (228.092,92.075,0) cm

Energy (MeV)	Activity (Photons/sec)	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.0139	1.580e+10	5.003e-01	1.078e+00	5.454e-02	1.175e-01
0.0263	8.880e+08	6.768e-01	3.721e+00	9.936e-03	5.463e-02
0.0332	3.922e+07	5.438e-02	4.886e-01	4.002e-04	3.595e-03
0.0595	1.328e+10	4.931e+01	1.058e+03	9.892e-02	2.122e+00
0.0692	6.635e+07	3.044e-01	6.714e+00	5.228e-04	1.153e-02
Totals	**3.008e+10**	**5.084e+01**	**1.070e+03**	**1.643e-01**	**2.309e+00**

Results - Dose Point # 4 - (278.092,92.075,0) cm

Energy (MeV)	Activity (Photons/sec)	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.0139	1.580e+10	3.067e-01	6.636e-01	3.343e-02	7.233e-02
0.0263	8.880e+08	4.408e-01	2.459e+00	6.471e-03	3.610e-02
0.0332	3.922e+07	3.572e-02	3.243e-01	2.628e-04	2.386e-03
0.0595	1.328e+10	3.259e+01	6.975e+02	6.537e-02	1.399e+00
0.0692	6.635e+07	2.012e-01	4.423e+00	3.456e-04	7.597e-03
Totals	**3.008e+10**	**3.357e+01**	**7.054e+02**	**1.059e-01**	**1.518e+00**

Results - Dose Point # 5 - (328.092,92.075,0) cm

Energy (MeV)	Activity (Photons/sec)	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.0139	1.580e+10	1.985e-01	4.328e-01	2.164e-02	4.718e-02
0.0263	8.880e+08	3.061e-01	1.728e+00	4.493e-03	2.536e-02
0.0332	3.922e+07	2.499e-02	2.287e-01	1.839e-04	1.683e-03
0.0595	1.328e+10	2.292e+01	4.910e+02	4.598e-02	9.850e-01
0.0692	6.635e+07	1.416e-01	3.114e+00	2.432e-04	5.348e-03
Totals	**3.008e+10**	**2.359e+01**	**4.965e+02**	**7.254e-02**	**1.065e+00**

Results - Dose Point # 6 - (378.092,92.075,0) cm					
Energy (MeV)	Activity (Photons/sec)	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.0139	1.580e+10	1.345e-01	2.958e-01	1.466e-02	3.224e-02
0.0263	8.880e+08	2.228e-01	1.271e+00	3.270e-03	1.866e-02
0.0332	3.922e+07	1.832e-02	1.690e-01	1.348e-04	1.244e-03
0.0595	1.328e+10	1.689e+01	3.631e+02	3.389e-02	7.284e-01
0.0692	6.635e+07	1.044e-01	2.303e+00	1.793e-04	3.956e-03
Totals	**3.008e+10**	**1.737e+01**	**3.671e+02**	**5.213e-02**	**7.845e-01**

MicroShield 8.03
rscs (8.03-0000)

Date	By	Checked

Filename	Run Date	Run Time	Duration
contact 1m model.msd	August 19, 2020	13:11:20	00:00:01

Project Info

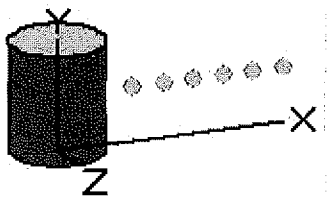
Case Title	Case 1
Description	Case 1
Geometry	7 - Cylinder Volume - Side Shields

Source Dimensions

Height	184.15 cm (6 ft 0.5 in)
Radius	77.788 cm (2 ft 6.6 in)

Dose Points

A	X	Y	Z
#1	128.092 cm (4 ft 2.4 in)	92.075 cm (3 ft 0.3 in)	0.0 cm (0 in)
#2	178.092 cm (5 ft 10.1 in)	92.075 cm (3 ft 0.3 in)	0.0 cm (0 in)
#3	228.092 cm (7 ft 5.8 in)	92.075 cm (3 ft 0.3 in)	0.0 cm (0 in)
#4	278.092 cm (9 ft 1.5 in)	92.075 cm (3 ft 0.3 in)	0.0 cm (0 in)
#5	328.092 cm (10 ft 9.2 in)	92.075 cm (3 ft 0.3 in)	0.0 cm (0 in)
#6	378.092 cm (12 ft 4.9 in)	92.075 cm (3 ft 0.3 in)	0.0 cm (0 in)



Shields

Shield N	Dimension	Material	Density
Source	3.50e+06 cm³	polystyrene	0.72
Transition		Air	0.00122
Air Gap		Air	0.00122
Wall Clad	.304 cm	Carbon	7.85

Source Input: Grouping Method - Actual Photon Energies

Nuclide	Ci	Bq	µCi/cm³	Bq/cm³
Ce-144	1.0000e+000	3.7000e+010	2.8566e-001	1.0570e+004
Pr-144	9.8570e-001	3.6471e+010	2.8158e-001	1.0418e+004

Buildup: The material reference is Source
Integration Parameters

Radial	10
Circumferential	10
Y Direction (axial)	20

Results - Dose Point # 1 - (128.092,92.075,0) cm

Energy (MeV)	Activity (Photons/sec)	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.005	5.840e+08	1.920e-02	4.160e-02	1.169e-02	2.534e-02

0.0336	1.047e+08	4.627e-01	4.308e+00	3.286e-03	3.059e-02
0.0356	8.995e+08	4.465e+00	4.673e+01	2.708e-02	2.834e-01
0.036	1.647e+09	8.397e+00	9.034e+01	4.909e-02	5.281e-01
0.0407	6.189e+08	3.955e+00	5.405e+01	1.674e-02	2.287e-01
0.0409	1.439e+08	9.284e-01	1.282e+01	3.874e-03	5.348e-02
0.0673	4.903e+07	6.712e-01	1.493e+01	1.179e-03	2.623e-02
0.0801	5.914e+08	1.028e+01	2.227e+02	1.626e-02	3.523e-01
0.1335	3.996e+09	1.409e+02	2.133e+03	2.254e-01	3.411e+00
0.6965	5.398e+08	2.232e+02	7.255e+02	4.308e-01	1.400e+00
1.0586	7.422e+06	5.895e+00	1.513e+01	1.076e-02	2.761e-02
1.4892	1.096e+08	1.486e+02	3.270e+02	2.505e-01	5.513e-01
2.1857	2.823e+08	6.956e+02	1.322e+03	1.046e+00	1.987e+00
Totals	**9.574e+09**	**1.243e+03**	**4.968e+03**	**2.092e+00**	**8.906e+00**

Results - Dose Point # 2 - (178.092,92.075,0) cm

Energy (MeV)	Activity (Photons/sec)	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.005	5.840e+08	1.145e-02	2.470e-02	6.974e-03	1.505e-02
0.0336	1.047e+08	2.485e-01	2.254e+00	1.764e-03	1.601e-02
0.0356	8.995e+08	2.394e+00	2.451e+01	1.452e-02	1.486e-01
0.036	1.647e+09	4.501e+00	4.740e+01	2.631e-02	2.771e-01
0.0407	6.189e+08	2.116e+00	2.851e+01	8.953e-03	1.207e-01
0.0409	1.439e+08	4.966e-01	6.764e+00	2.072e-03	2.822e-02
0.0673	4.903e+07	3.576e-01	7.918e+00	6.283e-04	1.391e-02
0.0801	5.914e+08	5.474e+00	1.178e+02	8.658e-03	1.864e-01
0.1335	3.996e+09	7.488e+01	1.122e+03	1.198e-01	1.795e+00
0.6965	5.398e+08	1.180e+02	3.776e+02	2.277e-01	7.287e-01
1.0586	7.422e+06	3.106e+00	7.868e+00	5.667e-03	1.436e-02
1.4892	1.096e+08	7.807e+01	1.699e+02	1.316e-01	2.865e-01
2.1857	2.823e+08	3.641e+02	6.862e+02	5.474e-01	1.032e+00
Totals	**9.574e+09**	**6.537e+02**	**2.599e+03**	**1.102e+00**	**4.662e+00**

Results - Dose Point # 3 - (228.092,92.075,0) cm

Energy (MeV)	Activity (Photons/sec)	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.005	5.840e+08	6.693e-03	1.442e-02	4.077e-03	8.781e-03
0.0336	1.047e+08	1.491e-01	1.376e+00	1.059e-03	9.774e-03
0.0356	8.995e+08	1.439e+00	1.497e+01	8.727e-03	9.081e-02
0.036	1.647e+09	2.706e+00	2.896e+01	1.582e-02	1.693e-01
0.0407	6.189e+08	1.275e+00	1.740e+01	5.395e-03	7.365e-02
0.0409	1.439e+08	2.993e-01	4.128e+00	1.249e-03	1.722e-02
0.0673	4.903e+07	2.165e-01	4.777e+00	3.803e-04	8.392e-03
0.0801	5.914e+08	3.316e+00	7.093e+01	5.245e-03	1.122e-01
0.1335	3.996e+09	4.542e+01	6.732e+02	7.265e-02	1.077e+00
0.6965	5.398e+08	7.138e+01	2.269e+02	1.378e-01	4.379e-01

1.0586	7.422e+06	1.876e+00	4.734e+00	3.424e-03	8.638e-03
1.4892	1.096e+08	4.712e+01	1.024e+02	7.943e-02	1.726e-01
2.1857	2.823e+08	2.197e+02	4.141e+02	3.303e-01	6.225e-01
Totals	**9.574e+09**	**3.949e+02**	**1.564e+03**	**6.655e-01**	**2.809e+00**

Results - Dose Point # 4 - (278.092,92.075,0) cm

Energy (MeV)	Activity (Photons/sec)	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.005	5.840e+08	4.102e-03	8.877e-03	2.499e-03	5.407e-03
0.0336	1.047e+08	9.798e-02	9.135e-01	6.957e-04	6.487e-03
0.0356	8.995e+08	9.465e-01	9.935e+00	5.740e-03	6.025e-02
0.036	1.647e+09	1.780e+00	1.922e+01	1.041e-02	1.123e-01
0.0407	6.189e+08	8.403e-01	1.153e+01	3.556e-03	4.880e-02
0.0409	1.439e+08	1.973e-01	2.735e+00	8.230e-04	1.141e-02
0.0673	4.903e+07	1.431e-01	3.148e+00	2.515e-04	5.530e-03
0.0801	5.914e+08	2.193e+00	4.671e+01	3.469e-03	7.387e-02
0.1335	3.996e+09	3.006e+01	4.432e+02	4.808e-02	7.089e-01
0.6965	5.398e+08	4.718e+01	1.502e+02	9.105e-02	2.899e-01
1.0586	7.422e+06	1.240e+00	3.139e+00	2.263e-03	5.727e-03
1.4892	1.096e+08	3.116e+01	6.797e+01	5.253e-02	1.146e-01
2.1857	2.823e+08	1.455e+02	2.754e+02	2.187e-01	4.140e-01
Totals	**9.574e+09**	**2.613e+02**	**1.034e+03**	**4.401e-01**	**1.857e+00**

Results - Dose Point # 5 - (328.092,92.075,0) cm

Energy (MeV)	Activity (Photons/sec)	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.005	5.840e+08	2.655e-03	5.790e-03	1.617e-03	3.527e-03
0.0336	1.047e+08	6.856e-02	6.444e-01	4.868e-04	4.576e-03
0.0356	8.995e+08	6.630e-01	7.009e+00	4.021e-03	4.251e-02
0.036	1.647e+09	1.247e+00	1.356e+01	7.292e-03	7.924e-02
0.0407	6.189e+08	5.896e-01	8.131e+00	2.495e-03	3.441e-02
0.0409	1.439e+08	1.384e-01	1.928e+00	5.775e-04	8.045e-03
0.0673	4.903e+07	1.007e-01	2.216e+00	1.769e-04	3.893e-03
0.0801	5.914e+08	1.544e+00	3.288e+01	2.442e-03	5.200e-02
0.1335	3.996e+09	2.117e+01	3.124e+02	3.386e-02	4.997e-01
0.6965	5.398e+08	3.326e+01	1.064e+02	6.419e-02	2.054e-01
1.0586	7.422e+06	8.752e-01	2.227e+00	1.597e-03	4.063e-03
1.4892	1.096e+08	2.202e+01	4.828e+01	3.711e-02	8.138e-02
2.1857	2.823e+08	1.030e+02	1.958e+02	1.548e-01	2.944e-01
Totals	**9.574e+09**	**1.846e+02**	**7.316e+02**	**3.106e-01**	**1.313e+00**

Results - Dose Point # 6 - (378.092,92.075,0) cm

Energy (MeV)	Activity (Photons/sec)	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup

0.005	5.840e+08	1.799e-03	3.957e-03	1.096e-03	2.410e-03
0.0336	1.047e+08	5.027e-02	4.763e-01	3.569e-04	3.382e-03
0.0356	8.995e+08	4.866e-01	5.181e+00	2.951e-03	3.142e-02
0.036	1.647e+09	9.157e-01	1.002e+01	5.353e-03	5.858e-02
0.0407	6.189e+08	4.335e-01	6.011e+00	1.835e-03	2.544e-02
0.0409	1.439e+08	1.018e-01	1.426e+00	4.246e-04	5.948e-03
0.0673	4.903e+07	7.425e-02	1.639e+00	1.304e-04	2.879e-03
0.0801	5.914e+08	1.139e+00	2.433e+01	1.801e-03	3.848e-02
0.1335	3.996e+09	1.563e+01	2.316e+02	2.499e-02	3.704e-01
0.6965	5.398e+08	2.460e+01	7.925e+01	4.749e-02	1.529e-01
1.0586	7.422e+06	6.483e-01	1.660e+00	1.183e-03	3.028e-03
1.4892	1.096e+08	1.633e+01	3.600e+01	2.753e-02	6.069e-02
2.1857	2.823e+08	7.650e+01	1.462e+02	1.150e-01	2.198e-01
Totals	**9.574e+09**	**1.369e+02**	**5.438e+02**	**2.302e-01**	**9.755e-01**

MicroShield 8.03
rscs (8.03-0000)

Date	By	Checked

Filename	Run Date	Run Time	Duration
contact 1m model.msd	August 19, 2020	13:15:08	00:00:01

Project Info

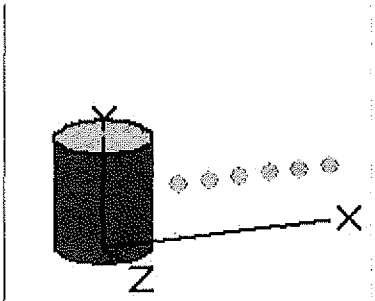
Case Title	Case 1
Description	Case 1
Geometry	7 - Cylinder Volume - Side Shields

Source Dimensions

Height	184.15 cm (6 ft 0.5 in)
Radius	77.788 cm (2 ft 6.6 in)

Dose Points

A	X	Y	Z
#1	128.092 cm (4 ft 2.4 in)	92.075 cm (3 ft 0.3 in)	0.0 cm (0 in)
#2	178.092 cm (5 ft 10.1 in)	92.075 cm (3 ft 0.3 in)	0.0 cm (0 in)
#3	228.092 cm (7 ft 5.8 in)	92.075 cm (3 ft 0.3 in)	0.0 cm (0 in)
#4	278.092 cm (9 ft 1.5 in)	92.075 cm (3 ft 0.3 in)	0.0 cm (0 in)
#5	328.092 cm (10 ft 9.2 in)	92.075 cm (3 ft 0.3 in)	0.0 cm (0 in)
#6	378.092 cm (12 ft 4.9 in)	92.075 cm (3 ft 0.3 in)	0.0 cm (0 in)



Shields

Shield N	Dimension	Material	Density
Source	3.50e+06 cm³	polystyrene	0.72
Transition		Air	0.00122
Air Gap		Air	0.00122
Wall Clad	.304 cm	Carbon	7.85

Source Input: Grouping Method - Actual Photon Energies

Nuclide	Ci	Bq	µCi/cm³	Bq/cm³
Cm-243	1.0000e+000	3.7000e+010	2.8566e-001	1.0570e+004

Buildup: The material reference is Source
Integration Parameters

Radial	10
Circumferential	10
Y Direction (axial)	20

Results - Dose Point # 1 - (128.092,92.075,0) cm

Energy (MeV)	Activity (Photons/sec)	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.0143	2.250e+10	2.103e+00	4.556e+00	2.096e-01	4.542e-01
0.0447	4.429e+07	3.308e-01	5.292e+00	1.119e-03	1.790e-02

0.0573	5.167e+07	5.626e-01	1.186e+01	1.190e-03	2.510e-02
0.0678	5.167e+07	7.146e-01	1.590e+01	1.248e-03	2.776e-02
0.0995	5.286e+09	1.239e+02	2.420e+03	1.895e-01	3.702e+00
0.1038	8.498e+09	2.109e+02	4.007e+03	3.231e-01	6.140e+00
0.1061	9.597e+07	2.457e+00	4.592e+01	3.772e-03	7.051e-02
0.117	3.997e+09	1.171e+02	2.022e+03	1.822e-01	3.145e+00
0.167	1.236e+08	5.993e+00	6.876e+01	1.014e-02	1.163e-01
0.2098	1.218e+09	8.225e+01	7.060e+02	1.467e-01	1.259e+00
0.2282	3.913e+09	2.989e+02	2.346e+03	5.423e-01	4.256e+00
0.2544	4.060e+07	3.642e+00	2.576e+01	6.740e-03	4.767e-02
0.2776	5.167e+09	5.275e+02	3.455e+03	9.899e-01	6.483e+00
0.2854	2.695e+08	2.867e+01	1.833e+02	5.401e-02	3.454e-01
Totals	**5.126e+10**	**1.405e+03**	**1.532e+04**	**2.662e+00**	**2.609e+01**

