

ENGINEERING CALCULATIONS AND ANALYSIS REPORT

ECAR No.: 651 ECAR Rev. No.: 0 Project File No.: 0409-C.R-10-000935 Date: 6/10/2009

Title: RSWF REMOTE HANDLED TRANSURANIC WASTE DOSE RATE EVALUATION

1. Index Codes	Building/Type: <u>RSWF</u>	SSC ID: <u>N/A</u>	Site Area: <u>Materials and Fuels Complex</u>
2. Quality Level:	<u>3</u>		
3. Objective/Purpose	This ECAR calculates the expected dose rates for four separate containers of remote handled transuranic (RH-TRU) waste stored in liners at the Radioactive Scrap and Waste Facility (RSWF). The containers are Container No. B315 stored in Liner Z-20, Container No. SN165 stored in Liner E-33, Container No. N-20 stored in Liner LL-41 and Container No. B259 stored in Liner V-18.		
4. Conclusions/Recommendations	The dose rates on the four waste containers have been reduced due to decay. The dose rates on the three containers that were stored in the 1970's and 1980's are calculated to have been reduced by several orders of magnitude. Current calculated contact dose rates are about 100 R/hr or less for all the containers.		

5. Review (R) and Approval (A) and Acceptance (Ac) ¹ :			
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Nuclear Safety ³	Ac	Greg A. Hula / W301	<i>Greg Hula</i> 6/9/09

- 1 Review and Approval are required. See LWP-10200 for definitions and responsibilities.
- 2 An Electronic Change Request (ECR) indicating final review and concurrence by the listed individuals can be used in lieu of signatures.
- 3 If Required, per LWP-10200.

6. Additional Distribution: (Name and Mail Stop)	Document Control:	<i>Julie Pappeo</i> 6/5/09

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Scope and Brief Description

Remote handled transuranic (RH-TRU) waste stored in storage liners of the Radioactive Scrap and Waste Facility (RSWF) are to be removed and transferred from RSWF to Idaho Nuclear Technology and Engineering Complex (INTEC) for repackaging and eventual shipment to the Waste Isolation Pilot Project (WIPP) in Carlsbad, New Mexico. The laboratory will open the storage liners, connect onto the waste container and transfer it with a free air transfer to a shielded shipping cask. The shipment of the cask and further disposition of the waste will be performed by an independent DOE contractor.

This ECAR calculates the expected dose rates for four separate containers of RH-TRU waste stored in liners at the RSWF. The containers are Container No. B315 stored in Liner Z-20, Container No. SN165 stored in Liner E-33, Container No. N-20 stored in Liner LL-41 and Container No. B259 stored in Liner V-18.

Design Inputs and Sources

The quality level for this analysis was based on Quality Level Determination: All-000477, Calculation and Analysis of Radionuclide Inventory and Dose Rate.

Results of Literature Searches and Other Background Data

None

Assumptions

1. Radionuclide inventory was obtained from Sealion Database. After discussions with the waste generator, it was determined that the radionuclide inventories in the Sealion Database are based on the date that the waste was generated and have not been decay corrected. For this evaluation the radionuclide inventory was decayed to July 1, 2009 using Microshield, Version 7.02 by Grove Software. A listing of the initial radionuclide inventory and the decayed inventory for each container is provided in Appendix A.
2. The mass of the waste was obtained from the Sealion Database. Waste was assumed to be evenly distributed through a right cylindrical volume. Containers with a steel shield plug have a waste container with an inside diameter of 11.6 inches (29.5 cm) and a height of 59 inches (150 cm). Their total volume is 6235 cubic inches (102,178 cm³). Containers with a lead shield plug have a waste container with an inside diameter of 11.6 inches (29.5 cm) and a height of 64.688 inches (164.3 cm). Their total volume is 6836 cubic inches (112,024 cm³).
3. The densities used in the evaluation were calculated from the content weight in the Sealion database. Container B315 in Liner Z-20 did not have a content weight, so the tare weight for container B259 in Liner V-18 (274465 g – 75613 g = 198852 g) was used as the tare weight for container B315. This resulted in the container B315 having an estimated content weight of 140689 g (339541 g – 198852 g). The table below provides the densities used in this analysis.

Table 1 – Waste Density

Liner	Container	Content Weight	Volume	Density
E-33	SN165	19924 g	102,178 cm ³	0.195 g/cm ³
LL-41	N-20	32724 g	112,024 cm ³	0.292 g/cm ³
V-18	B259	75613 g	112,024 cm ³	0.675 g/cm ³
Z-20	B315	140689 g	112,024 cm ³	1.260 g/cm ³

4. Shielding provided by the inner and outer waste cans was included in this evaluation. The wall thickness for the inner and outer cans is 14 gauge (0.075 inch).
5. The crane that is planned for use at RSWF suspends the load between 20 feet and 75 feet from the crane operator. Dose rates were calculated at two inches and 20, 30, 40, 50 and 60 feet.

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Computer Code Validation

Computer calculations were performed using the following computer:

System Property No.	383296
OS Name	Microsoft Windows XP Professional
Version	2002 Service Pack 3
System Manufacturer	Dell Inc.
System Model	OptiPlex GX620
Processor	x86 Family15Model 4 Stepping 1 Genuine Intel 2800 Mhz
BIOS Version/Date	Dell Inc. A05, 10/13/2005
Total Physical Memory	1,024.00 MB

Spreadsheet calculations were performed using the following software:

Application Name	Microsoft Office Excel 2003
Version	11.0
Build	8237
Product ID	73931-640-8047002-57560
Language	English (United States)

Shielding calculations were performed using MicroShield, Version 7.02 by Grove Software, Inc. licensed to the Idaho National Laboratory. It is a radiological safety analysis and engineering program that has been used extensively at the INL. It has been independently verified and validated for these types of calculations.

Body

The dose rates for four separate containers of RH-TRU waste stored in liners at the RSWF were calculated using Microshield. The containers are Container No. B315 stored in Liner Z-20, Container No. SN165 stored in Liner E-33, Container No. N-20 stored in Liner LL-41 and Container No. B259 stored in Liner V-18.

The original radionuclide inventory was obtained from the Sealion Database and it was modeled using the dimensions from a typical HFEF waste container. See Figure 1 for a dimensional drawing of a waste container with a steel shield plug or a lead shield plug. The dose rates at contact (2 inches), 20 feet, 30 feet, 40 feet, 50 feet and 60 feet were calculated for each container (see Appendix B for Microshield output).

The original inventory was then decayed to July 1, 2009 and then modeled using the same dimensions and densities. The dose rates at contact (2 inches), 20 feet, 30 feet, 40 feet, 50 feet and 60 feet were calculated for each container (see Appendix C for Microshield output).

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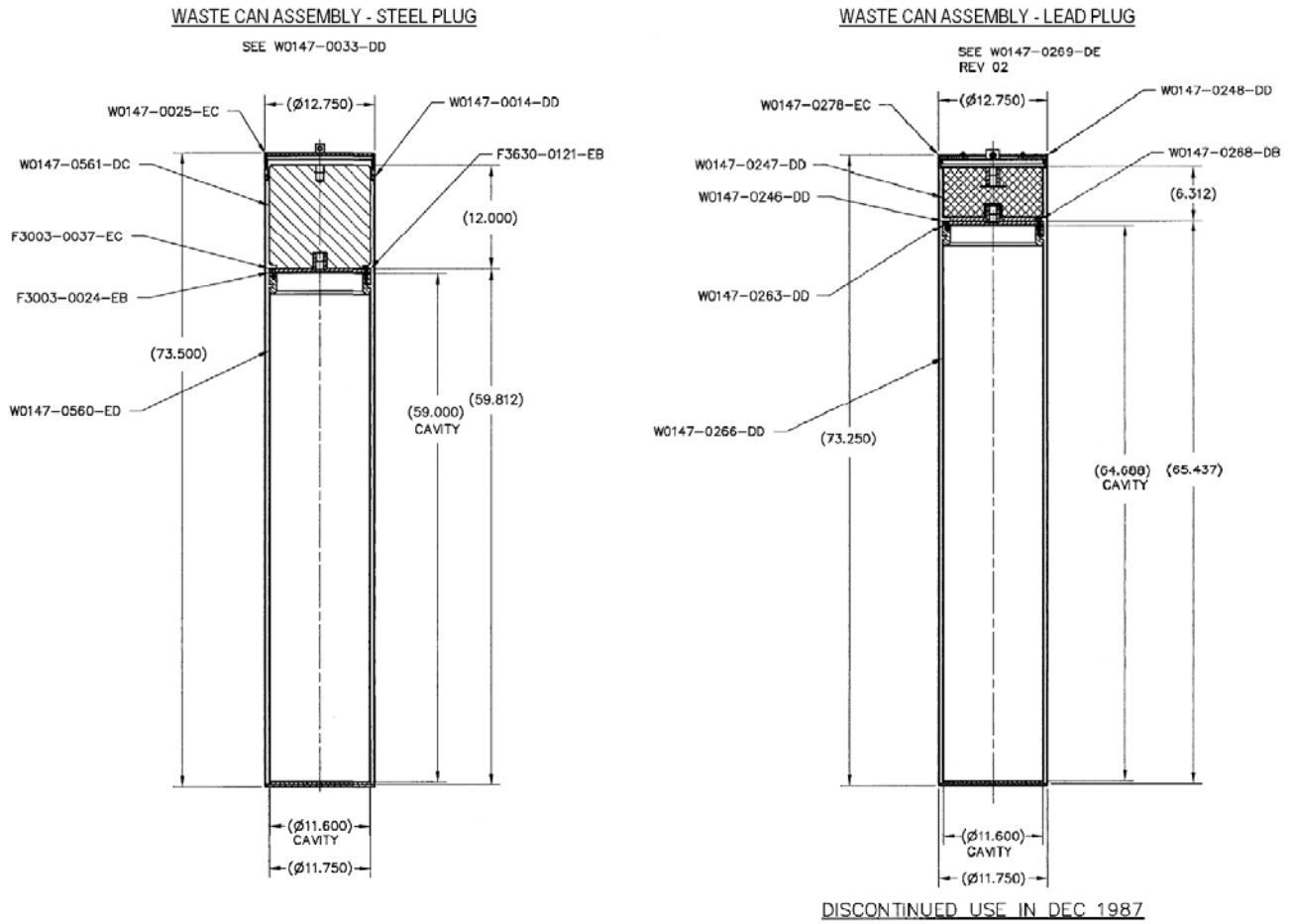


Figure 1 - Typical Waste Can Assemblies

The initial dose rates and the decayed dose rates are summarized in the following tables for each waste container.