Results - Dose Point # 2 - (178.092,92.075,0) cm

Energy (MeV)	Activity (Photons/sec)	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.0143	2.250e+10	1.254e+00	2.706e+00	1.250e-01	2.697e-01
0.0447	4.429e+07	1.767e-01	2.801e+00	5.979e-04	9.478e-03
0.0573	5.167e+07	3.000e-01	6.298e+00	6.348e-04	1.333e-02
0.0678	5.167e+07	3.807e-01	8.431e+00	6.647e-04	1.472e-02
0.0995	5.286e+09	6.589e+01	1.278e+03	1.008e-01	1.956e+00
0.1038	8.498e+09	1.122e+02	2.116e+03	1.719e-01	3.242e+00
0.1061	9.597e+07	1.307e+00	2.424e+01	2.006e-03	3.722e-02
0.117	3.997e+09	6.228e+01	1.066e+03	9.688e-02	1.659e+00
0.167	1.236e+08	3.183e+00	3.607e+01	5.384e-03	6.101e-02
0.2098	1.218e+09	4.366e+01	3.692e+02	7.785e-02	6.584e-01
0.2282	3.913e+09	1.587e+02	1.226e+03	2.878e-01	2.224e+00
0.2544	4.060e+07	1.932e+00	1.346e+01	3.576e-03	2.491e-02
0.2776	5.167e+09	2.798e+02	1.805e+03	5.251e-01	3.387e+00
0.2854	2.695e+08	1.520e+01	9.577e+01	2.865e-02	1.804e-01
Totals	**5.126e+10**	**7.462e+02**	**8.050e+03**	**1.427e+00**	**1.374e+01**

Results - Dose Point # 3 - (228.092,92.075,0) cm

Energy (MeV)	Activity (Photons/sec)	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.0143	2.250e+10	7.330e-01	1.579e+00	7.308e-02	1.574e-01
0.0447	4.429e+07	1.066e-01	1.706e+00	3.608e-04	5.772e-03
0.0573	5.167e+07	1.814e-01	3.812e+00	3.839e-04	8.066e-03
0.0678	5.167e+07	2.305e-01	5.086e+00	4.024e-04	8.880e-03
0.0995	5.286e+09	3.995e+01	7.682e+02	6.111e-02	1.175e+00
0.1038	8.498e+09	6.800e+01	1.271e+03	1.042e-01	1.948e+00
0.1061	9.597e+07	7.922e-01	1.456e+01	1.216e-03	2.236e-02
0.117	3.997e+09	3.777e+01	6.400e+02	5.875e-02	9.956e-01
0.167	1.236e+08	1.931e+00	2.160e+01	3.267e-03	3.654e-02

0.2098	1.218e+09	2.650e+01	2.211e+02	4.725e-02	3.943e-01
0.2282	3.913e+09	9.628e+01	7.344e+02	1.747e-01	1.332e+00
0.2544	4.060e+07	1.173e+00	8.065e+00	2.170e-03	1.492e-02
0.2776	5.167e+09	1.698e+02	1.082e+03	3.186e-01	2.030e+00
0.2854	2.695e+08	9.226e+00	5.740e+01	1.738e-02	1.082e-01
Totals	**5.126e+10**	**4.527e+02**	**4.830e+03**	**8.629e-01**	**8.237e+00**

Results - Dose Point # 4 - (278.092,92.075,0) cm

Energy (MeV)	Activity (Photons/sec)	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.0143	2.250e+10	4.493e-01	9.722e-01	4.479e-02	9.692e-02
0.0447	4.429e+07	7.036e-02	1.129e+00	2.380e-04	3.819e-03
0.0573	5.167e+07	1.199e-01	2.515e+00	2.537e-04	5.322e-03
0.0678	5.167e+07	1.524e-01	3.351e+00	2.660e-04	5.851e-03
0.0995	5.286e+09	2.643e+01	5.057e+02	4.043e-02	7.736e-01
0.1038	8.498e+09	4.499e+01	8.367e+02	6.895e-02	1.282e+00
0.1061	9.597e+07	5.242e-01	9.587e+00	8.048e-04	1.472e-02
0.117	3.997e+09	2.499e+01	4.214e+02	3.888e-02	6.554e-01
0.167	1.236e+08	1.278e+00	1.423e+01	2.162e-03	2.407e-02
0.2098	1.218e+09	1.753e+01	1.457e+02	3.127e-02	2.598e-01
0.2282	3.913e+09	6.371e+01	4.841e+02	1.156e-01	8.782e-01
0.2544	4.060e+07	7.759e-01	5.318e+00	1.436e-03	9.842e-03
0.2776	5.167e+09	1.123e+02	7.136e+02	2.108e-01	1.339e+00
0.2854	2.695e+08	6.104e+00	3.787e+01	1.150e-02	7.135e-02
Totals	**5.126e+10**	**2.995e+02**	**3.182e+03**	**5.674e-01**	**5.420e+00**

Results - Dose Point # 5 - (328.092,92.075,0) cm

Energy (MeV)	Activity (Photons/sec)	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.0143	2.250e+10	2.908e-01	6.341e-01	2.899e-02	6.322e-02
0.0447	4.429e+07	4.941e-02	7.956e-01	1.672e-04	2.692e-03
0.0573	5.167e+07	8.432e-02	1.770e+00	1.784e-04	3.746e-03
0.0678	5.167e+07	1.072e-01	2.359e+00	1.872e-04	4.119e-03
0.0995	5.286e+09	1.861e+01	3.562e+02	2.847e-02	5.448e-01
0.1038	8.498e+09	3.168e+01	5.893e+02	4.855e-02	9.032e-01
0.1061	9.597e+07	3.691e-01	6.753e+00	5.667e-04	1.037e-02
0.117	3.997e+09	1.760e+01	2.969e+02	2.738e-02	4.618e-01
0.167	1.236e+08	9.003e-01	1.004e+01	1.523e-03	1.698e-02
0.2098	1.218e+09	1.235e+01	1.029e+02	2.203e-02	1.834e-01
0.2282	3.913e+09	4.488e+01	3.419e+02	8.142e-02	6.202e-01
0.2544	4.060e+07	5.466e-01	3.757e+00	1.011e-03	6.952e-03
0.2776	5.167e+09	7.914e+01	5.042e+02	1.485e-01	9.462e-01
0.2854	2.695e+08	4.300e+00	2.676e+01	8.102e-03	5.042e-02
Totals	**5.126e+10**	**2.109e+02**	**2.244e+03**	**3.971e-01**	**3.818e+00**

Results - Dose Point # 6 - (378.092,92.075,0) cm					
Energy (MeV)	Activity (Photons/sec)	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.0143	2.250e+10	1.970e-01	4.334e-01	1.964e-02	4.321e-02
0.0447	4.429e+07	3.636e-02	5.882e-01	1.230e-04	1.990e-03
0.0573	5.167e+07	6.213e-02	1.309e+00	1.315e-04	2.770e-03
0.0678	5.167e+07	7.905e-02	1.745e+00	1.380e-04	3.046e-03
0.0995	5.286e+09	1.373e+01	2.638e+02	2.100e-02	4.035e-01
0.1038	8.498e+09	2.337e+01	4.365e+02	3.582e-02	6.689e-01
0.1061	9.597e+07	2.724e-01	5.002e+00	4.181e-04	7.680e-03
0.117	3.997e+09	1.299e+01	2.200e+02	2.021e-02	3.422e-01
0.167	1.236e+08	6.647e-01	7.446e+00	1.124e-03	1.260e-02
0.2098	1.218e+09	9.121e+00	7.637e+01	1.626e-02	1.362e-01
0.2282	3.913e+09	3.314e+01	2.539e+02	6.013e-02	4.606e-01
0.2544	4.060e+07	4.037e-01	2.791e+00	7.471e-04	5.164e-03
0.2776	5.167e+09	5.846e+01	3.746e+02	1.097e-01	7.030e-01
0.2854	2.695e+08	3.176e+00	1.988e+01	5.985e-03	3.746e-02
Totals	**5.126e+10**	**1.557e+02**	**1.664e+03**	**2.914e-01**	**2.828e+00**

MicroShield 8.03
rscs (8.03-0000)

Date	By	Checked

Filename	Run Date	Run Time	Duration
contact 1m model.msd	August 19, 2020	13:13:18	00:00:00

Project Info

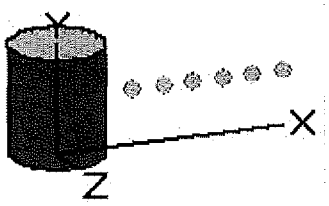
Case Title	Case 1
Description	Case 1
Geometry	7 - Cylinder Volume - Side Shields

Source Dimensions

Height	184.15 cm (6 ft 0.5 in)
Radius	77.788 cm (2 ft 6.6 in)

Dose Points

A	X	Y	Z
#1	128.092 cm (4 ft 2.4 in)	92.075 cm (3 ft 0.3 in)	0.0 cm (0 in)
#2	178.092 cm (5 ft 10.1 in)	92.075 cm (3 ft 0.3 in)	0.0 cm (0 in)
#3	228.092 cm (7 ft 5.8 in)	92.075 cm (3 ft 0.3 in)	0.0 cm (0 in)
#4	278.092 cm (9 ft 1.5 in)	92.075 cm (3 ft 0.3 in)	0.0 cm (0 in)
#5	328.092 cm (10 ft 9.2 in)	92.075 cm (3 ft 0.3 in)	0.0 cm (0 in)
#6	378.092 cm (12 ft 4.9 in)	92.075 cm (3 ft 0.3 in)	0.0 cm (0 in)



Shields

Shield N	Dimension	Material	Density
Source	3.50e+06 cm³	polystyrene	0.72
Transition		Air	0.00122
Air Gap		Air	0.00122
Wall Clad	.304 cm	Carbon	7.85

Source Input: Grouping Method - Actual Photon Energies

Nuclide	Ci	Bq	µCi/cm³	Bq/cm³
Cm-242	1.0000e+000	3.7000e+010	2.8566e-001	1.0570e+004

Buildup: The material reference is Source
Integration Parameters

Radial	10
Circumferential	10
Y Direction (axial)	20

Results - Dose Point # 1 - (128.092,92.075,0) cm

Energy (MeV)	Activity (Photons/sec)	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.0143	4.271e+09	3.991e-01	8.648e-01	3.979e-02	8.622e-02
0.0592	1.428e+07	1.633e-01	3.509e+00	3.296e-04	7.085e-03

Totals	4.285e+09	5.624e-01	4.374e+00	4.012e-02	9.330e-02

Results - Dose Point # 2 - (178.092,92.075,0) cm

Energy (MeV)	Activity (Photons/sec)	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.0143	4.271e+09	2.380e-01	5.136e-01	2.373e-02	5.120e-02
0.0592	1.428e+07	8.705e-02	1.863e+00	1.758e-04	3.762e-03
Totals	**4.285e+09**	**3.251e-01**	**2.377e+00**	**2.390e-02**	**5.496e-02**

Results - Dose Point # 3 - (228.092,92.075,0) cm

Energy (MeV)	Activity (Photons/sec)	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.0143	4.271e+09	1.391e-01	2.997e-01	1.387e-02	2.988e-02
0.0592	1.428e+07	5.266e-02	1.127e+00	1.063e-04	2.275e-03
Totals	**4.285e+09**	**1.918e-01**	**1.427e+00**	**1.398e-02**	**3.215e-02**

Results - Dose Point # 4 - (278.092,92.075,0) cm

Energy (MeV)	Activity (Photons/sec)	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.0143	4.271e+09	8.529e-02	1.845e-01	8.503e-03	1.840e-02
0.0592	1.428e+07	3.480e-02	7.432e-01	7.026e-05	1.501e-03
Totals	**4.285e+09**	**1.201e-01**	**9.278e-01**	**8.573e-03**	**1.990e-02**

Results - Dose Point # 5 - (328.092,92.075,0) cm

Energy (MeV)	Activity (Photons/sec)	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.0143	4.271e+09	5.520e-02	1.204e-01	5.503e-03	1.200e-02
0.0592	1.428e+07	2.448e-02	5.232e-01	4.942e-05	1.056e-03
Totals	**4.285e+09**	**7.968e-02**	**6.436e-01**	**5.553e-03**	**1.306e-02**

Results - Dose Point # 6 - (378.092,92.075,0) cm

Energy (MeV)	Activity (Photons/sec)	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.0143	4.271e+09	3.740e-02	8.226e-02	3.729e-03	8.202e-03
0.0592	1.428e+07	1.804e-02	3.869e-01	3.642e-05	7.811e-04
Totals	**4.285e+09**	**5.544e-02**	**4.691e-01**	**3.765e-03**	**8.983e-03**

MicroShield 8.03
rscs (8.03-0000)

Date	By	Checked

Filename	Run Date	Run Time	Duration
contact 1m model.msd	August 19, 2020	13:32:26	00:00:01

Project Info

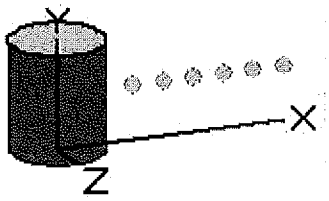
Case Title	Case 1
Description	Case 1
Geometry	7 - Cylinder Volume - Side Shields

Source Dimensions

Height	184.15 cm (6 ft 0.5 in)
Radius	77.788 cm (2 ft 6.6 in)

Dose Points

A	X	Y	Z
#1	128.092 cm (4 ft 2.4 in)	92.075 cm (3 ft 0.3 in)	0.0 cm (0 in)
#2	178.092 cm (5 ft 10.1 in)	92.075 cm (3 ft 0.3 in)	0.0 cm (0 in)
#3	228.092 cm (7 ft 5.8 in)	92.075 cm (3 ft 0.3 in)	0.0 cm (0 in)
#4	278.092 cm (9 ft 1.5 in)	92.075 cm (3 ft 0.3 in)	0.0 cm (0 in)
#5	328.092 cm (10 ft 9.2 in)	92.075 cm (3 ft 0.3 in)	0.0 cm (0 in)
#6	378.092 cm (12 ft 4.9 in)	92.075 cm (3 ft 0.3 in)	0.0 cm (0 in)



Shields

Shield N	Dimension	Material	Density
Source	3.50e+06 cm³	polystyrene	0.72
Transition		Air	0.00122
Air Gap		Air	0.00122
Wall Clad	.304 cm	Carbon	7.85

Source Input: Grouping Method - Actual Photon Energies

Nuclide	Ci	Bq	μCi/cm³	Bq/cm³
Co-57	1.0000e+000	3.7000e+010	2.8566e-001	1.0570e+004

Buildup: The material reference is Source
Integration Parameters

Radial	10
Circumferential	10
Y Direction (axial)	20

Results - Dose Point # 1 - (128.092,92.075,0) cm

Energy (MeV)	Activity (Photons/sec)	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.0007	2.869e+08	1.312e-03	2.844e-03	5.744e-03	1.245e-02
0.0064	6.153e+09	2.570e-01	5.568e-01	1.232e-01	2.669e-01

0.0064	1.214e+10	5.079e-01	1.100e+00	2.430e-01	5.265e-01
0.0071	2.451e+09	1.131e-01	2.450e-01	4.907e-02	1.063e-01
0.0144	3.531e+09	3.326e-01	7.206e-01	3.235e-02	7.008e-02
0.1221	3.164e+10	9.835e+02	1.632e+04	1.542e+00	2.559e+01
0.1365	3.923e+09	1.426e+02	2.108e+03	2.293e-01	3.389e+00
0.536	1.061e+07	2.929e+00	1.136e+01	5.743e-03	2.227e-02
0.692	5.916e+07	2.422e+01	7.907e+01	4.677e-02	1.527e-01
Totals	**6.019e+10**	**1.154e+03**	**1.852e+04**	**2.277e+00**	**3.014e+01**

Results - Dose Point # 2 - (178.092,92.075,0) cm

Energy (MeV)	Activity (Photons/sec)	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.0007	2.869e+08	7.826e-04	1.689e-03	3.426e-03	7.392e-03
0.0064	6.153e+09	1.532e-01	3.307e-01	7.347e-02	1.585e-01
0.0064	1.214e+10	3.029e-01	6.535e-01	1.449e-01	3.127e-01
0.0071	2.451e+09	6.743e-02	1.455e-01	2.926e-02	6.314e-02
0.0144	3.531e+09	1.983e-01	4.279e-01	1.929e-02	4.162e-02
0.1221	3.164e+10	5.228e+02	8.603e+03	8.197e-01	1.349e+01
0.1365	3.923e+09	7.580e+01	1.109e+03	1.219e-01	1.783e+00
0.536	1.061e+07	1.550e+00	5.908e+00	3.040e-03	1.159e-02
0.692	5.916e+07	1.280e+01	4.114e+01	2.472e-02	7.946e-02
Totals	**6.019e+10**	**6.137e+02**	**9.760e+03**	**1.240e+00**	**1.595e+01**