Table 2 – Dose Rates for Container SN165, Liner E-33

Distance from Container SN165	Original Dose Rate	Decayed Dose Rate
Contact Reading	22 R/hr	14 R/hr
20 Feet	0.068 R/hr	0.042 R/hr
30 Feet	0.030 R/hr	0.019 R/hr
40 Feet	0.017 R/hr	0.011 R/hr
50 Feet	0.011 R/hr	0.007 R/hr
60 Feet	0.008 R/hr	0.005 R/hr

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Table 3 – Dose Rates for Container N-20, Liner LL-41

Distance from Container N-20	Original Dose Rate	Decayed Dose Rate
Contact Reading	5900 R/hr	6.2 R/hr
20 Feet	20 R/hr	0.021 R/hr
30 Feet	9.0 R/hr	0.009 R/hr
40 Feet	5.0 R/hr	0.005 R/hr
50 Feet	3.2 R/hr	0.003 R/hr
60 Feet	2.2 R/hr	0.002 R/hr

Table 4 – Dose Rates for Container B259, Liner V-18

Distance from Container B259	Original Dose Rate	Decayed Dose Rate
Contact Reading	36000 R/hr	74 R/hr
20 Feet	130 R/hr	0.27 R/hr
30 Feet	58 R/hr	0.12 R/hr
40 Feet	33 R/hr	0.068 R/hr
50 Feet	21 R/hr	0.043 R/hr
60 Feet	14 R/hr	0.030 R/hr

Table 5 – Dose Rates for Container B315, Liner Z-20

Distance from Container B315	Original Dose Rate	Decayed Dose Rate
Contact Reading	22000 R/hr	100 R/hr
20 Feet	86 R/hr	0.38 R/hr
30 Feet	38 R/hr	0.17 R/hr
40 Feet	22 R/hr	0.096 R/hr
50 Feet	14 R/hr	0.061 R/hr
60 Feet	9.4 R/hr	0.042 R/hr

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A comparison was made between the calculated values and the measured values. The Sealion database provides contact dose rates for each of the waste containers. Table 6 below provides the calculated initial contact values, the radiation instrument measured contact values (the measured dose rates occurred at a date later than the initial date) and the calculated contact value decayed to July 1, 2009. A slight discrepancy was noted between the calculated and measured for container SN165 in Liner E-33. The calculated values are slightly higher than the measured values, so the calculated values should bound the actual decayed value.

Table 6 – Summary of Contact Dose Rates (Calculated & Measured) at Various Times

Liner	Container	Initial Contact Values		Measured Contact Value		Decayed Contact Value	
		Date	Rate (R/hr)	Date	Rate (R/hr)	Date	Rate (R/hr)
E-33	SN165	10/26/2004	22	3/16/2005	8.5	7/1/2009	14
LL-41	N-20	7/7/1977	5900	5/14/1992	700*	7/1/2009	6.2
V-18	B259	1/12/1979	36000	7/16/1993	2200	7/1/2009	74
Z-20	B315	5/2/1983	22000	5/18/1993	4500	7/1/2009	100

*Sealion database indicates reading as Max Rad Level during Translocation

Conclusions

The dose rates on the four waste containers have been reduced due to decay. The dose rates on the three containers that were stored in the 1970’s and 1980’s are calculated to have been reduced by several orders of magnitude. Current calculated contact dose rates are about 100 R/hr or less for all the containers.

PE Stamp

None

References

1. Drawing 698848, F3003-0024-EB, TR-H127 Gasket, Fuel Storage Waste Can
2. Drawing 699154, F3003-0037-EC, TR-H127 Lid Fuel Storage Waste Can
3. Drawing 712361, F3630-102-ED-00, RSWF Interim Storage and Waste Containers
4. Drawing 712526, F3630-0121-EB, WBS 1.3.6.3 TR-95 - Screw, Captive (5/16-18 X 1 3/8 Lg) - Storage Waste Cans
5. Drawing 732844, W0147-0246-DD, HFEF/N - Lid - South Inner Waste Can
6. Drawing 732845, W0147-0247-DD, HFEF/N - Shield Plug - Waste Can
7. Drawing 732846, W0147-0248-DD, HFEF/N - Outer Waste Can - Waste Can Assembly
8. Drawing 732855, W0147-0263-DD, HFEF/S - Gasket - South Inner Waste Can

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9. Drawing 732857, W0147-0266-DD, HFEF/S - Can - Can Assembly
10. Drawing 732859, W0147-0268-DB, HFEF-S MP-S389 Screw, Captive - South Inner Waste Can Assembly
11. Drawing 732860, W0147-0269-DE, HFEF/S MP-S389 Waste Can Assembly HFEF/S Waste Transfer Coffin
12. Drawing 732869, W0147-0278-DD, HFEF/S MP-S389 Lid - Waste Can Assembly
13. Drawing 734200, W0147-0560-ED, MFC/HFEF Bldg. 785 Container South Inner Waste Can
14. Drawing 734201, W0147-0561-DC, HFEF/N MP-N2284/N2285 Shield Plug (Steel) Waste Can
15. Drawing 735313, W0147-0014-DD, HFEF/N - Waste Can - Waste Can Assembly
16. Drawing 735324, W0147-0025-DC, HFEF MP-N1125 Cover, Waste Can Waste Can Assembly
17. Drawing 735332, W0147-0033-DD, HFEF/N - Waste Can Assembly
18. Sealion Database, (see PLN-3066, Radioactive Scrap and Waste Facility—Sealion Database and Liner Characterization Stage 1)

Appendices

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Appendix A

Radionuclide Source Term for the Waste Containers

1. Waste Container SN165, Liner E-33

Radionuclide	Initial Activity (Ci)	Decayed Activity (Ci)
Ac-225		1.91E-17
Ac-227		1.91E-15
Am-241	9.58E-03	9.51E-03
At-217		1.91E-17
Ba-137m		2.13E+00
Bi-210		1.07E-16
Bi-211		1.77E-15
Bi-213		1.91E-17
Bi-214		3.07E-15
Ce-144	8.75E-02	1.36E-03
Co-58	1.12E-02	6.07E-10
Co-60	1.76E+00	9.51E-01
Cs-134	2.58E-02	5.35E-03
Cs-137	2.51E+00	2.25E+00
Eu-154	7.03E-03	4.86E-03
Eu-155	2.96E-02	1.54E-02
Fr-221		1.91E-17
Fr-223		2.64E-17
H-3	1.92E-05	1.47E-05
I-129	2.13E-02	2.13E-02
Mn-54	2.64E-02	5.98E-04
Np-237		1.45E-08
Pa-231		3.98E-14
Pa-233		1.41E-08
Pb-209		1.90E-17
Pb-210		1.09E-16
Pb-211		1.77E-15
Pb-214		3.07E-15

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Radionuclide	Initial Activity (Ci)	Decayed Activity (Ci)
Po-210		7.08E-17
Po-211		4.84E-18
Po-213		1.86E-17
Po-214		3.07E-15
Po-215		1.77E-15
Po-218		3.07E-15
Pr-144		1.36E-03
Pr-144m		1.94E-05
Pu-238	1.66E-02	1.60E-02
Pu-239	1.74E-01	1.74E-01
Ra-223		1.77E-15
Ra-225		1.96E-17
Ra-226		3.10E-15
Rh-106	9.16E-03	3.67E-04
Rn-219		1.77E-15
Rn-222		3.07E-15
Ru-106	9.16E-03	3.67E-04
Sb-125	1.77E-02	5.49E-03
Sr-90	3.32E+00	2.96E+00
Te-125m		1.35E-03
Th-227		1.80E-15
Th-229		2.03E-17
Th-230		4.58E-12
Th-231		8.03E-10
Tl-207		1.77E-15
Tl-209		4.12E-19
U-233		1.41E-13
U-234		2.16E-07
U-235	2.31E-12	8.04E-10
Y-90	2.32E+00	2.96E+00

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2. Waste Container N-20, Liner LL-41

Radionuclide	Initial Activity (Ci)	Decayed Activity (Ci)
Ac-227		1.09E-08
Ac-228		2.49E-17
Ba-137m		1.32E+00
Bi-210		4.13E-17
Bi-211		1.09E-08
Bi-212		2.03E-17
Bi-214		2.01E-16
Ce-144	7.61E-01	3.25E-13
Co-58	8.26E+02	1.77E-47
Co-60	2.90E+01	4.32E-01
Cr-51	1.50E+01	1.74E-126
Cs-134	9.89E-02	2.12E-06
Cs-137	2.92E+00	1.40E+00
Eu-154	1.17E-02	9.42E-04
Eu-155	2.41E-01	2.76E-03
Fe-59	6.00E+00	9.61E-79
Fr-223		1.51E-10
Mn-54	9.75E+02	5.53E-09
Pa-231		2.94E-08
Pa-234		5.41E-09
Pa-234m		3.38E-06
Pb-210		4.14E-17
Pb-211		1.09E-08
Pb-212		2.03E-17
Pb-214		2.01E-16
Po-210		3.87E-17
Po-211		2.97E-11
Po-212		1.30E-17
Po-214		2.01E-16
Po-215		1.09E-08
Po-216		2.03E-17

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Radionuclide	Initial Activity (Ci)	Decayed Activity (Ci)
Po-218		2.01E-16
Pr-144		3.25E-13
Pr-144m		4.65E-15
Pu-239	1.12E-01	1.12E-01
Pu-240	5.45E-02	5.43E-02
Ra-223		1.09E-08
Ra-224		2.03E-17
Ra-226		2.01E-16
Ra-228		2.49E-17
Rh-106	3.53E-02	9.93E-12
Rn-219		1.09E-08
Rn-220		2.03E-17
Rn-222		2.01E-16
Ru-106	3.53E-02	9.93E-12
Sb-125	1.28E-02	4.28E-06
Sr-90	3.24E+00	1.49E+00
Te-125m		1.05E-06
Th-227		1.07E-08
Th-228		2.03E-17
Th-230		4.39E-14
Th-231		4.34E-05
Th-232		4.07E-17
Th-234		3.38E-06
Tl-207		1.08E-08
Tl-208		7.28E-18
U-234		3.06E-10
U-235	4.34E-05	4.34E-05
U-236		5.15E-08
U-238	3.38E-06	3.38E-06
Y-90	3.24E+00	1.49E+00

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3. Waste Container B259, Liner V-18

Radionuclide	Initial Activity (Ci)	Decayed Activity (Ci)
Ac-227		6.08E-09
Ac-228		3.69E-18
Ba-137m		4.11E+01
Bi-210		2.95E-15
Bi-211		6.04E-09
Bi-212		2.96E-18
Bi-214		1.49E-14
Ce-144	2.28E+01	3.76E-11
Co-58	9.04E+03	4.38E-44
Co-60	7.30E+01	1.33E+00
Cr-51	1.16E+03	1.41E-118
Cs-134	2.96E+00	1.06E-04
Cs-137	8.74E+01	4.34E+01
Eu-154	3.51E-01	3.18E-02
Eu-155	7.21E+00	1.02E-01
Fe-59	7.50E+01	6.55E-74
Fr-223		8.38E-11
Mn-54	3.99E+03	7.73E-08
Pa-231		1.69E-08
Pa-234		4.66E-07
Pa-234m		2.91E-04
Pb-210		2.96E-15
Pb-211		6.04E-09
Pb-212		2.96E-18
Pb-214		1.49E-14
Po-210		2.76E-15
Po-211		1.65E-11
Po-212		1.90E-18
Po-214		1.49E-14
Po-215		6.04E-09
Po-216		2.96E-18

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Radionuclide	Initial Activity (Ci)	Decayed Activity (Ci)
Po-218		1.50E-14
Pr-144		3.76E-11
Pr-144m		5.38E-13
Pu-239	4.66E-01	4.66E-01
Pu-240	9.08E-03	9.05E-03
Ra-223		6.04E-09
Ra-224		2.96E-18
Ra-226		1.50E-14
Ra-228		3.69E-18
Rh-106	1.05E+00	8.38E-10
Rn-219		6.04E-09
Rn-220		2.96E-18
Rn-222		1.50E-14
Ru-106	1.05E+00	8.38E-10
Sb-125	3.83E-01	1.87E-04
Sr-90	9.69E+01	4.63E+01
Te-125m		4.59E-05
Th-227		5.97E-09
Th-228		2.97E-18
Th-230		3.42E-12
Th-231		2.62E-05
Th-232		6.15E-18
Th-234		2.91E-04
Tl-207		6.02E-09
Tl-208		1.06E-18
U-234		2.51E-08
U-235	2.62E-05	2.62E-05
U-236		8.18E-09
U-238	2.91E-04	2.91E-04
Y-90	9.69E+01	4.63E+01

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4. Waste Container B315, Liner Z-20

Radionuclide	Initial Activity (Ci)	Decayed Activity (Ci)
Ac-227		3.76E-12
Ac-228		2.64E-16
Ba-137m		1.14E+01
Bi-210		1.44E-15
Bi-211		3.71E-12
Bi-212		2.04E-16
Bi-214		8.32E-15
Ce-144	5.50E+01	4.18E-09
Co-58	5.29E+03	1.23E-37
Co-60	4.87E+02	1.56E+01
Cr-51	5.40E+01	7.70E-103
Cs-134	1.10E+01	1.67E-03
Cs-137	2.20E+01	1.21E+01
Fe-59	2.60E+01	8.97E-64
Fr-223		5.19E-14
Mn-54	4.69E+03	2.96E-06
Pa-231		1.65E-11
Pa-234		4.10E-07
Pa-234m		2.56E-04
Pb-210		1.45E-15
Pb-211		3.71E-12
Pb-212		2.04E-16
Pb-214		8.32E-15
Po-210		1.33E-15
Po-211		1.01E-14
Po-212		1.31E-16
Po-214		8.32E-15
Po-215		3.71E-12
Po-216		2.04E-16
Po-218		8.32E-15
Pr-144		4.18E-09

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Radionuclide	Initial Activity (Ci)	Decayed Activity (Ci)
Pr-144m		5.97E-11
Pu-239	2.31E+00	2.31E+00
Pu-240	9.46E-01	9.43E-01
Ra-223		3.71E-12
Ra-224		2.04E-16
Ra-226		8.33E-15
Ra-228		2.64E-16
Rn-219		3.71E-12
Rn-220		2.04E-16
Rn-222		8.32E-15
Sr-90	2.20E+01	1.17E+01
Th-227		3.68E-12
Th-228		2.04E-16
Th-230		2.22E-12
Th-231		5.95E-08
Th-232		4.73E-16
Th-234		2.56E-04
Tl-207		3.70E-12
Tl-208		7.33E-17
U-234		1.89E-08
U-235		5.95E-08
U-236		7.32E-07
U-238	2.56E-04	2.56E-04
Y-90	2.20E+01	1.17E+01

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Title: RSWF REMOTE HANDLED TRANSURANIC WASTE DOSE RATE EVALUATION

Appendix B

Dose Rates from Bare Waste Containers – No Decay

1. Waste Container SN165, Liner E-33

MicroShield 7.02 INL (7.02-0000)			
Date	By	Checked	
Filename		Run Date	Run Time
Waste Container SN165, Liner E-33 - Initial Dose Rates.ms7		May 27, 2009	12:20:57 PM
Duration			
00:00:14			
Project Info			
Case Title	RSWF - RHTRU		
Description	Waste Container SN165, Liner E-33 - Initial Dose Rates		
Geometry	7 - Cylinder Volume - Side Shields		

Source Dimensions			
Height	149.86 cm (4 ft 11.0 in)		
Radius	14.732 cm (5.8 in)		

Dose Points			
A	X	Y	Z
#1	21.273 cm (8.4 in)	74.93 cm (2 ft 5.5 in)	0.0 cm (0.0 in)
#2	625.793 cm (20 ft 6.4 in)	74.93 cm (2 ft 5.5 in)	0.0 cm (0.0 in)
#3	930.593 cm (30 ft 6.4 in)	74.93 cm (2 ft 5.5 in)	0.0 cm (0.0 in)
#4	1.2e+3 cm (40 ft 6.4 in)	74.93 cm (2 ft 5.5 in)	0.0 cm (0.0 in)
#5	1.5e+3 cm (50 ft 6.4 in)	74.93 cm (2 ft 5.5 in)	0.0 cm (0.0 in)
#6	1.8e+3 cm (60 ft 6.4 in)	74.93 cm (2 ft 5.5 in)	0.0 cm (0.0 in)

Shields			
Shield N	Dimension	Material	Density
Source	6235.308 in ³	Iron	0.195
Shield 1	.075 in	Iron	7.86
Shield 2	.425 in	Air	0.00122
Shield 3	.075 in	Iron	7.86
Transition		Air	0.00122
Air Gap		Air	0.00122

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



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Library: Grove					
Nuclide	Ci	Bq	µCi/cm³	Bq/cm³	
Am-241	9.5800e-003	3.5446e+008	9.3758e-002	3.4690e+003	
Ba-137m	2.3745e+000	8.7855e+010	2.3238e+001	8.5982e+005	
Ce-144	8.7500e-002	3.2375e+009	8.5635e-001	3.1685e+004	
Co-58	1.1200e-002	4.1440e+008	1.0961e-001	4.0557e+003	
Co-60	1.7600e+000	6.5120e+010	1.7225e+001	6.3732e+005	
Cs-134	2.5800e-002	9.5460e+008	2.5250e-001	9.3425e+003	
Cs-137	2.5100e+000	9.2870e+010	2.4565e+001	9.0890e+005	
Eu-154	7.0300e-003	2.6011e+008	6.8801e-002	2.5456e+003	
Eu-155	2.9600e-002	1.0952e+009	2.8969e-001	1.0719e+004	
H-3	1.9200e-005	7.1040e+005	1.8791e-004	6.9525e+000	
I-129	2.1300e-002	7.8810e+008	2.0846e-001	7.7130e+003	
Mn-54	2.6400e-002	9.7680e+008	2.5837e-001	9.5598e+003	
Pr-144	8.6249e-002	3.1912e+009	8.4410e-001	3.1232e+004	
Pu-238	1.6600e-002	6.1420e+008	1.6246e-001	6.0111e+003	
Pu-239	1.7400e-001	6.4380e+009	1.7029e+000	6.3007e+004	
Rh-106	9.1600e-003	3.3892e+008	8.9647e-002	3.3169e+003	
Ru-106	9.1600e-003	3.3892e+008	8.9647e-002	3.3169e+003	
Sb-125	1.7700e-002	6.5490e+008	1.7323e-001	6.4094e+003	
Sr-90	3.3200e+000	1.2284e+011	3.2492e+001	1.2022e+006	
U-235	2.3100e-012	8.5470e-002	2.2608e-011	8.3648e-007	
Y-90	2.3200e+000	8.5840e+010	2.2705e+001	8.4010e+005	
Buildup: The material reference is Source Integration Parameters					
Radial				20	
Circumferential				20	
Y Direction (axial)				40	
Results - Dose Point # 1 - (8.375,29.5,0) in					
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	2.034e+09	2.929e-75	1.903e-23	2.512e-76	1.632e-24
0.03	6.049e+09	7.751e-10	8.382e-10	7.682e-12	8.307e-12
0.04	1.850e+09	9.254e-04	1.065e-03	4.093e-06	4.712e-06
0.05	7.802e+07	1.954e-02	2.409e-02	5.205e-05	6.418e-05
0.06	1.467e+08	8.907e-01	1.174e+00	1.769e-03	2.331e-03

ENGINEERING CALCULATIONS AND ANALYSIS REPORT

ECAR No.: 651 ECAR Rev. No.: 0 Project File No.: 0409-C.R-10-000935 Date: 6/10/2009

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0.08	3.918e+08	5.361e+01	7.950e+01	8.483e-02	1.258e-01
0.1	3.364e+08	1.918e+02	3.113e+02	2.934e-01	4.763e-01
0.15	3.513e+08	8.555e+02	1.554e+03	1.409e+00	2.559e+00
0.2	6.747e+07	3.024e+02	5.667e+02	5.337e-01	1.000e+00
0.3	3.069e+06	2.628e+01	4.780e+01	4.984e-02	9.067e-02
0.4	2.069e+08	2.644e+03	4.571e+03	5.151e+00	8.907e+00
0.5	2.759e+08	4.740e+03	7.796e+03	9.305e+00	1.530e+01
0.6	8.056e+10	1.754e+06	2.761e+06	3.423e+03	5.390e+03
0.8	2.393e+09	7.518e+04	1.107e+05	1.430e+02	2.106e+02
1.0	6.523e+10	2.712e+06	3.808e+06	4.999e+03	7.020e+03
1.5	6.526e+10	4.464e+06	5.798e+06	7.511e+03	9.755e+03
2.0	2.470e+07	2.374e+03	2.962e+03	3.671e+00	4.580e+00
Totals	2.253e+11	9.016e+06	1.250e+07	1.610e+04	2.241e+04
Results - Dose Point # 2 - (246.375,29.5,0) in					
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	2.034e+09	2.415e-77	5.458e-26	2.072e-78	4.682e-27
0.03	6.049e+09	9.683e-12	1.047e-11	9.597e-14	1.037e-13
0.04	1.850e+09	8.822e-06	1.015e-05	3.902e-08	4.488e-08
0.05	7.802e+07	1.500e-04	1.846e-04	3.995e-07	4.918e-07
0.06	1.467e+08	5.807e-03	7.620e-03	1.153e-05	1.514e-05
0.08	3.918e+08	2.801e-01	4.109e-01	4.432e-04	6.502e-04
0.1	3.364e+08	8.726e-01	1.389e+00	1.335e-03	2.125e-03
0.15	3.513e+08	3.306e+00	5.763e+00	5.443e-03	9.490e-03
0.2	6.747e+07	1.100e+00	1.946e+00	1.942e-03	3.434e-03
0.3	3.069e+06	9.138e-02	1.547e-01	1.733e-04	2.935e-04
0.4	2.069e+08	9.007e+00	1.444e+01	1.755e-02	2.813e-02
0.5	2.759e+08	1.594e+01	2.430e+01	3.129e-02	4.770e-02
0.6	8.056e+10	5.839e+03	8.538e+03	1.140e+01	1.667e+01
0.8	2.393e+09	2.466e+02	3.392e+02	4.691e-01	6.451e-01
1.0	6.523e+10	8.800e+03	1.160e+04	1.622e+01	2.139e+01
1.5	6.526e+10	1.422e+04	1.750e+04	2.392e+01	2.945e+01
2.0	2.470e+07	7.483e+00	8.897e+00	1.157e-02	1.376e-02
Totals	2.253e+11	2.914e+04	3.804e+04	5.208e+01	6.826e+01
Results - Dose Point # 3 - (366.375,29.5,0) in					
Energy (MeV)	Activity (Photons/sec)	Fluence Rate	Fluence Rate	Exposure Rate	Exposure Rate