Results - Dose Point # 3 - (228.092,92.075,0) cm

Energy (MeV)	Activity (Photons/sec)	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.0007	2.869e+08	4.575e-04	9.854e-04	2.003e-03	4.313e-03
0.0064	6.153e+09	8.959e-02	1.929e-01	4.295e-02	9.250e-02
0.0064	1.214e+10	1.771e-01	3.813e-01	8.472e-02	1.825e-01
0.0071	2.451e+09	3.942e-02	8.490e-02	1.711e-02	3.684e-02
0.0144	3.531e+09	1.159e-01	2.497e-01	1.128e-02	2.429e-02
0.1221	3.164e+10	3.171e+02	5.163e+03	4.972e-01	8.094e+00
0.1365	3.923e+09	4.598e+01	6.649e+02	7.394e-02	1.069e+00
0.536	1.061e+07	9.389e-01	3.549e+00	1.841e-03	6.960e-03
0.692	5.916e+07	7.746e+00	2.473e+01	1.496e-02	4.775e-02
Totals	**6.019e+10**	**3.722e+02**	**5.857e+03**	**7.460e-01**	**9.559e+00**

Results - Dose Point # 4 - (278.092,92.075,0) cm

Energy (MeV)	Activity (Photons/sec)	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.0007	2.869e+08	2.804e-04	6.068e-04	1.227e-03	2.656e-03
0.0064	6.153e+09	5.491e-02	1.188e-01	2.632e-02	5.696e-02
0.0064	1.214e+10	1.085e-01	2.348e-01	5.192e-02	1.124e-01
0.0071	2.451e+09	2.416e-02	5.228e-02	1.049e-02	2.269e-02

0.0144	3.531e+09	7.107e-02	1.538e-01	6.912e-03	1.496e-02
0.1221	3.164e+10	2.098e+02	3.399e+03	3.290e-01	5.329e+00
0.1365	3.923e+09	3.043e+01	4.378e+02	4.893e-02	7.039e-01
0.536	1.061e+07	6.207e-01	2.347e+00	1.217e-03	4.603e-03
0.692	5.916e+07	5.120e+00	1.637e+01	9.887e-03	3.161e-02
Totals	**6.019e+10**	**2.463e+02**	**3.856e+03**	**4.859e-01**	**6.279e+00**

Results - Dose Point # 5 - (328.092,92.075,0) cm

Energy (MeV)	Activity (Photons/sec)	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.0007	2.869e+08	1.815e-04	3.958e-04	7.945e-04	1.732e-03
0.0064	6.153e+09	3.554e-02	7.749e-02	1.704e-02	3.715e-02
0.0064	1.214e+10	7.024e-02	1.532e-01	3.361e-02	7.328e-02
0.0071	2.451e+09	1.564e-02	3.410e-02	6.787e-03	1.480e-02
0.0144	3.531e+09	4.600e-02	1.003e-01	4.474e-03	9.754e-03
0.1221	3.164e+10	1.478e+02	2.395e+03	2.317e-01	3.755e+00
0.1365	3.923e+09	2.143e+01	3.086e+02	3.446e-02	4.962e-01
0.536	1.061e+07	4.374e-01	1.662e+00	8.578e-04	3.260e-03
0.692	5.916e+07	3.609e+00	1.160e+01	6.970e-03	2.240e-02
Totals	**6.019e+10**	**1.734e+02**	**2.717e+03**	**3.367e-01**	**4.414e+00**

Results - Dose Point # 6 - (378.092,92.075,0) cm

Energy (MeV)	Activity (Photons/sec)	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.0007	2.869e+08	1.230e-04	2.705e-04	5.383e-04	1.184e-03
0.0064	6.153e+09	2.408e-02	5.296e-02	1.154e-02	2.539e-02
0.0064	1.214e+10	4.759e-02	1.047e-01	2.277e-02	5.008e-02
0.0071	2.451e+09	1.059e-02	2.330e-02	4.598e-03	1.011e-02
0.0144	3.531e+09	3.116e-02	6.855e-02	3.031e-03	6.667e-03
0.1221	3.164e+10	1.091e+02	1.775e+03	1.710e-01	2.783e+00
0.1365	3.923e+09	1.582e+01	2.288e+02	2.544e-02	3.679e-01
0.536	1.061e+07	3.234e-01	1.237e+00	6.343e-04	2.425e-03
0.692	5.916e+07	2.670e+00	8.636e+00	5.156e-03	1.668e-02
Totals	**6.019e+10**	**1.280e+02**	**2.014e+03**	**2.447e-01**	**3.263e+00**

MicroShield 8.03
rscs (8.03-0000)

Date	By	Checked

Filename	Run Date	Run Time	Duration
contact 1m model.msd	August 19, 2020	13:36:06	00:00:00

Project Info

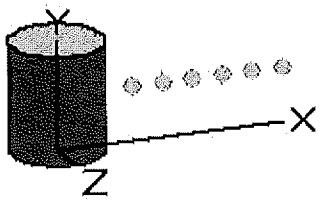
Case Title	Case 1
Description	Case 1
Geometry	7 - Cylinder Volume - Side Shields

Source Dimensions

Height	184.15 cm (6 ft 0.5 in)
Radius	77.788 cm (2 ft 6.6 in)

Dose Points

A	X	Y	Z
#1	128.092 cm (4 ft 2.4 in)	92.075 cm (3 ft 0.3 in)	0.0 cm (0 in)
#2	178.092 cm (5 ft 10.1 in)	92.075 cm (3 ft 0.3 in)	0.0 cm (0 in)
#3	228.092 cm (7 ft 5.8 in)	92.075 cm (3 ft 0.3 in)	0.0 cm (0 in)
#4	278.092 cm (9 ft 1.5 in)	92.075 cm (3 ft 0.3 in)	0.0 cm (0 in)
#5	328.092 cm (10 ft 9.2 in)	92.075 cm (3 ft 0.3 in)	0.0 cm (0 in)
#6	378.092 cm (12 ft 4.9 in)	92.075 cm (3 ft 0.3 in)	0.0 cm (0 in)



Shields

Shield N	Dimension	Material	Density
Source	3.50e+06 cm³	polystyrene	0.72
Transition		Air	0.00122
Air Gap		Air	0.00122
Wall Clad	.304 cm	Carbon	7.85

Source Input: Grouping Method - Actual Photon Energies

Nuclide	Ci	Bq	µCi/cm³	Bq/cm³
Co-60	1.0000e+000	3.7000e+010	2.8566e-001	1.0570e+004

Buildup: The material reference is Source
Integration Parameters

Radial	10
Circumferential	10
Y Direction (axial)	20

Results - Dose Point # 1 - (128.092,92.075,0) cm

Energy (MeV)	Activity (Photons/sec)	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.6938	6.035e+06	2.481e+00	8.085e+00	4.790e-03	1.561e-02
1.1732	3.700e+10	3.453e+04	8.439e+04	6.171e+01	1.508e+02

1.3325	3.700e+10	4.216e+04	9.728e+04	7.315e+01	1.688e+02
Totals	**7.401e+10**	**7.670e+04**	**1.817e+05**	**1.349e+02**	**3.196e+02**

Results - Dose Point # 2 - (178.092,92.075,0) cm

Energy (MeV)	Activity (Photons/sec)	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.6938	6.035e+06	1.311e+00	4.207e+00	2.531e-03	8.123e-03
1.1732	3.700e+10	1.818e+04	4.387e+04	3.248e+01	7.840e+01
1.3325	3.700e+10	2.217e+04	5.056e+04	3.846e+01	8.773e+01
Totals	**7.401e+10**	**4.035e+04**	**9.444e+04**	**7.095e+01**	**1.661e+02**

Results - Dose Point # 3 - (228.092,92.075,0) cm

Energy (MeV)	Activity (Photons/sec)	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.6938	6.035e+06	7.934e-01	2.529e+00	1.532e-03	4.882e-03
1.1732	3.700e+10	1.098e+04	2.641e+04	1.962e+01	4.720e+01
1.3325	3.700e+10	1.338e+04	3.045e+04	2.322e+01	5.283e+01
Totals	**7.401e+10**	**2.436e+04**	**5.687e+04**	**4.284e+01**	**1.000e+02**

Results - Dose Point # 4 - (278.092,92.075,0) cm

Energy (MeV)	Activity (Photons/sec)	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.6938	6.035e+06	5.244e-01	1.674e+00	1.012e-03	3.232e-03
1.1732	3.700e+10	7.257e+03	1.752e+04	1.297e+01	3.130e+01
1.3325	3.700e+10	8.850e+03	2.021e+04	1.535e+01	3.506e+01
Totals	**7.401e+10**	**1.611e+04**	**3.773e+04**	**2.832e+01**	**6.637e+01**

Results - Dose Point # 5 - (328.092,92.075,0) cm

Energy (MeV)	Activity (Photons/sec)	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.6938	6.035e+06	3.697e-01	1.186e+00	7.137e-04	2.290e-03
1.1732	3.700e+10	5.123e+03	1.243e+04	9.154e+00	2.222e+01
1.3325	3.700e+10	6.250e+03	1.435e+04	1.084e+01	2.489e+01
Totals	**7.401e+10**	**1.137e+04**	**2.678e+04**	**2.000e+01**	**4.711e+01**

Results - Dose Point # 6 - (378.092,92.075,0) cm

Energy (MeV)	Activity (Photons/sec)	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.6938	6.035e+06	2.735e-01	8.831e-01	5.280e-04	1.705e-03
1.1732	3.700e+10	3.796e+03	9.267e+03	6.784e+00	1.656e+01
1.3325	3.700e+10	4.634e+03	1.070e+04	8.039e+00	1.856e+01
Totals	**7.401e+10**	**8.430e+03**	**1.997e+04**	**1.482e+01**	**3.512e+01**

MicroShield 8.03
rscs (8.03-0000)

Date	By	Checked

Filename	Run Date	Run Time	Duration
contact 1m model.msd	August 19, 2020	13:35:04	00:00:01

Project Info

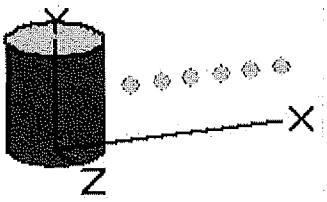
Case Title	Case 1
Description	Case 1
Geometry	7 - Cylinder Volume - Side Shields

Source Dimensions

Height	184.15 cm (6 ft 0.5 in)
Radius	77.788 cm (2 ft 6.6 in)

Dose Points

A	X	Y	Z
#1	128.092 cm (4 ft 2.4 in)	92.075 cm (3 ft 0.3 in)	0.0 cm (0 in)
#2	178.092 cm (5 ft 10.1 in)	92.075 cm (3 ft 0.3 in)	0.0 cm (0 in)
#3	228.092 cm (7 ft 5.8 in)	92.075 cm (3 ft 0.3 in)	0.0 cm (0 in)
#4	278.092 cm (9 ft 1.5 in)	92.075 cm (3 ft 0.3 in)	0.0 cm (0 in)
#5	328.092 cm (10 ft 9.2 in)	92.075 cm (3 ft 0.3 in)	0.0 cm (0 in)
#6	378.092 cm (12 ft 4.9 in)	92.075 cm (3 ft 0.3 in)	0.0 cm (0 in)



Shields

Shield N	Dimension	Material	Density
Source	3.50e+06 cm³	polystyrene	0.72
Transition		Air	0.00122
Air Gap		Air	0.00122
Wall Clad	.304 cm	Carbon	7.85

Source Input: Grouping Method - Actual Photon Energies

Nuclide	Ci	Bq	µCi/cm³	Bq/cm³
Co-58	1.0000e+000	3.7000e+010	2.8566e-001	1.0570e+004

Buildup: The material reference is Source
Integration Parameters

Radial	10
Circumferential	10
Y Direction (axial)	20

Results - Dose Point # 1 - (128.092,92.075,0) cm

Energy (MeV)	Activity (Photons/sec)	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.0007	1.340e+08	6.131e-04	1.328e-03	2.684e-03	5.815e-03
0.0064	2.880e+09	1.203e-01	2.606e-01	5.766e-02	1.249e-01

0.0064	5.679e+09	2.377e-01	5.150e-01	1.137e-01	2.464e-01
0.0071	1.147e+09	5.292e-02	1.147e-01	2.297e-02	4.976e-02
0.511	1.105e+10	2.835e+03	1.137e+04	5.565e+00	2.231e+01
0.8108	3.679e+10	1.926e+04	5.692e+04	3.657e+01	1.081e+02
0.8639	2.722e+08	1.573e+02	4.486e+02	2.964e-01	8.451e-01
1.6747	1.987e+08	3.237e+02	6.793e+02	5.281e-01	1.108e+00
Totals	**5.815e+10**	**2.257e+04**	**6.942e+04**	**4.315e+01**	**1.328e+02**

Results - Dose Point # 2 - (178.092,92.075,0) cm

Energy (MeV)	Activity (Photons/sec)	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.0007	1.340e+08	3.656e-04	7.889e-04	1.600e-03	3.453e-03
0.0064	2.880e+09	7.172e-02	1.548e-01	3.438e-02	7.419e-02
0.0064	5.679e+09	1.417e-01	3.058e-01	6.781e-02	1.463e-01
0.0071	1.147e+09	3.156e-02	6.809e-02	1.369e-02	2.955e-02
0.511	1.105e+10	1.501e+03	5.914e+03	2.946e+00	1.161e+01
0.8108	3.679e+10	1.017e+04	2.961e+04	1.931e+01	5.623e+01
0.8639	2.722e+08	8.302e+01	2.333e+02	1.564e-01	4.395e-01
1.6747	1.987e+08	1.698e+02	3.529e+02	2.771e-01	5.757e-01
Totals	**5.815e+10**	**1.192e+04**	**3.611e+04**	**2.280e+01**	**6.910e+01**

Results - Dose Point # 3 - (228.092,92.075,0) cm

Energy (MeV)	Activity (Photons/sec)	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.0007	1.340e+08	2.137e-04	4.604e-04	9.356e-04	2.015e-03
0.0064	2.880e+09	4.193e-02	9.030e-02	2.010e-02	4.329e-02
0.0064	5.679e+09	8.286e-02	1.785e-01	3.965e-02	8.539e-02
0.0071	1.147e+09	1.845e-02	3.973e-02	8.006e-03	1.724e-02
0.511	1.105e+10	9.093e+02	3.552e+03	1.785e+00	6.971e+00
0.8108	3.679e+10	6.148e+03	1.780e+04	1.168e+01	3.380e+01
0.8639	2.722e+08	5.019e+01	1.402e+02	9.457e-02	2.642e-01
1.6747	1.987e+08	1.025e+02	2.127e+02	1.672e-01	3.470e-01
Totals	**5.815e+10**	**7.210e+03**	**2.170e+04**	**1.379e+01**	**4.153e+01**

Results - Dose Point # 4 - (278.092,92.075,0) cm

Energy (MeV)	Activity (Photons/sec)	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.0007	1.340e+08	1.310e-04	2.835e-04	5.734e-04	1.241e-03
0.0064	2.880e+09	2.570e-02	5.561e-02	1.232e-02	2.666e-02
0.0064	5.679e+09	5.079e-02	1.099e-01	2.430e-02	5.258e-02
0.0071	1.147e+09	1.131e-02	2.447e-02	4.907e-03	1.062e-02
0.511	1.105e+10	6.012e+02	2.349e+03	1.180e+00	4.610e+00
0.8108	3.679e+10	4.063e+03	1.179e+04	7.716e+00	2.239e+01
0.8639	2.722e+08	3.317e+01	9.291e+01	6.250e-02	1.750e-01

1.6747	1.987e+08	6.781e+01	1.413e+02	1.106e-01	2.305e-01
Totals	**5.815e+10**	**4.765e+03**	**1.437e+04**	**9.111e+00**	**2.749e+01**

Results - Dose Point # 5 - (328.092,92.075,0) cm

Energy (MeV)	Activity (Photons/sec)	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.0007	1.340e+08	8.480e-05	1.849e-04	3.712e-04	8.093e-04
0.0064	2.880e+09	1.663e-02	3.627e-02	7.974e-03	1.739e-02
0.0064	5.679e+09	3.287e-02	7.168e-02	1.573e-02	3.429e-02
0.0071	1.147e+09	7.319e-03	1.596e-02	3.176e-03	6.925e-03
0.511	1.105e+10	4.236e+02	1.663e+03	8.315e-01	3.263e+00
0.8108	3.679e+10	2.865e+03	8.356e+03	5.441e+00	1.587e+01
0.8639	2.722e+08	2.340e+01	6.588e+01	4.408e-02	1.241e-01
1.6747	1.987e+08	4.793e+01	1.004e+02	7.819e-02	1.638e-01
Totals	**5.815e+10**	**3.360e+03**	**1.019e+04**	**6.422e+00**	**1.948e+01**