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		MeV/cm ² /sec No Buildup	MeV/cm ² /sec With Buildup	mR/hr No Buildup	mR/hr With Buildup
0.015	2.034e+09	7.405e-78	2.474e-26	6.351e-79	2.122e-27
0.03	6.049e+09	3.994e-12	4.319e-12	3.959e-14	4.280e-14
0.04	1.850e+09	3.705e-06	4.263e-06	1.639e-08	1.885e-08
0.05	7.802e+07	6.344e-05	7.813e-05	1.690e-07	2.081e-07
0.06	1.467e+08	2.467e-03	3.242e-03	4.900e-06	6.440e-06
0.08	3.918e+08	1.197e-01	1.762e-01	1.894e-04	2.789e-04
0.1	3.364e+08	3.742e-01	5.996e-01	5.725e-04	9.174e-04
0.15	3.513e+08	1.426e+00	2.523e+00	2.349e-03	4.154e-03
0.2	6.747e+07	4.768e-01	8.599e-01	8.414e-04	1.518e-03
0.3	3.069e+06	3.983e-02	6.899e-02	7.555e-05	1.309e-04
0.4	2.069e+08	3.942e+00	6.462e+00	7.681e-03	1.259e-02
0.5	2.759e+08	6.997e+00	1.090e+01	1.374e-02	2.139e-02
0.6	8.056e+10	2.570e+03	3.833e+03	5.016e+00	7.481e+00
0.8	2.393e+09	1.089e+02	1.524e+02	2.072e-01	2.899e-01
1.0	6.523e+10	3.897e+03	5.218e+03	7.183e+00	9.619e+00
1.5	6.526e+10	6.324e+03	7.879e+03	1.064e+01	1.326e+01
2.0	2.470e+07	3.337e+00	4.007e+00	5.161e-03	6.196e-03
Totals	2.253e+11	1.292e+04	1.711e+04	2.308e+01	3.069e+01

Results - Dose Point # 4 - (486.375,29.5,0) in

Energy (MeV)	Activity (Photons/sec)	Fluence Rate MeV/cm ² /sec No Buildup	Fluence Rate MeV/cm ² /sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.015	2.034e+09	2.558e-78	1.405e-26	2.194e-79	1.205e-27
0.03	6.049e+09	2.028e-12	2.192e-12	2.009e-14	2.173e-14
0.04	1.850e+09	1.935e-06	2.228e-06	8.560e-09	9.853e-09
0.05	7.802e+07	3.351e-05	4.129e-05	8.926e-08	1.100e-07
0.06	1.467e+08	1.311e-03	1.725e-03	2.603e-06	3.426e-06
0.08	3.918e+08	6.399e-02	9.459e-02	1.013e-04	1.497e-04
0.1	3.364e+08	2.009e-01	3.240e-01	3.074e-04	4.957e-04
0.15	3.513e+08	7.706e-01	1.383e+00	1.269e-03	2.277e-03
0.2	6.747e+07	2.587e-01	4.758e-01	4.566e-04	8.398e-04
0.3	3.069e+06	2.174e-02	3.850e-02	4.125e-05	7.303e-05
0.4	2.069e+08	2.161e+00	3.621e+00	4.210e-03	7.055e-03
0.5	2.759e+08	3.848e+00	6.118e+00	7.553e-03	1.201e-02
0.6	8.056e+10	1.416e+03	2.154e+03	2.765e+00	4.205e+00
0.8	2.393e+09	6.026e+01	8.578e+01	1.146e-01	1.632e-01

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1.0	6.523e+10	2.162e+03	2.939e+03	3.984e+00	5.418e+00
1.5	6.526e+10	3.523e+03	4.443e+03	5.928e+00	7.475e+00
2.0	2.470e+07	1.864e+00	2.261e+00	2.883e-03	3.496e-03
Totals	2.253e+11	7.171e+03	9.636e+03	1.281e+01	1.729e+01
Results - Dose Point # 5 - (606.375,29.5,0) in					
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	2.034e+09	9.659e-79	9.044e-27	8.285e-80	7.758e-28
0.03	6.049e+09	1.161e-12	1.255e-12	1.150e-14	1.244e-14
0.04	1.850e+09	1.144e-06	1.317e-06	5.059e-09	5.825e-09
0.05	7.802e+07	2.004e-05	2.471e-05	5.339e-08	6.584e-08
0.06	1.467e+08	7.890e-04	1.040e-03	1.567e-06	2.065e-06
0.08	3.918e+08	3.878e-02	5.754e-02	6.136e-05	9.105e-05
0.1	3.364e+08	1.222e-01	1.984e-01	1.870e-04	3.035e-04
0.15	3.513e+08	4.718e-01	8.585e-01	7.769e-04	1.414e-03
0.2	6.747e+07	1.591e-01	2.983e-01	2.808e-04	5.264e-04
0.3	3.069e+06	1.345e-02	2.433e-02	2.552e-05	4.616e-05
0.4	2.069e+08	1.342e+00	2.298e+00	2.616e-03	4.478e-03
0.5	2.759e+08	2.398e+00	3.891e+00	4.706e-03	7.638e-03
0.6	8.056e+10	8.848e+02	1.372e+03	1.727e+00	2.678e+00
0.8	2.393e+09	3.778e+01	5.469e+01	7.186e-02	1.040e-01
1.0	6.523e+10	1.359e+03	1.876e+03	2.505e+00	3.457e+00
1.5	6.526e+10	2.225e+03	2.839e+03	3.743e+00	4.777e+00
2.0	2.470e+07	1.180e+00	1.445e+00	1.825e-03	2.235e-03
Totals	2.253e+11	4.512e+03	6.150e+03	8.057e+00	1.103e+01
Results - Dose Point # 6 - (726.375,29.5,0) in					
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	2.034e+09	3.890e-79	6.304e-27	3.337e-80	5.407e-28
0.03	6.049e+09	7.181e-13	7.767e-13	7.117e-15	7.697e-15
0.04	1.850e+09	7.318e-07	8.428e-07	3.236e-09	3.727e-09
0.05	7.802e+07	1.298e-05	1.602e-05	3.458e-08	4.267e-08
0.06	1.467e+08	5.143e-04	6.788e-04	1.022e-06	1.348e-06
0.08	3.918e+08	2.545e-02	3.790e-02	4.027e-05	5.997e-05
0.1	3.364e+08	8.055e-02	1.315e-01	1.232e-04	2.013e-04
0.15	3.513e+08	3.128e-01	5.770e-01	5.152e-04	9.501e-04

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0.2	6.747e+07	1.060e-01	2.024e-01	1.870e-04	3.572e-04
0.3	3.069e+06	9.013e-03	1.665e-02	1.710e-05	3.159e-05
0.4	2.069e+08	9.031e-01	1.579e+00	1.760e-03	3.077e-03
0.5	2.759e+08	1.618e+00	2.679e+00	3.176e-03	5.259e-03
0.6	8.056e+10	5.985e+02	9.458e+02	1.168e+00	1.846e+00
0.8	2.393e+09	2.565e+01	3.776e+01	4.879e-02	7.181e-02
1.0	6.523e+10	9.250e+02	1.296e+03	1.705e+00	2.389e+00
1.5	6.526e+10	1.521e+03	1.965e+03	2.559e+00	3.305e+00
2.0	2.470e+07	8.092e-01	1.001e+00	1.251e-03	1.548e-03
Totals	2.253e+11	3.074e+03	4.250e+03	5.488e+00	7.623e+00

2. Waste Container N-20, Liner LL-41

MicroShield 7.02 INL (7.02-0000)			
Date	By	Checked	
Filename		Run Date	Run Time
Waste Container N-20, Liner LL-41 - Initial Dose Rates.ms7		May 27, 2009	12:50:06 PM
Duration			
00:00:14			
Project Info			
Case Title	RSWF - RHTRU		
Description	Waste Container N-20, Liner LL-41 - Initial Dose Rates		
Geometry	7 - Cylinder Volume - Side Shields		

Source Dimensions			
Height	164.308 cm (5 ft 4.7 in)		
Radius	14.732 cm (5.8 in)		
Dose Points			
A	X	Y	Z
#1	21.273 cm (8.4 in)	82.154 cm (2 ft 8.3 in)	0.0 cm (0.0 in)
#2	625.793 cm (20 ft 6.4 in)	82.154 cm (2 ft 8.3 in)	0.0 cm (0.0 in)
#3	930.593 cm (30 ft 6.4 in)	82.154 cm (2 ft 8.3 in)	0.0 cm (0.0 in)
#4	1.2e+3 cm (40 ft 6.4 in)	82.154 cm (2 ft 8.3 in)	0.0 cm (0.0 in)
#5	1.5e+3 cm (50 ft 6.4 in)	82.154 cm (2 ft 8.3 in)	0.0 cm (0.0 in)
#6	1.8e+3 cm (60 ft 6.4 in)	82.154 cm (2 ft 8.3 in)	0.0 cm (0.0 in)
Shields			
Shield N	Dimension	Material	Density



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Source	6836.433 in ³	Iron	0.292
Shield 1	.075 in	Iron	7.86
Shield 2	.425 in	Air	0.00122
Shield 3	.075 in	Iron	7.86
Transition		Air	0.00122
Air Gap		Air	0.00122

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/cm ³	Bq/cm ³
Ba-137m	2.7623e+000	1.0221e+011	2.4657e+001	9.1232e+005
Ce-144	7.6100e-001	2.8157e+010	6.7929e+000	2.5134e+005
Co-58	8.2600e+002	3.0562e+013	7.3731e+003	2.7280e+008
Co-60	2.9000e+001	1.0730e+012	2.5886e+002	9.5779e+006
Cr-51	1.5000e+001	5.5500e+011	1.3389e+002	4.9541e+006
Cs-134	9.8900e-002	3.6593e+009	8.8281e-001	3.2664e+004
Cs-137	2.9200e+000	1.0804e+011	2.6065e+001	9.6439e+005
Eu-154	1.1700e-002	4.3290e+008	1.0444e-001	3.8642e+003
Eu-155	2.4100e-001	8.9170e+009	2.1512e+000	7.9595e+004
Fe-59	6.0000e+000	2.2200e+011	5.3558e+001	1.9816e+006
Mn-54	9.7500e+002	3.6075e+013	8.7031e+003	3.2201e+008
Pr-144	7.5012e-001	2.7754e+010	6.6957e+000	2.4774e+005
Pu-239	1.1200e-001	4.1440e+009	9.9974e-001	3.6990e+004
Pu-240	5.4500e-002	2.0165e+009	4.8648e-001	1.8000e+004
Rh-106	3.5300e-002	1.3061e+009	3.1510e-001	1.1659e+004
Ru-106	3.5300e-002	1.3061e+009	3.1510e-001	1.1659e+004
Sb-125	1.2800e-002	4.7360e+008	1.1426e-001	4.2275e+003
Sr-90	3.2400e+000	1.1988e+011	2.8921e+001	1.0701e+006
U-235	4.3400e-005	1.6058e+006	3.8740e-004	1.4334e+001
U-238	3.3800e-006	1.2506e+005	3.0171e-005	1.1163e+000
Y-90	3.2400e+000	1.1988e+011	2.8921e+001	1.0701e+006
Buildup: The material reference is Source Integration Parameters				
Radial				20
Circumferential				20
Y Direction (axial)				40

ECAR No.: 651 ECAR Rev. No.: 0 Project File No.: 0409-C.R-10-000935 Date: 6/10/2009