Results - Dose Point # 6 - (378.092,92.075,0) cm

Energy (MeV)	Activity (Photons/sec)	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.0007	1.340e+08	5.745e-05	1.264e-04	2.515e-04	5.531e-04
0.0064	2.880e+09	1.127e-02	2.479e-02	5.403e-03	1.188e-02
0.0064	5.679e+09	2.227e-02	4.899e-02	1.066e-02	2.344e-02
0.0071	1.147e+09	4.959e-03	1.091e-02	2.152e-03	4.733e-03
0.511	1.105e+10	3.132e+02	1.237e+03	6.147e-01	2.428e+00
0.8108	3.679e+10	2.121e+03	6.223e+03	4.027e+00	1.182e+01
0.8639	2.722e+08	1.732e+01	4.907e+01	3.263e-02	9.244e-02
1.6747	1.987e+08	3.557e+01	7.490e+01	5.803e-02	1.222e-01
Totals	**5.815e+10**	**2.487e+03**	**7.584e+03**	**4.751e+00**	**1.450e+01**

MicroShield 8.03
rscs (8.03-0000)

Date	By	Checked

Filename	Run Date	Run Time	Duration
contact 1m model.msd	August 19, 2020	13:37:19	00:00:00

Project Info

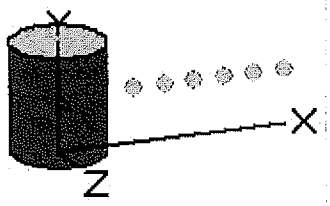
Case Title	Case 1
Description	Case 1
Geometry	7 - Cylinder Volume - Side Shields

Source Dimensions

Height	184.15 cm (6 ft 0.5 in)
Radius	77.788 cm (2 ft 6.6 in)

Dose Points

A	X	Y	Z
#1	128.092 cm (4 ft 2.4 in)	92.075 cm (3 ft 0.3 in)	0.0 cm (0 in)
#2	178.092 cm (5 ft 10.1 in)	92.075 cm (3 ft 0.3 in)	0.0 cm (0 in)
#3	228.092 cm (7 ft 5.8 in)	92.075 cm (3 ft 0.3 in)	0.0 cm (0 in)
#4	278.092 cm (9 ft 1.5 in)	92.075 cm (3 ft 0.3 in)	0.0 cm (0 in)
#5	328.092 cm (10 ft 9.2 in)	92.075 cm (3 ft 0.3 in)	0.0 cm (0 in)
#6	378.092 cm (12 ft 4.9 in)	92.075 cm (3 ft 0.3 in)	0.0 cm (0 in)



Shields

Shield N	Dimension	Material	Density
Source	3.50e+06 cm³	polystyrene	0.72
Transition		Air	0.00122
Air Gap		Air	0.00122
Wall Clad	.304 cm	Carbon	7.85

Source Input: Grouping Method - Actual Photon Energies

Nuclide	Ci	Bq	μCi/cm³	Bq/cm³
Ba-137m	9.4600e-001	3.5002e+010	2.7024e-001	9.9988e+003
Cs-137	1.0000e+000	3.7000e+010	2.8566e-001	1.0570e+004

Buildup: The material reference is Source
Integration Parameters

Radial	10
Circumferential	10
Y Direction (axial)	20

Results - Dose Point # 1 - (128.092,92.075,0) cm

Energy (MeV)	Activity (Photons/sec)	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.0045	3.634e+08	1.061e-02	2.300e-02	7.276e-03	1.576e-02

0.0318	7.246e+08	2.832e+00	2.347e+01	2.359e-02	1.955e-01
0.0322	1.337e+09	5.368e+00	4.561e+01	4.320e-02	3.670e-01
0.0364	4.865e+08	2.531e+00	2.781e+01	1.438e-02	1.580e-01
0.6616	3.149e+10	1.203e+04	4.046e+04	2.332e+01	7.843e+01
Totals	**3.441e+10**	**1.204e+04**	**4.055e+04**	**2.341e+01**	**7.917e+01**

Results - Dose Point # 2 - (178.092,92.075,0) cm

Energy (MeV)	Activity (Photons/sec)	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.0045	3.634e+08	6.330e-03	1.366e-02	4.339e-03	9.362e-03
0.0318	7.246e+08	1.523e+00	1.226e+01	1.269e-02	1.021e-01
0.0322	1.337e+09	2.886e+00	2.383e+01	2.323e-02	1.918e-01
0.0364	4.865e+08	1.356e+00	1.460e+01	7.706e-03	8.295e-02
0.6616	3.149e+10	6.360e+03	2.105e+04	1.233e+01	4.081e+01
Totals	**3.441e+10**	**6.366e+03**	**2.110e+04**	**1.238e+01**	**4.120e+01**

Results - Dose Point # 3 - (228.092,92.075,0) cm

Energy (MeV)	Activity (Photons/sec)	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.0045	3.634e+08	3.701e-03	7.970e-03	2.536e-03	5.463e-03
0.0318	7.246e+08	9.128e-01	7.475e+00	7.603e-03	6.226e-02
0.0322	1.337e+09	1.730e+00	1.454e+01	1.393e-02	1.170e-01
0.0364	4.865e+08	8.156e-01	8.920e+00	4.634e-03	5.068e-02
0.6616	3.149e+10	3.849e+03	1.265e+04	7.462e+00	2.453e+01
Totals	**3.441e+10**	**3.853e+03**	**1.268e+04**	**7.491e+00**	**2.476e+01**

Results - Dose Point # 4 - (278.092,92.075,0) cm

Energy (MeV)	Activity (Photons/sec)	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.0045	3.634e+08	2.268e-03	4.908e-03	1.555e-03	3.364e-03
0.0318	7.246e+08	5.989e-01	4.960e+00	4.988e-03	4.132e-02
0.0322	1.337e+09	1.136e+00	9.647e+00	9.139e-03	7.764e-02
0.0364	4.865e+08	5.367e-01	5.918e+00	3.049e-03	3.362e-02
0.6616	3.149e+10	2.544e+03	8.375e+03	4.932e+00	1.624e+01
Totals	**3.441e+10**	**2.546e+03**	**8.396e+03**	**4.951e+00**	**1.639e+01**

Results - Dose Point # 5 - (328.092,92.075,0) cm

Energy (MeV)	Activity (Photons/sec)	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.0045	3.634e+08	1.468e-03	3.201e-03	1.006e-03	2.194e-03
0.0318	7.246e+08	4.185e-01	3.498e+00	3.486e-03	2.914e-02
0.0322	1.337e+09	7.938e-01	6.804e+00	6.389e-03	5.476e-02
0.0364	4.865e+08	3.761e-01	4.175e+00	2.137e-03	2.372e-02
0.6616	3.149e+10	1.793e+03	5.934e+03	3.477e+00	1.150e+01

Totals	3.441e+10	1.795e+03	5.948e+03	3.490e+00	1.161e+01

Results - Dose Point # 6 - (378.092,92.075,0) cm

Energy (MeV)	Activity (Photons/sec)	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.0045	3.634e+08	9.946e-04	2.188e-03	6.817e-04	1.500e-03
0.0318	7.246e+08	3.065e-01	2.584e+00	2.553e-03	2.152e-02
0.0322	1.337e+09	5.815e-01	5.026e+00	4.680e-03	4.045e-02
0.0364	4.865e+08	2.761e-01	3.086e+00	1.569e-03	1.753e-02
0.6616	3.149e+10	1.327e+03	4.417e+03	2.572e+00	8.563e+00
Totals	**3.441e+10**	**1.328e+03**	**4.428e+03**	**2.581e+00**	**8.644e+00**

MicroShield 8.03
rscs (8.03-0000)

Date	By	Checked

Filename	Run Date	Run Time	Duration
contact 1m model.msd	August 19, 2020	13:38:38	00:00:00

Project Info

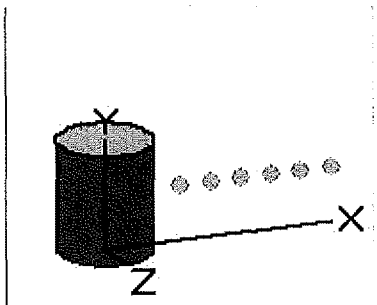
Case Title	Case 1
Description	Case 1
Geometry	7 - Cylinder Volume - Side Shields

Source Dimensions

Height	184.15 cm (6 ft 0.5 in)
Radius	77.788 cm (2 ft 6.6 in)

Dose Points

A	X	Y	Z
#1	128.092 cm (4 ft 2.4 in)	92.075 cm (3 ft 0.3 in)	0.0 cm (0 in)
#2	178.092 cm (5 ft 10.1 in)	92.075 cm (3 ft 0.3 in)	0.0 cm (0 in)
#3	228.092 cm (7 ft 5.8 in)	92.075 cm (3 ft 0.3 in)	0.0 cm (0 in)
#4	278.092 cm (9 ft 1.5 in)	92.075 cm (3 ft 0.3 in)	0.0 cm (0 in)
#5	328.092 cm (10 ft 9.2 in)	92.075 cm (3 ft 0.3 in)	0.0 cm (0 in)
#6	378.092 cm (12 ft 4.9 in)	92.075 cm (3 ft 0.3 in)	0.0 cm (0 in)



Shields

Shield N	Dimension	Material	Density
Source	3.50e+06 cm³	polystyrene	0.72
Transition		Air	0.00122
Air Gap		Air	0.00122
Wall Clad	.304 cm	Carbon	7.85

Source Input: Grouping Method - Actual Photon Energies

Nuclide	Ci	Bq	μCi/cm³	Bq/cm³
Fe-55	1.0000e+000	3.7000e+010	2.8566e-001	1.0570e+004

Buildup: The material reference is Source
Integration Parameters

Radial	10
Circumferential	10
Y Direction (axial)	20

Results - Dose Point # 1 - (128.092,92.075,0) cm

Energy (MeV)	Activity (Photons/sec)	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.0006	1.553e+08	6.495e-04	1.407e-03	3.109e-03	6.737e-03
0.0059	3.048e+09	1.173e-01	2.541e-01	6.103e-02	1.322e-01

0.0059	6.023e+09	2.322e-01	5.031e-01	1.206e-01	2.613e-01
0.0065	1.216e+09	5.155e-02	1.117e-01	2.434e-02	5.273e-02
Totals	**1.044e+10**	**4.017e-01**	**8.703e-01**	**2.091e-01**	**4.530e-01**

Results - Dose Point # 2 - (178.092,92.075,0) cm

Energy (MeV)	Activity (Photons/sec)	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.0006	1.553e+08	3.873e-04	8.358e-04	1.854e-03	4.001e-03
0.0059	3.048e+09	6.993e-02	1.509e-01	3.639e-02	7.853e-02
0.0059	6.023e+09	1.385e-01	2.988e-01	7.192e-02	1.552e-01
0.0065	1.216e+09	3.074e-02	6.634e-02	1.451e-02	3.132e-02
Totals	**1.044e+10**	**2.395e-01**	**5.168e-01**	**1.247e-01**	**2.690e-01**

Results - Dose Point # 3 - (228.092,92.075,0) cm

Energy (MeV)	Activity (Photons/sec)	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.0006	1.553e+08	2.264e-04	4.877e-04	1.084e-03	2.335e-03
0.0059	3.048e+09	4.088e-02	8.805e-02	2.128e-02	4.582e-02
0.0059	6.023e+09	8.095e-02	1.743e-01	4.205e-02	9.056e-02
0.0065	1.216e+09	1.797e-02	3.871e-02	8.485e-03	1.827e-02
Totals	**1.044e+10**	**1.400e-01**	**3.016e-01**	**7.289e-02**	**1.570e-01**

Results - Dose Point # 4 - (278.092,92.075,0) cm

Energy (MeV)	Activity (Photons/sec)	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.0006	1.553e+08	1.388e-04	3.003e-04	6.644e-04	1.438e-03
0.0059	3.048e+09	2.506e-02	5.422e-02	1.304e-02	2.822e-02
0.0059	6.023e+09	4.961e-02	1.074e-01	2.577e-02	5.576e-02
0.0065	1.216e+09	1.102e-02	2.384e-02	5.201e-03	1.125e-02
Totals	**1.044e+10**	**8.583e-02**	**1.857e-01**	**4.468e-02**	**9.667e-02**

Results - Dose Point # 5 - (328.092,92.075,0) cm

Energy (MeV)	Activity (Photons/sec)	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.0006	1.553e+08	8.983e-05	1.959e-04	4.300e-04	9.377e-04
0.0059	3.048e+09	1.622e-02	3.536e-02	8.440e-03	1.840e-02
0.0059	6.023e+09	3.211e-02	7.002e-02	1.668e-02	3.637e-02
0.0065	1.216e+09	7.130e-03	1.555e-02	3.366e-03	7.340e-03
Totals	**1.044e+10**	**5.555e-02**	**1.211e-01**	**2.892e-02**	**6.305e-02**

Results - Dose Point # 6 - (378.092,92.075,0) cm

Energy (MeV)	Activity (Photons/sec)	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.0006	1.553e+08	6.086e-05	1.339e-04	2.914e-04	6.409e-04

0.0059	3.048e+09	1.099e-02	2.417e-02	5.718e-03	1.258e-02
0.0059	6.023e+09	2.176e-02	4.786e-02	1.130e-02	2.486e-02
0.0065	1.216e+09	4.831e-03	1.063e-02	2.281e-03	5.016e-03
Totals	**1.044e+10**	**3.764e-02**	**8.279e-02**	**1.959e-02**	**4.309e-02**

MicroShield 8.03
rscs (8.03-0000)

Date	By	Checked

Filename	Run Date	Run Time	Duration
contact 1m model.msd	August 19, 2020	13:39:52	00:00:00

Project Info

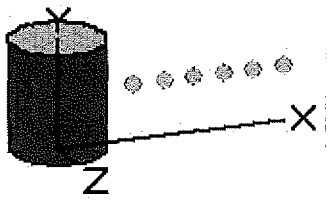
Case Title	Case 1
Description	Case 1
Geometry	7 - Cylinder Volume - Side Shields

Source Dimensions

Height	184.15 cm (6 ft 0.5 in)
Radius	77.788 cm (2 ft 6.6 in)

Dose Points

A	X	Y	Z
#1	128.092 cm (4 ft 2.4 in)	92.075 cm (3 ft 0.3 in)	0.0 cm (0 in)
#2	178.092 cm (5 ft 10.1 in)	92.075 cm (3 ft 0.3 in)	0.0 cm (0 in)
#3	228.092 cm (7 ft 5.8 in)	92.075 cm (3 ft 0.3 in)	0.0 cm (0 in)
#4	278.092 cm (9 ft 1.5 in)	92.075 cm (3 ft 0.3 in)	0.0 cm (0 in)
#5	328.092 cm (10 ft 9.2 in)	92.075 cm (3 ft 0.3 in)	0.0 cm (0 in)
#6	378.092 cm (12 ft 4.9 in)	92.075 cm (3 ft 0.3 in)	0.0 cm (0 in)



Shields

Shield N	Dimension	Material	Density
Source	3.50e+06 cm³	polystyrene	0.72
Transition		Air	0.00122
Air Gap		Air	0.00122
Wall Clad	.304 cm	Carbon	7.85

Source Input: Grouping Method - Actual Photon Energies

Nuclide	Ci	Bq	μCi/cm³	Bq/cm³
Mn-54	1.0000e+000	3.7000e+010	2.8566e-001	1.0570e+004

Buildup: The material reference is Source
Integration Parameters

Radial	10
Circumferential	10
Y Direction (axial)	20

Results - Dose Point # 1 - (128.092,92.075,0) cm

Energy (MeV)	Activity (Photons/sec)	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.0006	1.370e+08	5.103e-04	1.106e-03	2.743e-03	5.943e-03
0.0054	2.749e+09	9.710e-02	2.104e-01	5.504e-02	1.192e-01

0.0054	5.443e+09	1.926e-01	4.173e-01	1.090e-01	2.361e-01
0.0059	1.089e+09	4.236e-02	9.179e-02	2.181e-02	4.727e-02
0.8348	3.699e+10	2.026e+04	5.890e+04	3.834e+01	1.115e+02
Totals	**4.641e+10**	**2.026e+04**	**5.890e+04**	**3.853e+01**	**1.119e+02**

Results - Dose Point # 2 - (178.092,92.075,0) cm

Energy (MeV)	Activity (Photons/sec)	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.0006	1.370e+08	3.043e-04	6.566e-04	1.636e-03	3.529e-03
0.0054	2.749e+09	5.790e-02	1.249e-01	3.282e-02	7.082e-02
0.0054	5.443e+09	1.149e-01	2.478e-01	6.499e-02	1.402e-01
0.0059	1.089e+09	2.526e-02	5.451e-02	1.301e-02	2.807e-02
0.8348	3.699e+10	1.070e+04	3.063e+04	2.024e+01	5.797e+01
Totals	**4.641e+10**	**1.070e+04**	**3.063e+04**	**2.035e+01**	**5.821e+01**

Results - Dose Point # 3 - (228.092,92.075,0) cm

Energy (MeV)	Activity (Photons/sec)	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.0006	1.370e+08	1.779e-04	3.831e-04	9.562e-04	2.059e-03
0.0054	2.749e+09	3.385e-02	7.291e-02	1.919e-02	4.132e-02
0.0054	5.443e+09	6.715e-02	1.446e-01	3.800e-02	8.183e-02
0.0059	1.089e+09	1.477e-02	3.181e-02	7.605e-03	1.638e-02
0.8348	3.699e+10	6.468e+03	1.841e+04	1.224e+01	3.485e+01
Totals	**4.641e+10**	**6.468e+03**	**1.841e+04**	**1.230e+01**	**3.499e+01**

Results - Dose Point # 4 - (278.092,92.075,0) cm

Energy (MeV)	Activity (Photons/sec)	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.0006	1.370e+08	1.090e-04	2.359e-04	5.861e-04	1.268e-03
0.0054	2.749e+09	2.075e-02	4.489e-02	1.176e-02	2.545e-02
0.0054	5.443e+09	4.116e-02	8.905e-02	2.329e-02	5.039e-02
0.0059	1.089e+09	9.052e-03	1.959e-02	4.661e-03	1.009e-02
0.8348	3.699e+10	4.275e+03	1.220e+04	8.089e+00	2.308e+01
Totals	**4.641e+10**	**4.275e+03**	**1.220e+04**	**8.129e+00**	**2.317e+01**

Results - Dose Point # 5 - (328.092,92.075,0) cm

Energy (MeV)	Activity (Photons/sec)	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.0006	1.370e+08	7.057e-05	1.539e-04	3.794e-04	8.272e-04
0.0054	2.749e+09	1.343e-02	2.928e-02	7.612e-03	1.660e-02
0.0054	5.443e+09	2.664e-02	5.808e-02	1.507e-02	3.287e-02
0.0059	1.089e+09	5.859e-03	1.278e-02	3.017e-03	6.578e-03
0.8348	3.699e+10	3.014e+03	8.648e+03	5.704e+00	1.636e+01
Totals	**4.641e+10**	**3.015e+03**	**8.648e+03**	**5.730e+00**	**1.642e+01**

Results - Dose Point # 6 - (378.092,92.075,0) cm					
Energy (MeV)	Activity (Photons/sec)	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.0006	1.370e+08	4.781e-05	1.052e-04	2.570e-04	5.653e-04
0.0054	2.749e+09	9.098e-03	2.001e-02	5.157e-03	1.134e-02
0.0054	5.443e+09	1.805e-02	3.970e-02	1.021e-02	2.246e-02
0.0059	1.089e+09	3.970e-03	8.731e-03	2.044e-03	4.496e-03
0.8348	3.699e+10	2.231e+03	6.441e+03	4.222e+00	1.219e+01
Totals	**4.641e+10**	**2.231e+03**	**6.441e+03**	**4.240e+00**	**1.223e+01**

MicroShield 8.03
rscs (8.03-0000)

Date	By	Checked

Filename	Run Date	Run Time	Duration
contact 1m model.msd	August 19, 2020	13:58:11	00:00:00

Project Info

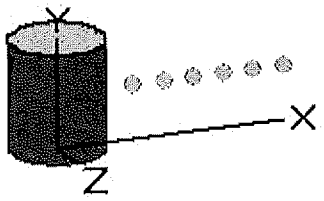
Case Title	Case 1
Description	Case 1
Geometry	7 - Cylinder Volume - Side Shields

Source Dimensions

Height	184.15 cm (6 ft 0.5 in)
Radius	77.788 cm (2 ft 6.6 in)

Dose Points

A	X	Y	Z
#1	128.092 cm (4 ft 2.4 in)	92.075 cm (3 ft 0.3 in)	0.0 cm (0 in)
#2	178.092 cm (5 ft 10.1 in)	92.075 cm (3 ft 0.3 in)	0.0 cm (0 in)
#3	228.092 cm (7 ft 5.8 in)	92.075 cm (3 ft 0.3 in)	0.0 cm (0 in)
#4	278.092 cm (9 ft 1.5 in)	92.075 cm (3 ft 0.3 in)	0.0 cm (0 in)
#5	328.092 cm (10 ft 9.2 in)	92.075 cm (3 ft 0.3 in)	0.0 cm (0 in)
#6	378.092 cm (12 ft 4.9 in)	92.075 cm (3 ft 0.3 in)	0.0 cm (0 in)



Shields

Shield N	Dimension	Material	Density
Source	3.50e+06 cm³	polystyrene	0.72
Transition		Air	0.00122
Air Gap		Air	0.00122
Wall Clad	.304 cm	Carbon	7.85

Source Input: Grouping Method - Actual Photon Energies

Nuclide	Ci	Bq	µCi/cm³	Bq/cm³
Tc-99	1.0000e+000	3.7000e+010	2.8566e-001	1.0570e+004

Buildup: The material reference is Source
Integration Parameters

Radial	10
Circumferential	10
Y Direction (axial)	20

Results - Dose Point # 1 - (128.092,92.075,0) cm

Energy (MeV)	Activity (Photons/sec)	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.0894	2.146e+05	4.335e-03	8.994e-02	6.671e-06	1.384e-04
Totals	**2.146e+05**	**4.335e-03**	**8.994e-02**	**6.671e-06**	**1.384e-04**

Results - Dose Point # 2 - (178.092,92.075,0) cm					
Energy (MeV)	Activity (Photons/sec)	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.0894	2.146e+05	2.307e-03	4.754e-02	3.550e-06	7.316e-05
Totals	**2.146e+05**	**2.307e-03**	**4.754e-02**	**3.550e-06**	**7.316e-05**

Results - Dose Point # 3 - (228.092,92.075,0) cm					
Energy (MeV)	Activity (Photons/sec)	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.0894	2.146e+05	1.398e-03	2.859e-02	2.151e-06	4.399e-05
Totals	**2.146e+05**	**1.398e-03**	**2.859e-02**	**2.151e-06**	**4.399e-05**

Results - Dose Point # 4 - (278.092,92.075,0) cm					
Energy (MeV)	Activity (Photons/sec)	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.0894	2.146e+05	9.248e-04	1.882e-02	1.423e-06	2.896e-05
Totals	**2.146e+05**	**9.248e-04**	**1.882e-02**	**1.423e-06**	**2.896e-05**

Results - Dose Point # 5 - (328.092,92.075,0) cm					
Energy (MeV)	Activity (Photons/sec)	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.0894	2.146e+05	6.511e-04	1.325e-02	1.002e-06	2.039e-05
Totals	**2.146e+05**	**6.511e-04**	**1.325e-02**	**1.002e-06**	**2.039e-05**

Results - Dose Point # 6 - (378.092,92.075,0) cm					
Energy (MeV)	Activity (Photons/sec)	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.0894	2.146e+05	4.803e-04	9.809e-03	7.391e-07	1.510e-05
Totals	**2.146e+05**	**4.803e-04**	**9.809e-03**	**7.391e-07**	**1.510e-05**

MicroShield 8.03
rscs (8.03-0000)

Date	By	Checked

Filename	Run Date	Run Time	Duration
contact 1m model.msd	August 19, 2020	13:40:52	00:00:00

Project Info

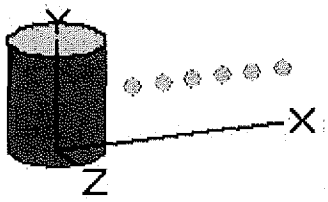
Case Title	Case 1
Description	Case 1
Geometry	7 - Cylinder Volume - Side Shields

Source Dimensions

Height	184.15 cm (6 ft 0.5 in)
Radius	77.788 cm (2 ft 6.6 in)

Dose Points

A	X	Y	Z
#1	128.092 cm (4 ft 2.4 in)	92.075 cm (3 ft 0.3 in)	0.0 cm (0 in)
#2	178.092 cm (5 ft 10.1 in)	92.075 cm (3 ft 0.3 in)	0.0 cm (0 in)
#3	228.092 cm (7 ft 5.8 in)	92.075 cm (3 ft 0.3 in)	0.0 cm (0 in)
#4	278.092 cm (9 ft 1.5 in)	92.075 cm (3 ft 0.3 in)	0.0 cm (0 in)
#5	328.092 cm (10 ft 9.2 in)	92.075 cm (3 ft 0.3 in)	0.0 cm (0 in)
#6	378.092 cm (12 ft 4.9 in)	92.075 cm (3 ft 0.3 in)	0.0 cm (0 in)



Shields

Shield N	Dimension	Material	Density
Source	3.50e+06 cm³	polystyrene	0.72
Transition		Air	0.00122
Air Gap		Air	0.00122
Wall Clad	.304 cm	Carbon	7.85

Source Input: Grouping Method - Actual Photon Energies

Nuclide	Ci	Bq	μCi/cm³	Bq/cm³
Ni-59	1.0000e+000	3.7000e+010	2.8566e-001	1.0570e+004

Buildup: The material reference is Source
Integration Parameters

Radial	10
Circumferential	10
Y Direction (axial)	20

Results - Dose Point # 1 - (128.092,92.075,0) cm

Energy (MeV)	Activity (Photons/sec)	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.0008	1.744e+08	8.892e-04	1.927e-03	3.493e-03	7.568e-03
0.0069	3.707e+09	1.675e-01	3.630e-01	7.423e-02	1.608e-01

0.0069	7.312e+09	3.312e-01	7.175e-01	1.464e-01	3.172e-01
0.0076	1.488e+09	7.437e-02	1.611e-01	2.979e-02	6.454e-02
Totals	**1.268e+10**	**5.740e-01**	**1.244e+00**	**2.539e-01**	**5.502e-01**

Results - Dose Point # 2 - (178.092,92.075,0) cm

Energy (MeV)	Activity (Photons/sec)	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.0008	1.744e+08	5.302e-04	1.144e-03	2.083e-03	4.494e-03
0.0069	3.707e+09	9.990e-02	2.156e-01	4.426e-02	9.551e-02
0.0069	7.312e+09	1.975e-01	4.261e-01	8.731e-02	1.884e-01
0.0076	1.488e+09	4.435e-02	9.570e-02	1.776e-02	3.833e-02
Totals	**1.268e+10**	**3.423e-01**	**7.385e-01**	**1.514e-01**	**3.267e-01**

Results - Dose Point # 3 - (228.092,92.075,0) cm

Energy (MeV)	Activity (Photons/sec)	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.0008	1.744e+08	3.100e-04	6.676e-04	1.218e-03	2.623e-03
0.0069	3.707e+09	5.841e-02	1.258e-01	2.588e-02	5.573e-02
0.0069	7.312e+09	1.155e-01	2.487e-01	5.104e-02	1.099e-01
0.0076	1.488e+09	2.593e-02	5.584e-02	1.038e-02	2.236e-02
Totals	**1.268e+10**	**2.001e-01**	**4.309e-01**	**8.852e-02**	**1.907e-01**

Results - Dose Point # 4 - (278.092,92.075,0) cm

Energy (MeV)	Activity (Photons/sec)	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.0008	1.744e+08	1.900e-04	4.111e-04	7.464e-04	1.615e-03
0.0069	3.707e+09	3.580e-02	7.746e-02	1.586e-02	3.432e-02
0.0069	7.312e+09	7.076e-02	1.531e-01	3.128e-02	6.769e-02
0.0076	1.488e+09	1.589e-02	3.439e-02	6.365e-03	1.377e-02
Totals	**1.268e+10**	**1.226e-01**	**2.654e-01**	**5.426e-02**	**1.174e-01**

Results - Dose Point # 5 - (328.092,92.075,0) cm

Energy (MeV)	Activity (Photons/sec)	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.0008	1.744e+08	1.230e-04	2.681e-04	4.831e-04	1.053e-03
0.0069	3.707e+09	2.317e-02	5.052e-02	1.027e-02	2.238e-02
0.0069	7.312e+09	4.580e-02	9.987e-02	2.025e-02	4.415e-02
0.0076	1.488e+09	1.029e-02	2.243e-02	4.120e-03	8.982e-03
Totals	**1.268e+10**	**7.938e-02**	**1.731e-01**	**3.512e-02**	**7.657e-02**

Results - Dose Point # 6 - (378.092,92.075,0) cm

Energy (MeV)	Activity (Photons/sec)	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.0008	1.744e+08	8.332e-05	1.833e-04	3.273e-04	7.199e-04

0.0069	3.707e+09	1.570e-02	3.453e-02	6.955e-03	1.530e-02
0.0069	7.312e+09	3.103e-02	6.826e-02	1.372e-02	3.018e-02
0.0076	1.488e+09	6.969e-03	1.533e-02	2.791e-03	6.139e-03
Totals	**1.268e+10**	**5.378e-02**	**1.183e-01**	**2.379e-02**	**5.233e-02**

MicroShield 8.03
rscs (8.03-0000)

Date	By	Checked

Filename	Run Date	Run Time	Duration
contact 1m model.msd	August 19, 2020	13:54:47	00:00:01

Project Info

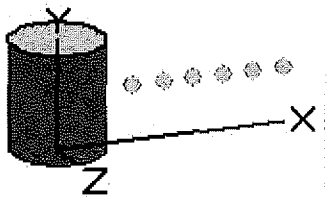
Case Title	Case 1
Description	Case 1
Geometry	7 - Cylinder Volume - Side Shields

Source Dimensions

Height	184.15 cm (6 ft 0.5 in)
Radius	77.788 cm (2 ft 6.6 in)

Dose Points

A	X	Y	Z
#1	128.092 cm (4 ft 2.4 in)	92.075 cm (3 ft 0.3 in)	0.0 cm (0 in)
#2	178.092 cm (5 ft 10.1 in)	92.075 cm (3 ft 0.3 in)	0.0 cm (0 in)
#3	228.092 cm (7 ft 5.8 in)	92.075 cm (3 ft 0.3 in)	0.0 cm (0 in)
#4	278.092 cm (9 ft 1.5 in)	92.075 cm (3 ft 0.3 in)	0.0 cm (0 in)
#5	328.092 cm (10 ft 9.2 in)	92.075 cm (3 ft 0.3 in)	0.0 cm (0 in)
#6	378.092 cm (12 ft 4.9 in)	92.075 cm (3 ft 0.3 in)	0.0 cm (0 in)



Shields

Shield N	Dimension	Material	Density
Source	3.50e+06 cm³	polystyrene	0.72
Transition		Air	0.00122
Air Gap		Air	0.00122
Wall Clad	.304 cm	Carbon	7.85

Source Input: Grouping Method - Standard Indices
Number of Groups: 25
Lower Energy Cutoff: 0.015
Photons < 0.015: Included
Library: Grove

Nuclide	Ci	Bq	µCi/cm³	Bq/cm³
Sb-124	1.0000e+000	3.7000e+010	2.8566e-001	1.0570e+004

Buildup: The material reference is Source
Integration Parameters

Radial	10
Circumferential	10
Y Direction (axial)	20

Results - Dose Point # 1 - (128.092,92.075,0) cm

	Fluence Rate	Fluence Rate	Exposure Rate	Exposure Rate

Energy (MeV)	Activity (Photons/sec)	MeV/cm²/sec No Buildup	MeV/cm²/sec With Buildup	mR/hr No Buildup	mR/hr With Buildup
0.015	1.246e+07	1.221e-03	2.646e-03	1.047e-04	2.269e-04
0.03	1.331e+08	4.512e-01	3.305e+00	4.472e-03	3.275e-02
0.4	1.238e+08	2.188e+01	1.056e+02	4.263e-02	2.057e-01
0.5	6.156e+07	1.528e+01	6.222e+01	2.999e-02	1.221e-01
0.6	3.895e+10	1.280e+04	4.595e+04	2.497e+01	8.969e+01
0.8	5.834e+09	2.990e+03	8.911e+03	5.688e+00	1.695e+01
1.0	1.892e+09	1.375e+03	3.630e+03	2.534e+00	6.691e+00
1.5	2.111e+10	2.895e+04	6.352e+04	4.872e+01	1.069e+02
2.0	2.118e+09	4.549e+03	8.927e+03	7.035e+00	1.380e+01
Totals	**7.024e+10**	**5.070e+04**	**1.311e+05**	**8.902e+01**	**2.344e+02**

Results - Dose Point # 2 - (178.092,92.075,0) cm

Energy (MeV)	Activity (Photons/sec)	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.015	1.246e+07	7.281e-04	1.571e-03	6.245e-05	1.348e-04
0.03	1.331e+08	2.432e-01	1.724e+00	2.411e-03	1.709e-02
0.4	1.238e+08	1.159e+01	5.499e+01	2.259e-02	1.071e-01
0.5	6.156e+07	8.090e+00	3.237e+01	1.588e-02	6.354e-02
0.6	3.895e+10	6.768e+03	2.391e+04	1.321e+01	4.667e+01
0.8	5.834e+09	1.579e+03	4.635e+03	3.003e+00	8.816e+00
1.0	1.892e+09	7.246e+02	1.887e+03	1.336e+00	3.479e+00
1.5	2.111e+10	1.521e+04	3.301e+04	2.559e+01	5.554e+01
2.0	2.118e+09	2.383e+03	4.635e+03	3.686e+00	7.168e+00
Totals	**7.024e+10**	**2.668e+04**	**6.816e+04**	**4.686e+01**	**1.219e+02**