Title: RSWF REMOTE HANDLED TRANSURANIC WASTE DOSE RATE EVALUATION

Results - Dose Point # 1 - (8.375,32.344,0) in					
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	1.744e+13	1.567e-71	1.513e-19	1.344e-72	1.297e-20
0.03	6.363e+09	4.962e-10	5.366e-10	4.917e-12	5.318e-12
0.04	5.669e+09	1.728e-03	1.989e-03	7.641e-06	8.796e-06
0.05	5.492e+08	8.377e-02	1.033e-01	2.232e-04	2.752e-04
0.06	1.530e+08	5.672e-01	7.475e-01	1.127e-03	1.485e-03
0.08	3.219e+09	2.793e+02	4.163e+02	4.419e-01	6.587e-01
0.1	2.022e+09	7.762e+02	1.279e+03	1.188e+00	1.957e+00
0.15	5.329e+09	9.591e+03	1.806e+04	1.579e+01	2.973e+01
0.2	6.971e+09	2.398e+04	4.728e+04	4.233e+01	8.345e+01
0.3	5.514e+10	3.742e+05	7.238e+05	7.098e+02	1.373e+03
0.4	1.514e+08	1.558e+03	2.872e+03	3.036e+00	5.595e+00
0.5	9.126e+12	1.277e+08	2.237e+08	2.507e+05	4.390e+05
0.6	9.734e+10	1.740e+06	2.911e+06	3.396e+03	5.682e+03
0.8	6.668e+13	1.742e+09	2.712e+09	3.313e+06	5.158e+06
1.0	1.199e+12	4.183e+07	6.181e+07	7.711e+04	1.139e+05
1.5	1.333e+12	7.775e+07	1.054e+08	1.308e+05	1.773e+05
2.0	2.148e+08	1.776e+04	2.301e+04	2.747e+01	3.558e+01
Totals	9.596e+13	1.991e+09	3.106e+09	3.776e+06	5.896e+06
Results - Dose Point # 2 - (246.375,32.344,0) in					
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	1.744e+13	1.292e-73	4.676e-22	1.108e-74	4.010e-23
0.03	6.363e+09	6.717e-12	7.261e-12	6.657e-14	7.196e-14
0.04	5.669e+09	1.794e-05	2.064e-05	7.935e-08	9.128e-08
0.05	5.492e+08	7.030e-04	8.653e-04	1.873e-06	2.305e-06
0.06	1.530e+08	4.053e-03	5.320e-03	8.050e-06	1.057e-05
0.08	3.219e+09	1.617e+00	2.387e+00	2.558e-03	3.778e-03
0.1	2.022e+09	3.954e+00	6.406e+00	6.049e-03	9.801e-03
0.15	5.329e+09	4.177e+01	7.566e+01	6.878e-02	1.246e-01
0.2	6.971e+09	9.827e+01	1.830e+02	1.735e-01	3.230e-01
0.3	5.514e+10	1.461e+03	2.622e+03	2.772e+00	4.974e+00
0.4	1.514e+08	5.949e+00	1.010e+01	1.159e-02	1.968e-02
0.5	9.126e+12	4.805e+05	7.736e+05	9.431e+02	1.518e+03

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Title: RSWF REMOTE HANDLED TRANSURANIC WASTE DOSE RATE EVALUATION

0.6	9.734e+10	6.472e+03	9.965e+03	1.263e+01	1.945e+01
0.8	6.668e+13	6.369e+06	9.165e+06	1.211e+04	1.743e+04
1.0	1.199e+12	1.510e+05	2.074e+05	2.783e+02	3.823e+02
1.5	1.333e+12	2.744e+05	3.494e+05	4.617e+02	5.879e+02
2.0	2.148e+08	6.189e+01	7.575e+01	9.571e-02	1.171e-01
Totals	9.596e+13	7.283e+06	1.051e+07	1.381e+04	1.995e+04
Results - Dose Point # 3 - (366.375,32.344,0) in					
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	1.744e+13	4.066e-74	2.121e-22	3.487e-75	1.819e-23
0.03	6.363e+09	2.790e-12	3.016e-12	2.765e-14	2.989e-14
0.04	5.669e+09	7.561e-06	8.700e-06	3.344e-08	3.848e-08
0.05	5.492e+08	2.979e-04	3.669e-04	7.936e-07	9.775e-07
0.06	1.530e+08	1.724e-03	2.266e-03	3.424e-06	4.501e-06
0.08	3.219e+09	6.912e-01	1.024e+00	1.094e-03	1.621e-03
0.1	2.022e+09	1.697e+00	2.766e+00	2.596e-03	4.232e-03
0.15	5.329e+09	1.803e+01	3.311e+01	2.969e-02	5.452e-02
0.2	6.971e+09	4.261e+01	8.081e+01	7.520e-02	1.426e-01
0.3	5.514e+10	6.373e+02	1.168e+03	1.209e+00	2.216e+00
0.4	1.514e+08	2.605e+00	4.518e+00	5.076e-03	8.804e-03
0.5	9.126e+12	2.110e+05	3.468e+05	4.143e+02	6.807e+02
0.6	9.734e+10	2.850e+03	4.472e+03	5.563e+00	8.728e+00
0.8	6.668e+13	2.814e+06	4.118e+06	5.353e+03	7.833e+03
1.0	1.199e+12	6.689e+04	9.324e+04	1.233e+02	1.719e+02
1.5	1.333e+12	1.221e+05	1.573e+05	2.055e+02	2.646e+02
2.0	2.148e+08	2.762e+01	3.413e+01	4.271e-02	5.278e-02
Totals	9.596e+13	3.218e+06	4.721e+06	6.103e+03	8.961e+03
Results - Dose Point # 4 - (486.375,32.344,0) in					
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	1.744e+13	1.423e-74	1.205e-22	1.220e-75	1.033e-23
0.03	6.363e+09	1.420e-12	1.535e-12	1.407e-14	1.521e-14
0.04	5.669e+09	3.955e-06	4.552e-06	1.749e-08	2.013e-08
0.05	5.492e+08	1.574e-04	1.940e-04	4.194e-07	5.169e-07
0.06	1.530e+08	9.161e-04	1.206e-03	1.820e-06	2.395e-06
0.08	3.219e+09	3.696e-01	5.498e-01	5.849e-04	8.701e-04

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Title: **RSWF REMOTE HANDLED TRANSURANIC WASTE DOSE RATE EVALUATION**

0.1	2.022e+09	9.110e-01	1.495e+00	1.394e-03	2.287e-03
0.15	5.329e+09	9.743e+00	1.813e+01	1.604e-02	2.986e-02
0.2	6.971e+09	2.312e+01	4.467e+01	4.081e-02	7.884e-02
0.3	5.514e+10	3.480e+02	6.514e+02	6.601e-01	1.236e+00
0.4	1.514e+08	1.428e+00	2.530e+00	2.783e-03	4.930e-03
0.5	9.126e+12	1.161e+05	1.946e+05	2.278e+02	3.820e+02
0.6	9.734e+10	1.571e+03	2.512e+03	3.067e+00	4.904e+00
0.8	6.668e+13	1.557e+06	2.317e+06	2.962e+03	4.406e+03
1.0	1.199e+12	3.711e+04	5.249e+04	6.841e+01	9.675e+01
1.5	1.333e+12	6.805e+04	8.866e+04	1.145e+02	1.492e+02
2.0	2.148e+08	1.543e+01	1.926e+01	2.386e-02	2.978e-02
Totals	9.596e+13	1.780e+06	2.656e+06	3.376e+03	5.040e+03

Results - Dose Point # 5 - (606.375,32.344,0) in

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	1.744e+13	5.408e-75	7.754e-23	4.639e-76	6.651e-24
0.03	6.363e+09	8.136e-13	8.798e-13	8.063e-15	8.719e-15
0.04	5.669e+09	2.339e-06	2.693e-06	1.034e-08	1.191e-08
0.05	5.492e+08	9.421e-05	1.162e-04	2.510e-07	3.095e-07
0.06	1.530e+08	5.515e-04	7.270e-04	1.095e-06	1.444e-06
0.08	3.219e+09	2.240e-01	3.344e-01	3.544e-04	5.291e-04
0.1	2.022e+09	5.543e-01	9.150e-01	8.479e-04	1.400e-03
0.15	5.329e+09	5.966e+00	1.125e+01	9.824e-03	1.852e-02
0.2	6.971e+09	1.422e+01	2.797e+01	2.510e-02	4.936e-02
0.3	5.514e+10	2.153e+02	4.114e+02	4.084e-01	7.804e-01
0.4	1.514e+08	8.873e-01	1.605e+00	1.729e-03	3.127e-03
0.5	9.126e+12	7.233e+04	1.237e+05	1.420e+02	2.428e+02
0.6	9.734e+10	9.815e+02	1.599e+03	1.916e+00	3.121e+00
0.8	6.668e+13	9.764e+05	1.476e+06	1.857e+03	2.808e+03
1.0	1.199e+12	2.333e+04	3.348e+04	4.300e+01	6.171e+01
1.5	1.333e+12	4.297e+04	5.663e+04	7.229e+01	9.527e+01
2.0	2.148e+08	9.769e+00	1.231e+01	1.511e-02	1.904e-02
Totals	9.596e+13	1.116e+06	1.692e+06	2.117e+03	3.212e+03

Results - Dose Point # 6 - (726.375,32.344,0) in

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
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ECAR No.: 651 ECAR Rev. No.: 0 Project File No.: 0409-C.R-10-000935 Date: 6/10/2009

Title: RSWF REMOTE HANDLED TRANSURANIC WASTE DOSE RATE EVALUATION

0.015	1.744e+13	2.187e-75	5.405e-23	1.876e-76	4.636e-24
0.03	6.363e+09	5.037e-13	5.448e-13	4.992e-15	5.399e-15
0.04	5.669e+09	1.496e-06	1.724e-06	6.618e-09	7.623e-09
0.05	5.492e+08	6.103e-05	7.530e-05	1.626e-07	2.006e-07
0.06	1.530e+08	3.595e-04	4.746e-04	7.140e-07	9.427e-07
0.08	3.219e+09	1.470e-01	2.202e-01	2.326e-04	3.485e-04
0.1	2.022e+09	3.652e-01	6.065e-01	5.587e-04	9.279e-04
0.15	5.329e+09	3.956e+00	7.554e+00	6.514e-03	1.244e-02
0.2	6.971e+09	9.470e+00	1.896e+01	1.671e-02	3.345e-02
0.3	5.514e+10	1.443e+02	2.813e+02	2.736e-01	5.335e-01
0.4	1.514e+08	5.970e-01	1.102e+00	1.163e-03	2.146e-03
0.5	9.126e+12	4.881e+04	8.512e+04	9.582e+01	1.671e+02
0.6	9.734e+10	6.640e+02	1.102e+03	1.296e+00	2.150e+00
0.8	6.668e+13	6.629e+05	1.019e+06	1.261e+03	1.937e+03
1.0	1.199e+12	1.588e+04	2.312e+04	2.928e+01	4.262e+01
1.5	1.333e+12	2.938e+04	3.916e+04	4.943e+01	6.589e+01
2.0	2.148e+08	6.698e+00	8.523e+00	1.036e-02	1.318e-02
Totals	9.596e+13	7.578e+05	1.167e+06	1.437e+03	2.216e+03

3. Waste Container B259, Liner V-18

MicroShield 7.02 INL (7.02-0000)				
Date	By	Checked		
Filename		Run Date	Run Time	Duration
Waste Container B259, Liner V-18 - Initial Dose Rates.ms7		May 27, 2009	3:38:47 PM	00:00:14
Project Info				
Case Title	RSWF - RHTRU			
Description	Waste Container B259, Liner V-18 - Initial Dose Rates			
Geometry	7 - Cylinder Volume - Side Shields			