Results - Dose Point # 3 - (228.092,92.075,0) cm

Energy (MeV)	Activity (Photons/sec)	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.015	1.246e+07	4.257e-04	9.168e-04	3.651e-05	7.864e-05
0.03	1.331e+08	1.455e-01	1.049e+00	1.442e-03	1.040e-02
0.4	1.238e+08	7.030e+00	3.299e+01	1.370e-02	6.428e-02
0.5	6.156e+07	4.901e+00	1.944e+01	9.621e-03	3.816e-02
0.6	3.895e+10	4.098e+03	1.437e+04	7.999e+00	2.804e+01
0.8	5.834e+09	9.549e+02	2.786e+03	1.816e+00	5.299e+00
1.0	1.892e+09	4.379e+02	1.135e+03	8.071e-01	2.093e+00
1.5	2.111e+10	9.179e+03	1.989e+04	1.544e+01	3.346e+01
2.0	2.118e+09	1.438e+03	2.796e+03	2.223e+00	4.324e+00
Totals	**7.024e+10**	**1.612e+04**	**4.103e+04**	**2.831e+01**	**7.333e+01**

Results - Dose Point # 4 - (278.092,92.075,0) cm

Energy (MeV)	Activity (Photons/sec)	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup

0.015	1.246e+07	2.609e-04	5.646e-04	2.238e-05	4.842e-05
0.03	1.331e+08	9.528e-02	6.958e-01	9.443e-04	6.896e-03
0.4	1.238e+08	4.649e+00	2.179e+01	9.059e-03	4.247e-02
0.5	6.156e+07	3.240e+00	1.285e+01	6.361e-03	2.523e-02
0.6	3.895e+10	2.709e+03	9.508e+03	5.287e+00	1.856e+01
0.8	5.834e+09	6.311e+02	1.845e+03	1.200e+00	3.510e+00
1.0	1.892e+09	2.894e+02	7.526e+02	5.335e-01	1.387e+00
1.5	2.111e+10	6.071e+03	1.320e+04	1.021e+01	2.222e+01
2.0	2.118e+09	9.519e+02	1.859e+03	1.472e+00	2.874e+00
Totals	**7.024e+10**	**1.066e+04**	**2.720e+04**	**1.872e+01**	**4.862e+01**

Results - Dose Point # 5 - (328.092,92.075,0) cm

Energy (MeV)	Activity (Photons/sec)	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.015	1.246e+07	1.689e-04	3.682e-04	1.448e-05	3.158e-05
0.03	1.331e+08	6.648e-02	4.904e-01	6.589e-04	4.860e-03
0.4	1.238e+08	3.276e+00	1.542e+01	6.382e-03	3.004e-02
0.5	6.156e+07	2.283e+00	9.099e+00	4.482e-03	1.786e-02
0.6	3.895e+10	1.909e+03	6.735e+03	3.727e+00	1.315e+01
0.8	5.834e+09	4.450e+02	1.308e+03	8.465e-01	2.488e+00
1.0	1.892e+09	2.042e+02	5.339e+02	3.764e-01	9.841e-01
1.5	2.111e+10	4.289e+03	9.378e+03	7.216e+00	1.578e+01
2.0	2.118e+09	6.733e+02	1.322e+03	1.041e+00	2.044e+00
Totals	**7.024e+10**	**7.526e+03**	**1.930e+04**	**1.322e+01**	**3.449e+01**

Results - Dose Point # 6 - (378.092,92.075,0) cm

Energy (MeV)	Activity (Photons/sec)	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.015	1.246e+07	1.144e-04	2.517e-04	9.814e-06	2.159e-05
0.03	1.331e+08	4.862e-02	3.619e-01	4.818e-04	3.587e-03
0.4	1.238e+08	2.421e+00	1.146e+01	4.717e-03	2.234e-02
0.5	6.156e+07	1.688e+00	6.769e+00	3.314e-03	1.329e-02
0.6	3.895e+10	1.412e+03	5.012e+03	2.756e+00	9.783e+00
0.8	5.834e+09	3.294e+02	9.741e+02	6.265e-01	1.853e+00
1.0	1.892e+09	1.512e+02	3.978e+02	2.787e-01	7.332e-01
1.5	2.111e+10	3.182e+03	6.994e+03	5.353e+00	1.177e+01
2.0	2.118e+09	5.002e+02	9.865e+02	7.734e-01	1.525e+00
Totals	**7.024e+10**	**5.579e+03**	**1.438e+04**	**9.796e+00**	**2.570e+01**

MicroShield 8.03
rscs (8.03-0000)

Date	By	Checked

Filename	Run Date	Run Time	Duration
contact 1m model.msd	August 19, 2020	13:52:24	00:00:00

Project Info

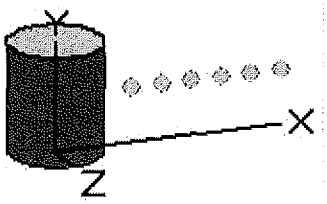
Case Title	Case 1
Description	Case 1
Geometry	7 - Cylinder Volume - Side Shields

Source Dimensions

Height	184.15 cm (6 ft 0.5 in)
Radius	77.788 cm (2 ft 6.6 in)

Dose Points

A	X	Y	Z
#1	128.092 cm (4 ft 2.4 in)	92.075 cm (3 ft 0.3 in)	0.0 cm (0 in)
#2	178.092 cm (5 ft 10.1 in)	92.075 cm (3 ft 0.3 in)	0.0 cm (0 in)
#3	228.092 cm (7 ft 5.8 in)	92.075 cm (3 ft 0.3 in)	0.0 cm (0 in)
#4	278.092 cm (9 ft 1.5 in)	92.075 cm (3 ft 0.3 in)	0.0 cm (0 in)
#5	328.092 cm (10 ft 9.2 in)	92.075 cm (3 ft 0.3 in)	0.0 cm (0 in)
#6	378.092 cm (12 ft 4.9 in)	92.075 cm (3 ft 0.3 in)	0.0 cm (0 in)



Shields

Shield N	Dimension	Material	Density
Source	3.50e+06 cm³	polystyrene	0.72
Transition		Air	0.00122
Air Gap		Air	0.00122
Wall Clad	.304 cm	Carbon	7.85

Source Input: Grouping Method - Actual Photon Energies

Nuclide	Ci	Bq	µCi/cm³	Bq/cm³
Pu-238	1.0000e+000	3.7000e+010	2.8566e-001	1.0570e+004

Buildup: The material reference is Source
Integration Parameters

Radial	10
Circumferential	10
Y Direction (axial)	20

Results - Dose Point # 1 - (128.092,92.075,0) cm

Energy (MeV)	Activity (Photons/sec)	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.0136	4.283e+09	3.806e-01	8.247e-01	4.444e-02	9.628e-02
0.0553	1.750e+07	1.811e-01	3.726e+00	4.041e-04	8.313e-03

Totals	4.300e+09	5.618e-01	4.551e+00	4.484e-02	1.046e-01

Results - Dose Point # 2 - (178.092,92.075,0) cm

Energy (MeV)	Activity (Photons/sec)	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.0136	4.283e+09	2.270e-01	4.898e-01	2.650e-02	5.718e-02
0.0553	1.750e+07	9.661e-02	1.979e+00	2.156e-04	4.415e-03
Totals	**4.300e+09**	**3.236e-01**	**2.468e+00**	**2.671e-02**	**6.159e-02**

Results - Dose Point # 3 - (228.092,92.075,0) cm

Energy (MeV)	Activity (Photons/sec)	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.0136	4.283e+09	1.327e-01	2.858e-01	1.549e-02	3.337e-02
0.0553	1.750e+07	5.841e-02	1.198e+00	1.303e-04	2.674e-03
Totals	**4.300e+09**	**1.911e-01**	**1.484e+00**	**1.562e-02**	**3.604e-02**

Results - Dose Point # 4 - (278.092,92.075,0) cm

Energy (MeV)	Activity (Photons/sec)	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.0136	4.283e+09	8.134e-02	1.760e-01	9.495e-03	2.055e-02
0.0553	1.750e+07	3.859e-02	7.909e-01	8.611e-05	1.765e-03
Totals	**4.300e+09**	**1.199e-01**	**9.669e-01**	**9.581e-03**	**2.231e-02**

Results - Dose Point # 5 - (328.092,92.075,0) cm

Energy (MeV)	Activity (Photons/sec)	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.0136	4.283e+09	5.264e-02	1.148e-01	6.146e-03	1.340e-02
0.0553	1.750e+07	2.714e-02	5.568e-01	6.055e-05	1.242e-03
Totals	**4.300e+09**	**7.978e-02**	**6.716e-01**	**6.206e-03**	**1.464e-02**

Results - Dose Point # 6 - (378.092,92.075,0) cm

Energy (MeV)	Activity (Photons/sec)	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.0136	4.283e+09	3.567e-02	7.845e-02	4.164e-03	9.159e-03
0.0553	1.750e+07	1.999e-02	4.117e-01	4.461e-05	9.186e-04
Totals	**4.300e+09**	**5.566e-02**	**4.902e-01**	**4.208e-03**	**1.008e-02**

MicroShield 8.03
rscs (8.03-0000)

Date	By	Checked

Filename	Run Date	Run Time	Duration
contact 1m model.msd	August 19, 2020	13:53:31	00:00:00

Project Info

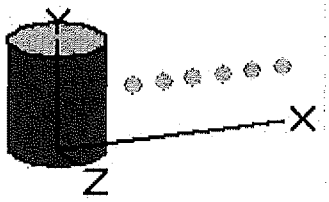
Case Title	Case 1
Description	Case 1
Geometry	7 - Cylinder Volume - Side Shields

Source Dimensions

Height	184.15 cm (6 ft 0.5 in)
Radius	77.788 cm (2 ft 6.6 in)

Dose Points

A	X	Y	Z
#1	128.092 cm (4 ft 2.4 in)	92.075 cm (3 ft 0.3 in)	0.0 cm (0 in)
#2	178.092 cm (5 ft 10.1 in)	92.075 cm (3 ft 0.3 in)	0.0 cm (0 in)
#3	228.092 cm (7 ft 5.8 in)	92.075 cm (3 ft 0.3 in)	0.0 cm (0 in)
#4	278.092 cm (9 ft 1.5 in)	92.075 cm (3 ft 0.3 in)	0.0 cm (0 in)
#5	328.092 cm (10 ft 9.2 in)	92.075 cm (3 ft 0.3 in)	0.0 cm (0 in)
#6	378.092 cm (12 ft 4.9 in)	92.075 cm (3 ft 0.3 in)	0.0 cm (0 in)



Shields

Shield N	Dimension	Material	Density
Source	3.50e+06 cm³	polystyrene	0.72
Transition		Air	0.00122
Air Gap		Air	0.00122
Wall Clad	.304 cm	Carbon	7.85

Source Input: Grouping Method - Actual Photon Energies

Nuclide	Ci	Bq	µCi/cm³	Bq/cm³
Pu-239	1.0000e+000	3.7000e+010	2.8566e-001	1.0570e+004

Buildup: The material reference is Source
Integration Parameters

Radial	10
Circumferential	10
Y Direction (axial)	20

Results - Dose Point # 1 - (128.092,92.075,0) cm

Energy (MeV)	Activity (Photons/sec)	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.0136	1.633e+09	1.452e-01	3.145e-01	1.695e-02	3.672e-02
0.1129	1.761e+07	4.910e-01	8.741e+00	7.595e-04	1.352e-02

Totals	1.651e+09	6.362e-01	9.055e+00	1.771e-02	5.024e-02

Results - Dose Point # 2 - (178.092,92.075,0) cm

Energy (MeV)	Activity (Photons/sec)	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.0136	1.633e+09	8.656e-02	1.868e-01	1.011e-02	2.181e-02
0.1129	1.761e+07	2.611e-01	4.611e+00	4.038e-04	7.132e-03
Totals	**1.651e+09**	**3.477e-01**	**4.798e+00**	**1.051e-02**	**2.894e-02**

Results - Dose Point # 3 - (228.092,92.075,0) cm

Energy (MeV)	Activity (Photons/sec)	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.0136	1.633e+09	5.061e-02	1.090e-01	5.908e-03	1.272e-02
0.1129	1.761e+07	1.583e-01	2.769e+00	2.449e-04	4.282e-03
Totals	**1.651e+09**	**2.089e-01**	**2.878e+00**	**6.153e-03**	**1.701e-02**

Results - Dose Point # 4 - (278.092,92.075,0) cm

Energy (MeV)	Activity (Photons/sec)	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.0136	1.633e+09	3.102e-02	6.711e-02	3.621e-03	7.835e-03
0.1129	1.761e+07	1.048e-01	1.823e+00	1.620e-04	2.819e-03
Totals	**1.651e+09**	**1.358e-01**	**1.890e+00**	**3.783e-03**	**1.065e-02**

Results - Dose Point # 5 - (328.092,92.075,0) cm

Energy (MeV)	Activity (Photons/sec)	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.0136	1.633e+09	2.008e-02	4.377e-02	2.344e-03	5.110e-03
0.1129	1.761e+07	7.378e-02	1.284e+00	1.141e-04	1.986e-03
Totals	**1.651e+09**	**9.386e-02**	**1.328e+00**	**2.458e-03**	**7.097e-03**

Results - Dose Point # 6 - (378.092,92.075,0) cm

Energy (MeV)	Activity (Photons/sec)	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.0136	1.633e+09	1.360e-02	2.992e-02	1.588e-03	3.493e-03
0.1129	1.761e+07	5.444e-02	9.514e-01	8.421e-05	1.472e-03
Totals	**1.651e+09**	**6.805e-02**	**9.813e-01**	**1.672e-03**	**4.964e-03**

MicroShield 8.03
rscs (8.03-0000)

Date	By	Checked

Filename	Run Date	Run Time	Duration
contact 1m model.msd	August 19, 2020	13:01:42	00:00:01

Project Info

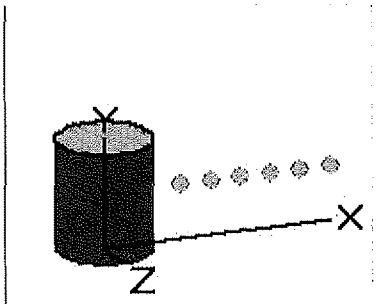
Case Title	Case 1
Description	Case 1
Geometry	7 - Cylinder Volume - Side Shields

Source Dimensions

Height	184.15 cm (6 ft 0.5 in)
Radius	77.788 cm (2 ft 6.6 in)

Dose Points

A	X	Y	Z
#1	128.092 cm (4 ft 2.4 in)	92.075 cm (3 ft 0.3 in)	0.0 cm (0 in)
#2	178.092 cm (5 ft 10.1 in)	92.075 cm (3 ft 0.3 in)	0.0 cm (0 in)
#3	228.092 cm (7 ft 5.8 in)	92.075 cm (3 ft 0.3 in)	0.0 cm (0 in)
#4	278.092 cm (9 ft 1.5 in)	92.075 cm (3 ft 0.3 in)	0.0 cm (0 in)
#5	328.092 cm (10 ft 9.2 in)	92.075 cm (3 ft 0.3 in)	0.0 cm (0 in)
#6	378.092 cm (12 ft 4.9 in)	92.075 cm (3 ft 0.3 in)	0.0 cm (0 in)



Shields

Shield N	Dimension	Material	Density
Source	3.50e+06 cm³	polystyrene	0.72
Transition		Air	0.00122
Air Gap		Air	0.00122
Wall Clad	.304 cm	Carbon	7.85

Source Input: Grouping Method - Actual Photon Energies

Nuclide	Ci	Bq	µCi/cm³	Bq/cm³
Sb-125	1.0000e+000	3.7000e+010	2.8566e-001	1.0570e+004

Buildup: The material reference is Source
Integration Parameters

Radial	10
Circumferential	10
Y Direction (axial)	20

Results - Dose Point # 1 - (128.092,92.075,0) cm

Energy (MeV)	Activity (Photons/sec)	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.0038	1.830e+09	4.510e-02	9.771e-02	3.665e-02	7.941e-02
0.0272	4.732e+09	1.229e+01	7.372e+01	1.636e-01	9.814e-01

0.0275	8.828e+09	2.360e+01	1.444e+02	3.049e-01	1.865e+00
0.031	3.065e+09	1.126e+01	8.836e+01	1.013e-01	7.945e-01
0.0355	1.541e+09	7.624e+00	7.953e+01	4.645e-02	4.845e-01
0.117	9.658e+07	2.829e+00	4.884e+01	4.400e-03	7.597e-02
0.159	2.580e+07	1.166e+00	1.427e+01	1.948e-03	2.385e-02
0.1726	6.707e+07	3.411e+00	3.742e+01	5.817e-03	6.382e-02
0.1763	2.550e+09	1.337e+02	1.426e+03	2.293e-01	2.445e+00
0.2041	1.194e+08	7.747e+00	6.859e+01	1.373e-02	1.216e-01
0.2081	8.997e+07	6.005e+00	5.200e+01	1.069e-02	9.258e-02
0.2279	4.862e+07	3.708e+00	2.913e+01	6.725e-03	5.284e-02
0.321	1.543e+08	1.957e+01	1.132e+02	3.743e-02	2.165e-01
0.3804	5.534e+08	9.063e+01	4.552e+02	1.760e-01	8.841e-01
0.408	6.728e+07	1.225e+01	5.817e+01	2.390e-02	1.135e-01
0.4279	1.085e+10	2.124e+03	9.716e+03	4.153e+00	1.900e+01
0.4435	1.118e+08	2.310e+01	1.028e+02	4.524e-02	2.014e-01
0.4634	3.831e+09	8.464e+02	3.644e+03	1.660e+00	7.146e+00
0.6006	6.576e+09	2.163e+03	7.764e+03	4.222e+00	1.515e+01
0.6066	1.858e+09	6.207e+02	2.213e+03	1.211e+00	4.316e+00
0.6359	4.189e+09	1.505e+03	5.197e+03	2.926e+00	1.011e+01
0.6714	6.707e+08	2.620e+02	8.726e+02	5.074e-01	1.690e+00
Totals	**5.186e+10**	**7.880e+03**	**3.220e+04**	**1.589e+01**	**6.591e+01**

Results - Dose Point # 2 - (178.092,92.075,0) cm

Energy (MeV)	Activity (Photons/sec)	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.0038	1.830e+09	2.689e-02	5.803e-02	2.186e-02	4.716e-02
0.0272	4.732e+09	6.663e+00	3.852e+01	8.870e-02	5.128e-01
0.0275	8.828e+09	1.279e+01	7.541e+01	1.652e-01	9.742e-01
0.031	3.065e+09	6.064e+00	4.613e+01	5.452e-02	4.148e-01
0.0355	1.541e+09	4.088e+00	4.170e+01	2.491e-02	2.541e-01
0.117	9.658e+07	1.504e+00	2.576e+01	2.339e-03	4.006e-02
0.159	2.580e+07	6.192e-01	7.492e+00	1.035e-03	1.252e-02
0.1726	6.707e+07	1.811e+00	1.962e+01	3.089e-03	3.346e-02
0.1763	2.550e+09	7.102e+01	7.475e+02	1.217e-01	1.281e+00
0.2041	1.194e+08	4.112e+00	3.588e+01	7.291e-03	6.362e-02
0.2081	8.997e+07	3.187e+00	2.720e+01	5.674e-03	4.842e-02
0.2279	4.862e+07	1.968e+00	1.523e+01	3.569e-03	2.762e-02
0.321	1.543e+08	1.038e+01	5.913e+01	1.985e-02	1.131e-01
0.3804	5.534e+08	4.804e+01	2.373e+02	9.329e-02	4.609e-01
0.408	6.728e+07	6.491e+00	3.030e+01	1.266e-02	5.911e-02
0.4279	1.085e+10	1.125e+03	5.059e+03	2.200e+00	9.892e+00
0.4435	1.118e+08	1.224e+01	5.351e+01	2.397e-02	1.048e-01
0.4634	3.831e+09	4.483e+02	1.896e+03	8.791e-01	3.719e+00
0.6006	6.576e+09	1.144e+03	4.040e+03	2.233e+00	7.885e+00
0.6066	1.858e+09	3.283e+02	1.151e+03	6.404e-01	2.246e+00

0.6359	4.189e+09	7.957e+02	2.704e+03	1.547e+00	5.259e+00
0.6714	6.707e+08	1.385e+02	4.541e+02	2.682e-01	8.793e-01
Totals	**5.186e+10**	**4.171e+03**	**1.676e+04**	**8.419e+00**	**3.433e+01**

Results - Dose Point # 3 - (228.092,92.075,0) cm

Energy (MeV)	Activity (Photons/sec)	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.0038	1.830e+09	1.572e-02	3.386e-02	1.278e-02	2.752e-02
0.0272	4.732e+09	3.970e+00	2.330e+01	5.285e-02	3.101e-01
0.0275	8.828e+09	7.621e+00	4.564e+01	9.845e-02	5.896e-01
0.031	3.065e+09	3.631e+00	2.810e+01	3.265e-02	2.527e-01
0.0355	1.541e+09	2.457e+00	2.548e+01	1.497e-02	1.552e-01
0.117	9.658e+07	9.121e-01	1.546e+01	1.419e-03	2.405e-02
0.159	2.580e+07	3.757e-01	4.488e+00	6.279e-04	7.501e-03
0.1726	6.707e+07	1.099e+00	1.175e+01	1.875e-03	2.004e-02
0.1763	2.550e+09	4.310e+01	4.476e+02	7.389e-02	7.673e-01
0.2041	1.194e+08	2.496e+00	2.149e+01	4.425e-03	3.809e-02
0.2081	8.997e+07	1.934e+00	1.629e+01	3.444e-03	2.900e-02
0.2279	4.862e+07	1.194e+00	9.121e+00	2.166e-03	1.654e-02
0.321	1.543e+08	6.295e+00	3.545e+01	1.204e-02	6.780e-02
0.3804	5.534e+08	2.913e+01	1.423e+02	5.657e-02	2.764e-01
0.408	6.728e+07	3.936e+00	1.818e+01	7.677e-03	3.546e-02
0.4279	1.085e+10	6.821e+02	3.036e+03	1.334e+00	5.936e+00
0.4435	1.118e+08	7.417e+00	3.212e+01	1.453e-02	6.290e-02
0.4634	3.831e+09	2.717e+02	1.138e+03	5.328e-01	2.232e+00
0.6006	6.576e+09	6.928e+02	2.428e+03	1.352e+00	4.738e+00
0.6066	1.858e+09	1.988e+02	6.919e+02	3.877e-01	1.350e+00
0.6359	4.189e+09	4.817e+02	1.625e+03	9.367e-01	3.160e+00
0.6714	6.707e+08	8.383e+01	2.729e+02	1.623e-01	5.285e-01
Totals	**5.186e+10**	**2.526e+03**	**1.007e+04**	**5.096e+00**	**2.063e+01**

Results - Dose Point # 4 - (278.092,92.075,0) cm

Energy (MeV)	Activity (Photons/sec)	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.0038	1.830e+09	9.636e-03	2.085e-02	7.831e-03	1.695e-02
0.0272	4.732e+09	2.589e+00	1.541e+01	3.447e-02	2.052e-01
0.0275	8.828e+09	4.974e+00	3.021e+01	6.425e-02	3.902e-01
0.031	3.065e+09	2.380e+00	1.864e+01	2.140e-02	1.676e-01
0.0355	1.541e+09	1.616e+00	1.691e+01	9.846e-03	1.030e-01
0.117	9.658e+07	6.035e-01	1.018e+01	9.387e-04	1.583e-02
0.159	2.580e+07	2.487e-01	2.956e+00	4.156e-04	4.939e-03
0.1726	6.707e+07	7.274e-01	7.738e+00	1.241e-03	1.320e-02
0.1763	2.550e+09	2.852e+01	2.948e+02	4.890e-02	5.054e-01
0.2041	1.194e+08	1.652e+00	1.416e+01	2.928e-03	2.510e-02
0.2081	8.997e+07	1.280e+00	1.073e+01	2.279e-03	1.911e-02

0.2279	4.862e+07	7.903e-01	6.012e+00	1.433e-03	1.090e-02
0.321	1.543e+08	4.164e+00	2.340e+01	7.964e-03	4.475e-02
0.3804	5.534e+08	1.926e+01	9.402e+01	3.741e-02	1.826e-01
0.408	6.728e+07	2.603e+00	1.201e+01	5.077e-03	2.343e-02
0.4279	1.085e+10	4.510e+02	2.006e+03	8.820e-01	3.923e+00
0.4435	1.118e+08	4.904e+00	2.123e+01	9.605e-03	4.157e-02
0.4634	3.831e+09	1.796e+02	7.525e+02	3.523e-01	1.476e+00
0.6006	6.576e+09	4.580e+02	1.606e+03	8.939e-01	3.135e+00
0.6066	1.858e+09	1.314e+02	4.579e+02	2.563e-01	8.931e-01
0.6359	4.189e+09	3.184e+02	1.076e+03	6.191e-01	2.092e+00
0.6714	6.707e+08	5.541e+01	1.807e+02	1.073e-01	3.498e-01
Totals	**5.186e+10**	**1.670e+03**	**6.658e+03**	**3.367e+00**	**1.364e+01**

Results - Dose Point # 5 - (328.092,92.075,0) cm

Energy (MeV)	Activity (Photons/sec)	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.0038	1.830e+09	6.237e-03	1.360e-02	5.069e-03	1.105e-02
0.0272	4.732e+09	1.801e+00	1.084e+01	2.397e-02	1.443e-01
0.0275	8.828e+09	3.460e+00	2.125e+01	4.469e-02	2.746e-01
0.031	3.065e+09	1.663e+00	1.315e+01	1.495e-02	1.182e-01
0.0355	1.541e+09	1.132e+00	1.193e+01	6.897e-03	7.266e-02
0.117	9.658e+07	4.250e-01	7.172e+00	6.611e-04	1.116e-02
0.159	2.580e+07	1.751e-01	2.085e+00	2.927e-04	3.484e-03
0.1726	6.707e+07	5.124e-01	5.460e+00	8.738e-04	9.311e-03
0.1763	2.550e+09	2.009e+01	2.080e+02	3.444e-02	3.566e-01
0.2041	1.194e+08	1.163e+00	9.995e+00	2.063e-03	1.772e-02
0.2081	8.997e+07	9.017e-01	7.578e+00	1.605e-03	1.349e-02
0.2279	4.862e+07	5.567e-01	4.246e+00	1.010e-03	7.700e-03
0.321	1.543e+08	2.934e+00	1.654e+01	5.611e-03	3.163e-02
0.3804	5.534e+08	1.357e+01	6.650e+01	2.636e-02	1.291e-01
0.408	6.728e+07	1.834e+00	8.497e+00	3.577e-03	1.658e-02
0.4279	1.085e+10	3.178e+02	1.419e+03	6.215e-01	2.776e+00
0.4435	1.118e+08	3.456e+00	1.502e+01	6.768e-03	2.942e-02
0.4634	3.831e+09	1.266e+02	5.325e+02	2.482e-01	1.044e+00
0.6006	6.576e+09	3.228e+02	1.138e+03	6.300e-01	2.221e+00
0.6066	1.858e+09	9.261e+01	3.243e+02	1.806e-01	6.326e-01
0.6359	4.189e+09	2.244e+02	7.621e+02	4.364e-01	1.482e+00
0.6714	6.707e+08	3.906e+01	1.280e+02	7.563e-02	2.479e-01
Totals	**5.186e+10**	**1.177e+03**	**4.712e+03**	**2.371e+00**	**9.650e+00**

Results - Dose Point # 6 - (378.092,92.075,0) cm

Energy (MeV)	Activity (Photons/sec)	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.0038	1.830e+09	4.226e-03	9.295e-03	3.434e-03	7.554e-03
0.0272	4.732e+09	1.312e+00	7.985e+00	1.747e-02	1.063e-01

0.0275	8.828e+09	2.523e+00	1.566e+01	3.259e-02	2.023e-01
0.031	3.065e+09	1.217e+00	9.707e+00	1.094e-02	8.729e-02
0.0355	1.541e+09	8.308e-01	8.816e+00	5.061e-03	5.371e-02
0.117	9.658e+07	3.137e-01	5.314e+00	4.879e-04	8.266e-03
0.159	2.580e+07	1.293e-01	1.546e+00	2.161e-04	2.584e-03
0.1726	6.707e+07	3.783e-01	4.051e+00	6.451e-04	6.909e-03
0.1763	2.550e+09	1.483e+01	1.544e+02	2.543e-02	2.646e-01
0.2041	1.194e+08	8.591e-01	7.420e+00	1.523e-03	1.316e-02
0.2081	8.997e+07	6.659e-01	5.626e+00	1.185e-03	1.002e-02
0.2279	4.862e+07	4.111e-01	3.153e+00	7.456e-04	5.718e-03
0.321	1.543e+08	2.167e+00	1.229e+01	4.145e-03	2.351e-02
0.3804	5.534e+08	1.003e+01	4.944e+01	1.948e-02	9.601e-02
0.408	6.728e+07	1.355e+00	6.318e+00	2.644e-03	1.232e-02
0.4279	1.085e+10	2.349e+02	1.055e+03	4.593e-01	2.064e+00
0.4435	1.118e+08	2.554e+00	1.117e+01	5.002e-03	2.188e-02
0.4634	3.831e+09	9.356e+01	3.961e+02	1.835e-01	7.768e-01
0.6006	6.576e+09	2.387e+02	8.469e+02	4.659e-01	1.653e+00
0.6066	1.858e+09	6.849e+01	2.414e+02	1.336e-01	4.708e-01
0.6359	4.189e+09	1.660e+02	5.672e+02	3.228e-01	1.103e+00
0.6714	6.707e+08	2.889e+01	9.529e+01	5.594e-02	1.845e-01
Totals	**5.186e+10**	**8.701e+02**	**3.505e+03**	**1.752e+00**	**7.174e+00**

MicroShield 8.03
rscs (8.03-0000)

Date	By	Checked

Filename	Run Date	Run Time	Duration
contact 1m model.msd	August 19, 2020	13:55:50	00:00:01

Project Info

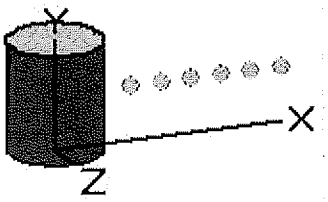
Case Title	Case 1
Description	Case 1
Geometry	7 - Cylinder Volume - Side Shields

Source Dimensions

Height	184.15 cm (6 ft 0.5 in)
Radius	77.788 cm (2 ft 6.6 in)

Dose Points

A	X	Y	Z
#1	128.092 cm (4 ft 2.4 in)	92.075 cm (3 ft 0.3 in)	0.0 cm (0 in)
#2	178.092 cm (5 ft 10.1 in)	92.075 cm (3 ft 0.3 in)	0.0 cm (0 in)
#3	228.092 cm (7 ft 5.8 in)	92.075 cm (3 ft 0.3 in)	0.0 cm (0 in)
#4	278.092 cm (9 ft 1.5 in)	92.075 cm (3 ft 0.3 in)	0.0 cm (0 in)
#5	328.092 cm (10 ft 9.2 in)	92.075 cm (3 ft 0.3 in)	0.0 cm (0 in)
#6	378.092 cm (12 ft 4.9 in)	92.075 cm (3 ft 0.3 in)	0.0 cm (0 in)



Shields

Shield N	Dimension	Material	Density
Source	3.50e+06 cm³	polystyrene	0.72
Transition		Air	0.00122
Air Gap		Air	0.00122
Wall Clad	.304 cm	Carbon	7.85

Source Input: Grouping Method - Actual Photon Energies

Nuclide	Ci	Bq	μCi/cm³	Bq/cm³
In-113m	1.0000e+000	3.7000e+010	2.8566e-001	1.0570e+004
Sn-113	1.0000e+000	3.7000e+010	2.8566e-001	1.0570e+004

Buildup: The material reference is Source
Integration Parameters

Radial	10
Circumferential	10
Y Direction (axial)	20

Results - Dose Point # 1 - (128.092,92.075,0) cm

Energy (MeV)	Activity (Photons/sec)	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.0033	8.640e+08	1.858e-02	4.025e-02	1.730e-02	3.748e-02

0.0033	2.482e+09	5.337e-02	1.156e-01	4.970e-02	1.077e-01
0.024	2.528e+09	4.351e+00	2.049e+01	8.514e-02	4.010e-01
0.024	7.655e+09	1.318e+01	6.206e+01	2.579e-01	1.214e+00
0.0242	1.442e+10	2.561e+01	1.226e+02	4.879e-01	2.335e+00
0.0242	4.760e+09	8.457e+00	4.047e+01	1.611e-01	7.710e-01
0.0273	1.581e+09	4.152e+00	2.508e+01	5.467e-02	3.302e-01
0.0273	4.789e+09	1.257e+01	7.595e+01	1.656e-01	1.000e+00
0.2551	7.156e+08	6.445e+01	4.547e+02	1.193e-01	8.419e-01
0.3917	2.401e+10	4.110e+03	2.016e+04	7.997e+00	3.923e+01
0.6381	3.592e+05	1.297e-01	4.470e-01	2.522e-04	8.690e-04
Totals	**6.380e+10**	**4.243e+03**	**2.096e+04**	**9.396e+00**	**4.627e+01**

Results - Dose Point # 2 - (178.092,92.075,0) cm

Energy (MeV)	Activity (Photons/sec)	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.0033	8.640e+08	1.108e-02	2.390e-02	1.032e-02	2.226e-02
0.0033	2.482e+09	3.183e-02	6.868e-02	2.964e-02	6.396e-02
0.024	2.528e+09	2.385e+00	1.081e+01	4.666e-02	2.115e-01
0.024	7.655e+09	7.222e+00	3.274e+01	1.413e-01	6.407e-01
0.0242	1.442e+10	1.402e+01	6.460e+01	2.671e-01	1.231e+00
0.0242	4.760e+09	4.630e+00	2.133e+01	8.820e-02	4.064e-01
0.0273	1.581e+09	2.250e+00	1.310e+01	2.963e-02	1.725e-01
0.0273	4.789e+09	6.814e+00	3.968e+01	8.972e-02	5.224e-01
0.2551	7.156e+08	3.420e+01	2.376e+02	6.331e-02	4.399e-01
0.3917	2.401e+10	2.178e+03	1.051e+04	4.238e+00	2.044e+01
0.6381	3.592e+05	6.860e-02	2.326e-01	1.334e-04	4.522e-04
Totals	**6.380e+10**	**2.250e+03**	**1.093e+04**	**5.004e+00**	**2.415e+01**