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Title: RSWF REMOTE HANDLED TRANSURANIC WASTE DOSE RATE EVALUATION

Source Dimensions			
Height	164.308 cm (5 ft 4.7 in)		
Radius	14.732 cm (5.8 in)		
Dose Points			
A	X	Y	Z
#1	21.273 cm (8.4 in)	82.154 cm (2 ft 8.3 in)	0.0 cm (0.0 in)
#2	625.793 cm (20 ft 6.4 in)	82.154 cm (2 ft 8.3 in)	0.0 cm (0.0 in)
#3	930.593 cm (30 ft 6.4 in)	82.154 cm (2 ft 8.3 in)	0.0 cm (0.0 in)
#4	1.2e+3 cm (40 ft 6.4 in)	82.154 cm (2 ft 8.3 in)	0.0 cm (0.0 in)
#5	1.5e+3 cm (50 ft 6.4 in)	82.154 cm (2 ft 8.3 in)	0.0 cm (0.0 in)
#6	1.8e+3 cm (60 ft 6.4 in)	82.154 cm (2 ft 8.3 in)	0.0 cm (0.0 in)
Shields			
Shield N	Dimension	Material	Density
Source	1.12e+05 cm ³	Iron	0.675
Shield 1	.191 cm	Iron	7.86
Shield 2	1.08 cm	Air	0.00122
Shield 3	.191 cm	Iron	7.86
Transition		Air	0.00122
Air Gap		Air	0.00122



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/cm ³	Bq/cm ³
Ba-137m	8.2680e+001	3.0592e+012	7.3803e+002	2.7307e+007
Ce-144	2.2800e+001	8.4360e+011	2.0352e+002	7.5302e+006
Co-58	9.0400e+003	3.3448e+014	8.0693e+004	2.9857e+009
Co-60	7.3000e+001	2.7010e+012	6.5162e+002	2.4110e+007
Cr-51	1.1600e+003	4.2920e+013	1.0354e+004	3.8311e+008
Cs-134	2.9600e+000	1.0952e+011	2.6422e+001	9.7760e+005
Cs-137	8.7400e+001	3.2338e+012	7.8015e+002	2.8866e+007
Eu-154	3.5100e-001	1.2987e+010	3.1331e+000	1.1593e+005
Eu-155	7.2100e+000	2.6677e+011	6.4358e+001	2.3813e+006
Fe-59	7.5000e+001	2.7750e+012	6.6947e+002	2.4770e+007
Mn-54	3.9900e+003	1.4763e+014	3.5616e+004	1.3178e+009
Pr-144	2.2474e+001	8.3154e+011	2.0061e+002	7.4225e+006

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Title: RSWF REMOTE HANDLED TRANSURANIC WASTE DOSE RATE EVALUATION

Pu-239	4.6600e-001	1.7242e+010	4.1596e+000	1.5391e+005	
Pu-240	9.0800e-003	3.3596e+008	8.1050e-002	2.9989e+003	
Rh-106	1.0500e+000	3.8850e+010	9.3726e+000	3.4678e+005	
Ru-106	1.0500e+000	3.8850e+010	9.3726e+000	3.4678e+005	
Sb-125	3.8300e-001	1.4171e+010	3.4188e+000	1.2649e+005	
Sr-90	9.6900e+001	3.5853e+012	8.6495e+002	3.2003e+007	
U-235	2.6200e-005	9.6940e+005	2.3387e-004	8.6531e+000	
U-238	2.9100e-004	1.0767e+007	2.5975e-003	9.6109e+001	
Y-90	9.6900e+001	3.5853e+012	8.6495e+002	3.2003e+007	
Buildup: The material reference is Source Integration Parameters					
Radial				20	
Circumferential				20	
Y Direction (axial)				40	
Results - Dose Point # 1 - (21.2725,82.15376,0) cm					
Energy (MeV)	Activity (Photons/sec)	Fluence Rate MeV/cm ² /sec No Buildup	Fluence Rate MeV/cm ² /sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.015	1.363e+14	3.839e-71	1.182e-18	3.293e-72	1.014e-19
0.03	1.905e+11	6.398e-09	6.919e-09	6.341e-11	6.857e-11
0.04	1.697e+11	2.241e-02	2.579e-02	9.909e-05	1.141e-04
0.05	1.640e+10	1.082e+00	1.334e+00	2.882e-03	3.554e-03
0.06	4.578e+09	7.345e+00	9.679e+00	1.459e-02	1.923e-02
0.08	9.632e+10	3.670e+03	5.485e+03	5.808e+00	8.680e+00
0.1	6.045e+10	1.075e+04	1.798e+04	1.644e+01	2.751e+01
0.15	1.197e+11	1.155e+05	2.319e+05	1.902e+02	3.820e+02
0.2	8.827e+10	1.765e+05	3.863e+05	3.115e+02	6.817e+02
0.3	4.226e+12	1.800e+07	4.011e+07	3.414e+04	7.608e+04
0.4	4.530e+09	3.048e+04	6.555e+04	5.939e+01	1.277e+02
0.5	9.989e+13	9.406e+08	1.927e+09	1.846e+06	3.783e+06
0.6	2.909e+12	3.578e+07	6.989e+07	6.984e+04	1.364e+05
0.8	4.827e+14	8.983e+09	1.620e+10	1.709e+07	3.081e+07
1.0	4.279e+12	1.092e+08	1.850e+08	2.013e+05	3.411e+05
1.5	5.707e+12	2.546e+08	3.879e+08	4.284e+05	6.527e+05
2.0	6.436e+09	4.185e+05	6.018e+05	6.471e+02	9.307e+02
Totals	7.368e+14	1.034e+10	1.881e+10	1.967e+07	3.580e+07
Results - Dose Point # 2 - (625.7925,82.15376,0) cm					

ECAR No.: 651 ECAR Rev. No.: 0 Project File No.: 0409-C.R-10-000935 Date: 6/10/2009

Title: RSWF REMOTE HANDLED TRANSURANIC WASTE DOSE RATE EVALUATION

Energy (MeV)	Activity (Photons/sec)	Fluence Rate MeV/cm ² /sec No Buildup	Fluence Rate MeV/cm ² /sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.015	1.363e+14	3.157e-73	3.655e-21	2.708e-74	3.135e-22
0.03	1.905e+11	8.700e-11	9.405e-11	8.622e-13	9.321e-13
0.04	1.697e+11	2.326e-04	2.676e-04	1.029e-06	1.183e-06
0.05	1.640e+10	9.096e-03	1.120e-02	2.423e-05	2.983e-05
0.06	4.578e+09	5.262e-02	6.908e-02	1.045e-04	1.372e-04
0.08	9.632e+10	2.146e+01	3.180e+01	3.395e-02	5.032e-02
0.1	6.045e+10	5.613e+01	9.280e+01	8.587e-02	1.420e-01
0.15	1.197e+11	5.308e+02	1.039e+03	8.741e-01	1.711e+00
0.2	8.827e+10	7.707e+02	1.617e+03	1.360e+00	2.854e+00
0.3	4.226e+12	7.526e+04	1.575e+05	1.428e+02	2.987e+02
0.4	4.530e+09	1.247e+02	2.491e+02	2.430e-01	4.853e-01
0.5	9.989e+13	3.791e+06	7.174e+06	7.441e+03	1.408e+04
0.6	2.909e+12	1.425e+05	2.565e+05	2.781e+02	5.007e+02
0.8	4.827e+14	3.510e+07	5.830e+07	6.676e+04	1.109e+05
1.0	4.279e+12	4.203e+05	6.575e+05	7.747e+02	1.212e+03
1.5	5.707e+12	9.539e+05	1.352e+06	1.605e+03	2.274e+03
2.0	6.436e+09	1.542e+03	2.074e+03	2.385e+00	3.207e+00
Totals	7.368e+14	4.048e+07	6.790e+07	7.700e+04	1.293e+05
Results - Dose Point # 3 - (930.5925,82.15376,0) cm					
Energy (MeV)	Activity (Photons/sec)	Fluence Rate MeV/cm ² /sec No Buildup	Fluence Rate MeV/cm ² /sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.015	1.363e+14	9.944e-74	1.658e-21	8.529e-75	1.422e-22
0.03	1.905e+11	3.613e-11	3.906e-11	3.581e-13	3.871e-13
0.04	1.697e+11	9.799e-05	1.128e-04	4.334e-07	4.987e-07
0.05	1.640e+10	3.853e-03	4.746e-03	1.026e-05	1.264e-05
0.06	4.578e+09	2.236e-02	2.940e-02	4.442e-05	5.839e-05
0.08	9.632e+10	9.160e+00	1.362e+01	1.449e-02	2.156e-02
0.1	6.045e+10	2.405e+01	4.001e+01	3.679e-02	6.120e-02
0.15	1.197e+11	2.289e+02	4.537e+02	3.770e-01	7.472e-01
0.2	8.827e+10	3.339e+02	7.122e+02	5.893e-01	1.257e+00
0.3	4.226e+12	3.280e+04	6.994e+04	6.223e+01	1.327e+02
0.4	4.530e+09	5.459e+01	1.111e+02	1.064e-01	2.165e-01
0.5	9.989e+13	1.664e+06	3.208e+06	3.267e+03	6.296e+03
0.6	2.909e+12	6.271e+04	1.149e+05	1.224e+02	2.242e+02

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Title: **RSWF REMOTE HANDLED TRANSURANIC WASTE DOSE RATE EVALUATION**

0.8	4.827e+14	1.550e+07	2.615e+07	2.949e+04	4.973e+04
1.0	4.279e+12	1.862e+05	2.952e+05	3.432e+02	5.441e+02
1.5	5.707e+12	4.244e+05	6.078e+05	7.140e+02	1.023e+03
2.0	6.436e+09	6.879e+02	9.335e+02	1.064e+00	1.444e+00
Totals	7.368e+14	1.788e+07	3.044e+07	3.400e+04	5.796e+04
Results - Dose Point # 4 - (1.24e+03,82.15376,0) 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	1.363e+14	3.481e-74	9.416e-22	2.986e-75	8.076e-23
0.03	1.905e+11	1.839e-11	1.988e-11	1.822e-13	1.970e-13
0.04	1.697e+11	5.124e-05	5.899e-05	2.266e-07	2.609e-07
0.05	1.640e+10	2.036e-03	2.509e-03	5.423e-06	6.683e-06
0.06	4.578e+09	1.188e-02	1.564e-02	2.360e-05	3.106e-05
0.08	9.632e+10	4.895e+00	7.308e+00	7.746e-03	1.156e-02
0.1	6.045e+10	1.290e+01	2.159e+01	1.974e-02	3.304e-02
0.15	1.197e+11	1.236e+02	2.480e+02	2.036e-01	4.085e-01
0.2	8.827e+10	1.811e+02	3.926e+02	3.197e-01	6.930e-01
0.3	4.226e+12	1.791e+04	3.889e+04	3.396e+01	7.377e+01
0.4	4.530e+09	2.992e+01	6.204e+01	5.830e-02	1.209e-01
0.5	9.989e+13	9.151e+05	1.795e+06	1.796e+03	3.524e+03
0.6	2.909e+12	3.457e+04	6.439e+04	6.747e+01	1.257e+02
0.8	4.827e+14	8.577e+06	1.468e+07	1.631e+04	2.793e+04
1.0	4.279e+12	1.033e+05	1.659e+05	1.903e+02	3.059e+02
1.5	5.707e+12	2.364e+05	3.422e+05	3.978e+02	5.758e+02
2.0	6.436e+09	3.843e+02	5.261e+02	5.943e-01	8.136e-01
Totals	7.368e+14	9.885e+06	1.709e+07	1.880e+04	3.254e+04
Results - Dose Point # 5 - (1.54e+03,82.15376,0) 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	1.363e+14	1.324e-74	6.061e-22	1.135e-75	5.199e-23
0.03	1.905e+11	1.054e-11	1.139e-11	1.044e-13	1.129e-13
0.04	1.697e+11	3.030e-05	3.489e-05	1.340e-07	1.543e-07
0.05	1.640e+10	1.218e-03	1.502e-03	3.244e-06	4.001e-06
0.06	4.578e+09	7.149e-03	9.426e-03	1.420e-05	1.872e-05
0.08	9.632e+10	2.965e+00	4.442e+00	4.692e-03	7.029e-03
0.1	6.045e+10	7.846e+00	1.321e+01	1.200e-02	2.021e-02

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Title: RSWF REMOTE HANDLED TRANSURANIC WASTE DOSE RATE EVALUATION

0.15	1.197e+11	7.568e+01	1.536e+02	1.246e-01	2.530e-01
0.2	8.827e+10	1.114e+02	2.452e+02	1.965e-01	4.328e-01
0.3	4.226e+12	1.108e+04	2.449e+04	2.101e+01	4.646e+01
0.4	4.530e+09	1.858e+01	3.925e+01	3.621e-02	7.647e-02
0.5	9.989e+13	5.702e+05	1.139e+06	1.119e+03	2.235e+03
0.6	2.909e+12	2.159e+04	4.089e+04	4.214e+01	7.981e+01
0.8	4.827e+14	5.377e+06	9.342e+06	1.023e+04	1.777e+04
1.0	4.279e+12	6.491e+04	1.057e+05	1.196e+02	1.948e+02
1.5	5.707e+12	1.493e+05	2.183e+05	2.512e+02	3.674e+02
2.0	6.436e+09	2.433e+02	3.360e+02	3.762e-01	5.196e-01
Totals	7.368e+14	6.194e+06	1.087e+07	1.178e+04	2.069e+04
Results - Dose Point # 6 - (1.84e+03,82.15376,0) 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	1.363e+14	5.352e-75	4.225e-22	4.591e-76	3.624e-23
0.03	1.905e+11	6.523e-12	7.055e-12	6.465e-14	6.992e-14
0.04	1.697e+11	1.939e-05	2.233e-05	8.575e-08	9.876e-08
0.05	1.640e+10	7.889e-04	9.734e-04	2.102e-06	2.593e-06
0.06	4.578e+09	4.660e-03	6.152e-03	9.256e-06	1.222e-05
0.08	9.632e+10	1.945e+00	2.924e+00	3.078e-03	4.628e-03
0.1	6.045e+10	5.168e+00	8.751e+00	7.907e-03	1.339e-02
0.15	1.197e+11	5.017e+01	1.030e+02	8.262e-02	1.697e-01
0.2	8.827e+10	7.415e+01	1.658e+02	1.309e-01	2.927e-01
0.3	4.226e+12	7.420e+03	1.670e+04	1.407e+01	3.169e+01
0.4	4.530e+09	1.250e+01	2.688e+01	2.436e-02	5.237e-02
0.5	9.989e+13	3.848e+05	7.816e+05	7.552e+02	1.534e+03
0.6	2.909e+12	1.460e+04	2.812e+04	2.851e+01	5.488e+01
0.8	4.827e+14	3.650e+06	6.436e+06	6.943e+03	1.224e+04
1.0	4.279e+12	4.419e+04	7.290e+04	8.145e+01	1.344e+02
1.5	5.707e+12	1.021e+05	1.508e+05	1.717e+02	2.538e+02
2.0	6.436e+09	1.668e+02	2.324e+02	2.580e-01	3.594e-01
Totals	7.368e+14	4.204e+06	7.487e+06	7.995e+03	1.425e+04

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Title: RSWF REMOTE HANDLED TRANSURANIC WASTE DOSE RATE EVALUATION

4. Waste Container B315, Liner Z-20

MicroShield 7.02 INL (7.02-0000)				
Date		By		Checked
Filename			Run Date	Run Time
Waste Container B315, Liner Z-20 - Initial Dose Rates.ms7			May 27, 2009	3:32:58 PM
Duration				
00:00:14				
Project Info				
Case Title		RSWF - RHTRU		
Description		Waste Container B315, Liner Z-20 - Initial Dose Rates		
Geometry		7 - Cylinder Volume - Side Shields		

Source Dimensions			
Height	164.308 cm (5 ft 4.7 in)		
Radius	14.732 cm (5.8 in)		
Dose Points			
A	X	Y	Z
#1	21.273 cm (8.4 in)	82.154 cm (2 ft 8.3 in)	0.0 cm (0.0 in)
#2	625.793 cm (20 ft 6.4 in)	82.154 cm (2 ft 8.3 in)	0.0 cm (0.0 in)
#3	930.593 cm (30 ft 6.4 in)	82.154 cm (2 ft 8.3 in)	0.0 cm (0.0 in)
#4	1.2e+3 cm (40 ft 6.4 in)	82.154 cm (2 ft 8.3 in)	0.0 cm (0.0 in)
#5	1.5e+3 cm (50 ft 6.4 in)	82.154 cm (2 ft 8.3 in)	0.0 cm (0.0 in)
#6	1.8e+3 cm (60 ft 6.4 in)	82.154 cm (2 ft 8.3 in)	0.0 cm (0.0 in)
Shields			
Shield N	Dimension	Material	Density
Source	1.12e+05 cm ³	Iron	1.26
Shield 1	.191 cm	Iron	7.86
Shield 2	1.08 cm	Air	0.00122
Shield 3	.191 cm	Iron	7.86
Transition		Air	0.00122
Air Gap		Air	0.00122

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

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Title: **RSWF REMOTE HANDLED TRANSURANIC WASTE DOSE RATE EVALUATION**

Ba-137m	2.0812e+001	7.7004e+011	1.8577e+002	6.8736e+006	
Ce-144	5.5000e+001	2.0350e+012	4.9094e+002	1.8165e+007	
Co-58	5.2900e+003	1.9573e+014	4.7220e+004	1.7471e+009	
Co-60	4.8700e+002	1.8019e+013	4.3471e+003	1.6084e+008	
Cr-51	5.4000e+001	1.9980e+012	4.8202e+002	1.7835e+007	
Cs-134	1.1000e+001	4.0700e+011	9.8189e+001	3.6330e+006	
Cs-137	2.2000e+001	8.1400e+011	1.9638e+002	7.2660e+006	
Fe-59	2.6000e+001	9.6200e+011	2.3208e+002	8.5871e+006	
Mn-54	4.6900e+003	1.7353e+014	4.1864e+004	1.5490e+009	
Pr-144	5.4214e+001	2.0059e+012	4.8392e+002	1.7905e+007	
Pu-239	2.3100e+000	8.5470e+010	2.0620e+001	7.6293e+005	
Pu-240	9.4600e-001	3.5002e+010	8.4442e+000	3.1244e+005	
Sr-90	2.2000e+001	8.1400e+011	1.9638e+002	7.2660e+006	
U-238	2.5600e-004	9.4720e+006	2.2851e-003	8.4549e+001	
Y-90	2.2000e+001	8.1400e+011	1.9638e+002	7.2660e+006	
Buildup: The material reference is Source Integration Parameters					
Radial				20	
Circumferential				20	
Y Direction (axial)				40	
Results - Dose Point # 1 - (21.2725,82.15376,0) cm					
Energy (MeV)	Activity (Photons/sec)	Fluence Rate MeV/cm ² /sec No Buildup	Fluence Rate MeV/cm ² /sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.015	9.673e+13	5.087e-72	8.389e-19	4.364e-73	7.196e-20
0.03	5.360e+10	9.623e-10	1.041e-09	9.537e-12	1.031e-11
0.04	1.933e+11	1.368e-02	1.575e-02	6.051e-05	6.966e-05
0.05	1.836e+07	6.490e-04	8.003e-04	1.729e-06	2.132e-06
0.06	2.697e+09	2.318e+00	3.055e+00	4.604e-03	6.067e-03
0.08	3.253e+10	6.642e+02	9.929e+02	1.051e+00	1.571e+00
0.1	4.067e+07	3.892e+00	6.526e+00	5.955e-03	9.984e-03
0.15	2.297e+11	1.236e+05	2.538e+05	2.036e+02	4.179e+02
0.2	2.992e+10	3.460e+04	7.962e+04	6.107e+01	1.405e+02
0.3	1.990e+11	5.127e+05	1.247e+06	9.726e+02	2.365e+03
0.5	5.845e+13	3.501e+08	8.049e+08	6.873e+05	1.580e+06
0.6	1.220e+12	9.716e+06	2.139e+07	1.897e+04	4.175e+04
0.8	3.699e+14	4.591e+09	9.349e+09	8.732e+06	1.778e+07

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Title: **RSWF REMOTE HANDLED TRANSURANIC WASTE DOSE RATE EVALUATION**

1.0	1.858e+13	3.237e+08	6.183e+08	5.968e+05	1.140e+06
1.5	1.950e+13	6.210e+08	1.057e+09	1.045e+06	1.778e+06
2.0	1.553e+10	7.410e+05	1.181e+06	1.146e+03	1.826e+03
Totals	5.652e+14	5.897e+09	1.185e+10	1.108e+07	2.233e+07
Results - Dose Point # 2 - (625.7925,82.15376,0) 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	9.673e+13	4.176e-74	2.593e-21	3.582e-75	2.224e-22
0.03	5.360e+10	1.311e-11	1.418e-11	1.300e-13	1.405e-13
0.04	1.933e+11	1.420e-04	1.633e-04	6.278e-07	7.222e-07
0.05	1.836e+07	5.460e-06	6.721e-06	1.454e-08	1.790e-08
0.06	2.697e+09	1.662e-02	2.182e-02	3.302e-05	4.334e-05
0.08	3.253e+10	3.892e+00	5.770e+00	6.159e-03	9.131e-03
0.1	4.067e+07	2.043e-02	3.386e-02	3.125e-05	5.181e-05
0.15	2.297e+11	5.785e+02	1.167e+03	9.526e-01	1.921e+00
0.2	2.992e+10	1.554e+02	3.483e+02	2.743e-01	6.147e-01
0.3	1.990e+11	2.229e+03	5.200e+03	4.229e+00	9.865e+00
0.5	5.845e+13	1.480e+06	3.209e+06	2.905e+03	6.299e+03
0.6	1.220e+12	4.068e+04	8.411e+04	7.941e+01	1.642e+02
0.8	3.699e+14	1.892e+07	3.603e+07	3.598e+04	6.854e+04
1.0	1.858e+13	1.316e+06	2.349e+06	2.426e+03	4.329e+03
1.5	1.950e+13	2.461e+06	3.916e+06	4.141e+03	6.589e+03
2.0	1.553e+10	2.888e+03	4.313e+03	4.466e+00	6.670e+00
Totals	5.652e+14	2.422e+07	4.560e+07	4.554e+04	8.594e+04
Results - Dose Point # 3 - (930.5925,82.15376,0) 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	9.673e+13	1.317e-74	1.176e-21	1.130e-75	1.009e-22
0.03	5.360e+10	5.446e-12	5.888e-12	5.398e-14	5.836e-14
0.04	1.933e+11	5.980e-05	6.881e-05	2.645e-07	3.043e-07
0.05	1.836e+07	2.312e-06	2.848e-06	6.160e-09	7.587e-09
0.06	2.697e+09	7.062e-03	9.284e-03	1.403e-05	1.844e-05
0.08	3.253e+10	1.660e+00	2.470e+00	2.628e-03	3.909e-03
0.1	4.067e+07	8.744e-03	1.458e-02	1.338e-05	2.231e-05
0.15	2.297e+11	2.492e+02	5.086e+02	4.104e-01	8.375e-01
0.2	2.992e+10	6.727e+01	1.531e+02	1.187e-01	2.702e-01