Results - Dose Point # 3 - (228.092,92.075,0) cm

Energy (MeV)	Activity (Photons/sec)	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.0033	8.640e+08	6.476e-03	1.395e-02	6.031e-03	1.299e-02
0.0033	2.482e+09	1.861e-02	4.007e-02	1.733e-02	3.732e-02
0.024	2.528e+09	1.412e+00	6.469e+00	2.762e-02	1.266e-01
0.024	7.655e+09	4.276e+00	1.959e+01	8.366e-02	3.834e-01
0.0242	1.442e+10	8.306e+00	3.869e+01	1.582e-01	7.370e-01
0.0242	4.760e+09	2.742e+00	1.277e+01	5.224e-02	2.433e-01
0.0273	1.581e+09	1.341e+00	7.926e+00	1.765e-02	1.044e-01
0.0273	4.789e+09	4.060e+00	2.400e+01	5.346e-02	3.161e-01
0.2551	7.156e+08	2.075e+01	1.424e+02	3.842e-02	2.636e-01
0.3917	2.401e+10	1.321e+03	6.303e+03	2.570e+00	1.226e+01
0.6381	3.592e+05	4.153e-02	1.398e-01	8.073e-05	2.718e-04
Totals	**6.380e+10**	**1.364e+03**	**6.555e+03**	**3.025e+00**	**1.449e+01**

Results - Dose Point # 4 - (278.092,92.075,0) cm

Energy (MeV)	Activity (Photons/sec)	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.0033	8.640e+08	3.969e-03	8.589e-03	3.697e-03	7.999e-03
0.0033	2.482e+09	1.140e-02	2.468e-02	1.062e-02	2.298e-02
0.024	2.528e+09	9.143e-01	4.251e+00	1.789e-02	8.319e-02
0.024	7.655e+09	2.769e+00	1.288e+01	5.418e-02	2.520e-01
0.0242	1.442e+10	5.382e+00	2.544e+01	1.025e-01	4.847e-01
0.0242	4.760e+09	1.777e+00	8.400e+00	3.385e-02	1.600e-01
0.0273	1.581e+09	8.746e-01	5.244e+00	1.152e-02	6.905e-02
0.0273	4.789e+09	2.649e+00	1.588e+01	3.488e-02	2.091e-01
0.2551	7.156e+08	1.373e+01	9.388e+01	2.542e-02	1.738e-01
0.3917	2.401e+10	8.734e+02	4.163e+03	1.699e+00	8.101e+00
0.6381	3.592e+05	2.745e-02	9.253e-02	5.336e-05	1.799e-04
Totals	**6.380e+10**	**9.015e+02**	**4.329e+03**	**1.994e+00**	**9.564e+00**

Results - Dose Point # 5 - (328.092,92.075,0) cm

Energy (MeV)	Activity (Photons/sec)	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.0033	8.640e+08	2.569e-03	5.602e-03	2.393e-03	5.217e-03
0.0033	2.482e+09	7.381e-03	1.609e-02	6.874e-03	1.499e-02
0.024	2.528e+09	6.315e-01	2.975e+00	1.236e-02	5.821e-02
0.024	7.655e+09	1.913e+00	9.010e+00	3.743e-02	1.763e-01
0.0242	1.442e+10	3.720e+00	1.781e+01	7.086e-02	3.393e-01
0.0242	4.760e+09	1.228e+00	5.881e+00	2.340e-02	1.120e-01
0.0273	1.581e+09	6.083e-01	3.689e+00	8.009e-03	4.858e-02
0.0273	4.789e+09	1.842e+00	1.117e+01	2.426e-02	1.471e-01
0.2551	7.156e+08	9.673e+00	6.632e+01	1.791e-02	1.228e-01
0.3917	2.401e+10	6.153e+02	2.945e+03	1.197e+00	5.730e+00
0.6381	3.592e+05	1.935e-02	6.555e-02	3.761e-05	1.274e-04
Totals	**6.380e+10**	**6.350e+02**	**3.062e+03**	**1.401e+00**	**6.755e+00**

Results - Dose Point # 6 - (378.092,92.075,0) cm

Energy (MeV)	Activity (Photons/sec)	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.0033	8.640e+08	1.741e-03	3.829e-03	1.621e-03	3.566e-03
0.0033	2.482e+09	5.001e-03	1.100e-02	4.657e-03	1.024e-02
0.024	2.528e+09	4.574e-01	2.180e+00	8.951e-03	4.266e-02
0.024	7.655e+09	1.385e+00	6.603e+00	2.711e-02	1.292e-01
0.0242	1.442e+10	2.696e+00	1.306e+01	5.135e-02	2.488e-01
0.0242	4.760e+09	8.901e-01	4.312e+00	1.696e-02	8.214e-02
0.0273	1.581e+09	4.434e-01	2.717e+00	5.838e-03	3.578e-02
0.0273	4.789e+09	1.343e+00	8.230e+00	1.768e-02	1.084e-01
0.2551	7.156e+08	7.144e+00	4.926e+01	1.323e-02	9.120e-02
0.3917	2.401e+10	4.547e+02	2.190e+03	8.848e-01	4.261e+00

0.6381	3.592e+05	1.431e-02	4.879e-02	2.782e-05	9.486e-05
Totals	**6.380e+10**	**4.691e+02**	**2.276e+03**	**1.032e+00**	**5.013e+00**

MicroShield 8.03
rscs (8.03-0000)

Date	By	Checked

Filename	Run Date	Run Time	Duration
contact 1m model.msd	August 19, 2020	13:57:05	00:00:00

Project Info

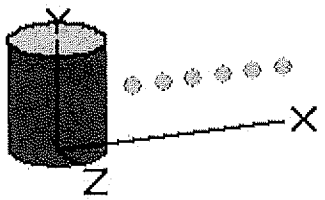
Case Title	Case 1
Description	Case 1
Geometry	7 - Cylinder Volume - Side Shields

Source Dimensions

Height	184.15 cm (6 ft 0.5 in)
Radius	77.788 cm (2 ft 6.6 in)

Dose Points

A	X	Y	Z
#1	128.092 cm (4 ft 2.4 in)	92.075 cm (3 ft 0.3 in)	0.0 cm (0 in)
#2	178.092 cm (5 ft 10.1 in)	92.075 cm (3 ft 0.3 in)	0.0 cm (0 in)
#3	228.092 cm (7 ft 5.8 in)	92.075 cm (3 ft 0.3 in)	0.0 cm (0 in)
#4	278.092 cm (9 ft 1.5 in)	92.075 cm (3 ft 0.3 in)	0.0 cm (0 in)
#5	328.092 cm (10 ft 9.2 in)	92.075 cm (3 ft 0.3 in)	0.0 cm (0 in)
#6	378.092 cm (12 ft 4.9 in)	92.075 cm (3 ft 0.3 in)	0.0 cm (0 in)



Shields

Shield N	Dimension	Material	Density
Source	3.50e+06 cm³	polystyrene	0.72
Transition		Air	0.00122
Air Gap		Air	0.00122
Wall Clad	.304 cm	Carbon	7.85

Source Input: Grouping Method - Actual Photon Energies

Nuclide	Ci	Bq	µCi/cm³	Bq/cm³
Sr-89	1.0000e+000	3.7000e+010	2.8566e-001	1.0570e+004

Buildup: The material reference is Source
Integration Parameters

Radial	10
Circumferential	10
Y Direction (axial)	20

Results - Dose Point # 1 - (128.092,92.075,0) cm

Energy (MeV)	Activity (Photons/sec)	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.9091	5.550e+06	3.473e+00	9.632e+00	6.498e-03	1.802e-02
Totals	**5.550e+06**	**3.473e+00**	**9.632e+00**	**6.498e-03**	**1.802e-02**

Results - Dose Point # 2 - (178.092,92.075,0) cm					
Energy (MeV)	Activity (Photons/sec)	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.9091	5.550e+06	1.832e+00	5.009e+00	3.428e-03	9.371e-03
Totals	**5.550e+06**	**1.832e+00**	**5.009e+00**	**3.428e-03**	**9.371e-03**

Results - Dose Point # 3 - (228.092,92.075,0) cm					
Energy (MeV)	Activity (Photons/sec)	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.9091	5.550e+06	1.107e+00	3.012e+00	2.072e-03	5.635e-03
Totals	**5.550e+06**	**1.107e+00**	**3.012e+00**	**2.072e-03**	**5.635e-03**

Results - Dose Point # 4 - (278.092,92.075,0) cm					
Energy (MeV)	Activity (Photons/sec)	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.9091	5.550e+06	7.319e-01	1.996e+00	1.369e-03	3.734e-03
Totals	**5.550e+06**	**7.319e-01**	**1.996e+00**	**1.369e-03**	**3.734e-03**

Results - Dose Point # 5 - (328.092,92.075,0) cm					
Energy (MeV)	Activity (Photons/sec)	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.9091	5.550e+06	5.163e-01	1.415e+00	9.659e-04	2.648e-03
Totals	**5.550e+06**	**5.163e-01**	**1.415e+00**	**9.659e-04**	**2.648e-03**

Results - Dose Point # 6 - (378.092,92.075,0) cm					
Energy (MeV)	Activity (Photons/sec)	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.9091	5.550e+06	3.822e-01	1.054e+00	7.151e-04	1.972e-03
Totals	**5.550e+06**	**3.822e-01**	**1.054e+00**	**7.151e-04**	**1.972e-03**

MicroShield 8.03
rscs (8.03-0000)

Date	By	Checked

Filename	Run Date	Run Time	Duration
contact 1m model.msd	August 19, 2020	14:00:07	00:00:01

Project Info

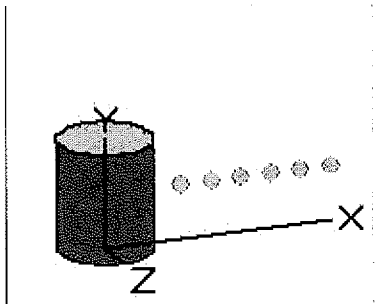
Case Title	Case 1
Description	Case 1
Geometry	7 - Cylinder Volume - Side Shields

Source Dimensions

Height	184.15 cm (6 ft 0.5 in)
Radius	77.788 cm (2 ft 6.6 in)

Dose Points

A	X	Y	Z
#1	128.092 cm (4 ft 2.4 in)	92.075 cm (3 ft 0.3 in)	0.0 cm (0 in)
#2	178.092 cm (5 ft 10.1 in)	92.075 cm (3 ft 0.3 in)	0.0 cm (0 in)
#3	228.092 cm (7 ft 5.8 in)	92.075 cm (3 ft 0.3 in)	0.0 cm (0 in)
#4	278.092 cm (9 ft 1.5 in)	92.075 cm (3 ft 0.3 in)	0.0 cm (0 in)
#5	328.092 cm (10 ft 9.2 in)	92.075 cm (3 ft 0.3 in)	0.0 cm (0 in)
#6	378.092 cm (12 ft 4.9 in)	92.075 cm (3 ft 0.3 in)	0.0 cm (0 in)



Shields

Shield N	Dimension	Material	Density
Source	3.50e+06 cm³	polystyrene	0.72
Transition		Air	0.00122
Air Gap		Air	0.00122
Wall Clad	.304 cm	Carbon	7.85

Source Input: Grouping Method - Actual Photon Energies

Nuclide	Ci	Bq	μCi/cm³	Bq/cm³
Zn-65	1.0000e+000	3.7000e+010	2.8566e-001	1.0570e+004

Buildup: The material reference is Source
Integration Parameters

Radial	10
Circumferential	10
Y Direction (axial)	20

Results - Dose Point # 1 - (128.092,92.075,0) cm

Energy (MeV)	Activity (Photons/sec)	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.0009	2.120e+08	1.288e-03	2.791e-03	4.244e-03	9.196e-03
0.008	4.257e+09	2.233e-01	4.839e-01	8.524e-02	1.847e-01

0.008	8.364e+09	4.399e-01	9.531e-01	1.675e-01	3.629e-01
0.0089	1.704e+09	9.922e-02	2.150e-01	3.412e-02	7.392e-02
0.511	1.047e+09	2.687e+02	1.077e+03	5.274e-01	2.114e+00
0.5577	2.220e+06	6.517e-01	2.459e+00	1.276e-03	4.816e-03
1.1155	1.878e+10	1.619e+04	4.052e+04	2.924e+01	7.319e+01
Totals	**3.436e+10**	**1.646e+04**	**4.161e+04**	**3.006e+01**	**7.594e+01**

Results - Dose Point # 2 - (178.092,92.075,0) cm

Energy (MeV)	Activity (Photons/sec)	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.0009	2.120e+08	7.682e-04	1.658e-03	2.531e-03	5.461e-03
0.008	4.257e+09	1.332e-01	2.874e-01	5.083e-02	1.097e-01
0.008	8.364e+09	2.623e-01	5.661e-01	9.987e-02	2.155e-01
0.0089	1.704e+09	5.917e-02	1.277e-01	2.035e-02	4.390e-02
0.511	1.047e+09	1.423e+02	5.605e+02	2.792e-01	1.100e+00
0.5577	2.220e+06	3.448e-01	1.279e+00	6.754e-04	2.506e-03
1.1155	1.878e+10	8.527e+03	2.107e+04	1.540e+01	3.805e+01
Totals	**3.436e+10**	**8.670e+03**	**2.163e+04**	**1.585e+01**	**3.953e+01**

Results - Dose Point # 3 - (228.092,92.075,0) cm

Energy (MeV)	Activity (Photons/sec)	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.0009	2.120e+08	4.491e-04	9.673e-04	1.480e-03	3.187e-03
0.008	4.257e+09	7.787e-02	1.677e-01	2.972e-02	6.400e-02
0.008	8.364e+09	1.534e-01	3.303e-01	5.839e-02	1.258e-01
0.0089	1.704e+09	3.459e-02	7.450e-02	1.189e-02	2.562e-02
0.511	1.047e+09	8.618e+01	3.366e+02	1.691e-01	6.607e-01
0.5577	2.220e+06	2.089e-01	7.686e-01	4.091e-04	1.505e-03
1.1155	1.878e+10	5.150e+03	1.268e+04	9.302e+00	2.290e+01
Totals	**3.436e+10**	**5.237e+03**	**1.302e+04**	**9.573e+00**	**2.378e+01**

Results - Dose Point # 4 - (278.092,92.075,0) cm

Energy (MeV)	Activity (Photons/sec)	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.0009	2.120e+08	2.753e-04	5.956e-04	9.069e-04	1.962e-03
0.008	4.257e+09	4.772e-02	1.033e-01	1.821e-02	3.941e-02
0.008	8.364e+09	9.400e-02	2.034e-01	3.579e-02	7.743e-02
0.0089	1.704e+09	2.120e-02	4.587e-02	7.290e-03	1.577e-02
0.511	1.047e+09	5.698e+01	2.226e+02	1.118e-01	4.369e-01
0.5577	2.220e+06	1.381e-01	5.085e-01	2.704e-04	9.959e-04
1.1155	1.878e+10	3.405e+03	8.409e+03	6.149e+00	1.519e+01
Totals	**3.436e+10**	**3.462e+03**	**8.632e+03**	**6.323e+00**	**1.576e+01**

Results - Dose Point # 5 - (328.092,92.075,0) cm

		Fluence Rate	Fluence Rate	Exposure Rate	Exposure Rate

Energy (MeV)	Activity (Photons/sec)	MeV/cm²/sec No Buildup	MeV/cm²/sec With Buildup	mR/hr No Buildup	mR/hr With Buildup
0.0009	2.120e+08	1.782e-04	3.885e-04	5.870e-04	1.280e-03
0.008	4.257e+09	3.089e-02	6.735e-02	1.179e-02	2.571e-02
0.008	8.364e+09	6.084e-02	1.327e-01	2.316e-02	5.051e-02
0.0089	1.704e+09	1.372e-02	2.992e-02	4.719e-03	1.029e-02
0.511	1.047e+09	4.015e+01	1.576e+02	7.880e-02	3.093e-01
0.5577	2.220e+06	9.730e-02	3.601e-01	1.906e-04	7.053e-04
1.1155	1.878e+10	2.403e+03	5.967e+03	4.340e+00	1.078e+01
Totals	**3.436e+10**	**2.443e+03**	**6.125e+03**	**4.459e+00**	**1.117e+01**

Results - Dose Point # 6 - (378.092,92.075,0) cm

Energy (MeV)	Activity (Photons/sec)	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.0009	2.120e+08	1.207e-04	2.655e-04	3.977e-04	8.748e-04
0.008	4.257e+09	2.093e-02	4.603e-02	7.988e-03	1.757e-02
0.008	8.364e+09	4.122e-02	9.067e-02	1.569e-02	3.452e-02
0.0089	1.704e+09	9.297e-03	2.045e-02	3.197e-03	7.032e-03
0.511	1.047e+09	2.968e+01	1.172e+02	5.826e-02	2.301e-01
0.5577	2.220e+06	7.195e-02	2.679e-01	1.409e-04	5.248e-04
1.1155	1.878e+10	1.780e+03	4.447e+03	3.215e+00	8.031e+00
Totals	**3.436e+10**	**1.810e+03**	**4.565e+03**	**3.301e+00**	**8.322e+00**