ENGINEERING CALCULATIONS AND ANALYSIS REPORT

ECAR No.: 651 ECAR Rev. No.: 0 Project File No.: 0409-C.R-10-000935 Date: 6/10/2009

Title: RSWF REMOTE HANDLED TRANSURANIC WASTE DOSE RATE EVALUATION

0.3	1.990e+11	9.709e+02	2.305e+03	1.842e+00	4.373e+00
0.5	5.845e+13	6.494e+05	1.432e+06	1.275e+03	2.810e+03
0.6	1.220e+12	1.790e+04	3.759e+04	3.493e+01	7.337e+01
0.8	3.699e+14	8.353e+06	1.613e+07	1.589e+04	3.069e+04
1.0	1.858e+13	5.828e+05	1.053e+06	1.074e+03	1.941e+03
1.5	1.950e+13	1.095e+06	1.759e+06	1.842e+03	2.960e+03
2.0	1.553e+10	1.288e+03	1.940e+03	1.992e+00	2.999e+00
Totals	5.652e+14	1.070e+07	2.042e+07	2.012e+04	3.848e+04

Results - Dose Point # 4 - (1.24e+03,82.15376,0) cm

Energy (MeV)	Activity (Photons/sec)	Fluence Rate MeV/cm ² /sec No Buildup	Fluence Rate MeV/cm ² /sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.015	9.673e+13	4.615e-75	6.681e-22	3.958e-76	5.731e-23
0.03	5.360e+10	2.771e-12	2.997e-12	2.747e-14	2.970e-14
0.04	1.933e+11	3.127e-05	3.600e-05	1.383e-07	1.592e-07
0.05	1.836e+07	1.222e-06	1.506e-06	3.254e-09	4.011e-09
0.06	2.697e+09	3.751e-03	4.938e-03	7.450e-06	9.808e-06
0.08	3.253e+10	8.871e-01	1.325e+00	1.404e-03	2.096e-03
0.1	4.067e+07	4.689e-03	7.867e-03	7.174e-06	1.204e-05
0.15	2.297e+11	1.345e+02	2.778e+02	2.215e-01	4.574e-01
0.2	2.992e+10	3.648e+01	8.427e+01	6.438e-02	1.487e-01
0.3	1.990e+11	5.297e+02	1.279e+03	1.005e+00	2.427e+00
0.5	5.845e+13	3.569e+05	7.999e+05	7.006e+02	1.570e+03
0.6	1.220e+12	9.860e+03	2.103e+04	1.925e+01	4.105e+01
0.8	3.699e+14	4.619e+06	9.046e+06	8.786e+03	1.721e+04
1.0	1.858e+13	3.232e+05	5.911e+05	5.957e+02	1.089e+03
1.5	1.950e+13	6.097e+05	9.894e+05	1.026e+03	1.665e+03
2.0	1.553e+10	7.193e+02	1.092e+03	1.112e+00	1.689e+00
Totals	5.652e+14	5.920e+06	1.145e+07	1.113e+04	2.158e+04

Results - Dose Point # 5 - (1.54e+03,82.15376,0) cm

Energy (MeV)	Activity (Photons/sec)	Fluence Rate MeV/cm ² /sec No Buildup	Fluence Rate MeV/cm ² /sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.015	9.673e+13	1.755e-75	4.301e-22	1.506e-76	3.689e-23
0.03	5.360e+10	1.588e-12	1.717e-12	1.574e-14	1.702e-14
0.04	1.933e+11	1.849e-05	2.129e-05	8.178e-08	9.416e-08
0.05	1.836e+07	7.308e-07	9.012e-07	1.947e-09	2.401e-09
0.06	2.697e+09	2.257e-03	2.976e-03	4.483e-06	5.911e-06

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0.08	3.253e+10	5.372e-01	8.050e-01	8.501e-04	1.274e-03
0.1	4.067e+07	2.851e-03	4.811e-03	4.361e-06	7.360e-06
0.15	2.297e+11	8.231e+01	1.719e+02	1.355e-01	2.831e-01
0.2	2.992e+10	2.242e+01	5.257e+01	3.957e-02	9.278e-02
0.3	1.990e+11	3.276e+02	8.044e+02	6.213e-01	1.526e+00
0.5	5.845e+13	2.223e+05	5.063e+05	4.364e+02	9.938e+02
0.6	1.220e+12	6.157e+03	1.333e+04	1.202e+01	2.603e+01
0.8	3.699e+14	2.895e+06	5.747e+06	5.507e+03	1.093e+04
1.0	1.858e+13	2.031e+05	3.760e+05	3.744e+02	6.930e+02
1.5	1.950e+13	3.849e+05	6.306e+05	6.476e+02	1.061e+03
2.0	1.553e+10	4.553e+02	6.970e+02	7.041e-01	1.078e+00
Totals	5.652e+14	3.712e+06	7.275e+06	6.979e+03	1.371e+04
Results - Dose Point # 6 - (1.84e+03,82.15376,0) 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	9.673e+13	7.099e-76	2.998e-22	6.089e-77	2.571e-23
0.03	5.360e+10	9.832e-13	1.063e-12	9.744e-15	1.054e-14
0.04	1.933e+11	1.183e-05	1.363e-05	5.233e-08	6.027e-08
0.05	1.836e+07	4.734e-07	5.841e-07	1.261e-09	1.556e-09
0.06	2.697e+09	1.471e-03	1.942e-03	2.922e-06	3.857e-06
0.08	3.253e+10	3.524e-01	5.299e-01	5.576e-04	8.385e-04
0.1	4.067e+07	1.877e-03	3.186e-03	2.872e-06	4.875e-06
0.15	2.297e+11	5.455e+01	1.152e+02	8.983e-02	1.897e-01
0.2	2.992e+10	1.492e+01	3.551e+01	2.634e-02	6.267e-02
0.3	1.990e+11	2.194e+02	5.477e+02	4.162e-01	1.039e+00
0.5	5.845e+13	1.500e+05	3.470e+05	2.944e+02	6.811e+02
0.6	1.220e+12	4.164e+03	9.153e+03	8.128e+00	1.787e+01
0.8	3.699e+14	1.965e+06	3.953e+06	3.738e+03	7.519e+03
1.0	1.858e+13	1.382e+05	2.590e+05	2.548e+02	4.774e+02
1.5	1.950e+13	2.631e+05	4.352e+05	4.427e+02	7.323e+02
2.0	1.553e+10	3.122e+02	4.817e+02	4.827e-01	7.449e-01
Totals	5.652e+14	2.521e+06	5.005e+06	4.739e+03	9.430e+03

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Appendix C

Dose Rates from Bare Waste Containers – Decayed to July 1, 2009

1. Waste Container SN165, Liner E-33 – Decayed to July 1, 2009 (1709 Days)

MicroShield 7.02 INL (7.02-0000)			
Date	By	Checked	
Filename		Run Date	Run Time
Waste Container SN165, Liner E-33 - Decayed 1709 Days.ms7		May 27, 2009	12:28:28 PM
Duration			
00:00:16			
Project Info			
Case Title	RSWF - RHTRU		
Description	Waste Container SN165, Liner E-33 - Decayed 1709 Days		
Geometry	7 - Cylinder Volume - Side Shields		

Source Dimensions	
Height	149.86 cm (4 ft 11.0 in)
Radius	14.732 cm (5.8 in)

Dose Points			
A	X	Y	Z
#1	21.273 cm (8.4 in)	74.93 cm (2 ft 5.5 in)	0.0 cm (0.0 in)
#2	625.793 cm (20 ft 6.4 in)	74.93 cm (2 ft 5.5 in)	0.0 cm (0.0 in)
#3	930.593 cm (30 ft 6.4 in)	74.93 cm (2 ft 5.5 in)	0.0 cm (0.0 in)
#4	1.2e+3 cm (40 ft 6.4 in)	74.93 cm (2 ft 5.5 in)	0.0 cm (0.0 in)
#5	1.5e+3 cm (50 ft 6.4 in)	74.93 cm (2 ft 5.5 in)	0.0 cm (0.0 in)
#6	1.8e+3 cm (60 ft 6.4 in)	74.93 cm (2 ft 5.5 in)	0.0 cm (0.0 in)



Shields			
Shield N	Dimension	Material	Density
Source	6235.308 in ³	Iron	0.195
Shield 1	.075 in	Iron	7.86
Shield 2	.425 in	Air	0.00122
Shield 3	.075 in	Iron	7.86
Transition		Air	0.00122
Air Gap		Air	0.00122

Source Input: Grouping Method - Standard Indices

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Number of Groups: 25 Lower Energy Cutoff: 0.015 Photons < 0.015: Included Library: Grove				
Nuclide	Ci	Bq	µCi/cm ³	Bq/cm ³
Ac-225	1.9057e-017	7.0511e-007	1.8651e-016	6.9008e-012
Ac-227	1.9105e-015	7.0687e-005	1.8697e-014	6.9180e-010
Am-241	9.5084e-003	3.5181e+008	9.3057e-002	3.4431e+003
At-217	1.9057e-017	7.0509e-007	1.8650e-016	6.9006e-012
Ba-137m	2.1325e+000	7.8901e+010	2.0870e+001	7.7219e+005
Bi-210	1.0676e-016	3.9502e-006	1.0449e-015	3.8660e-011
Bi-211	1.7730e-015	6.5603e-005	1.7352e-014	6.4204e-010
Bi-213	1.9055e-017	7.0504e-007	1.8649e-016	6.9001e-012
Bi-214	3.0723e-015	1.1367e-004	3.0068e-014	1.1125e-009
Ce-144	1.3566e-003	5.0193e+007	1.3276e-002	4.9123e+002
Co-58	6.0650e-010	2.2440e+001	5.9357e-009	2.1962e-004
Co-60	9.5125e-001	3.5196e+010	9.3097e+000	3.4446e+005
Cs-134	5.3523e-003	1.9803e+008	5.2382e-002	1.9381e+003
Cs-137	2.2542e+000	8.3405e+010	2.2061e+001	8.1626e+005
Eu-154	4.8629e-003	1.7993e+008	4.7592e-002	1.7609e+003
Eu-155	1.5393e-002	5.6953e+008	1.5065e-001	5.5739e+003
Fr-221	1.9057e-017	7.0510e-007	1.8650e-016	6.9007e-012
Fr-223	2.6363e-017	9.7545e-007	2.5801e-016	9.5465e-012
H-3	1.4744e-005	5.4551e+005	1.4429e-004	5.3388e+000
I-129	2.1300e-002	7.8810e+008	2.0846e-001	7.7130e+003
Mn-54	5.9756e-004	2.2110e+007	5.8482e-003	2.1638e+002
Np-237	1.4464e-008	5.3518e+002	1.4156e-007	5.2377e-003
Pa-231	3.9844e-014	1.4742e-003	3.8995e-013	1.4428e-008
Pa-233	1.4136e-008	5.2303e+002	1.3835e-007	5.1188e-003
Pb-209	1.9048e-017	7.0479e-007	1.8642e-016	6.8976e-012
Pb-210	1.0857e-016	4.0169e-006	1.0625e-015	3.9313e-011
Pb-211	1.7731e-015	6.5603e-005	1.7352e-014	6.4204e-010
Pb-214	3.0724e-015	1.1368e-004	3.0069e-014	1.1125e-009
Po-210	7.0755e-017	2.6180e-006	6.9247e-016	2.5621e-011
Po-211	4.8404e-018	1.7910e-007	4.7372e-017	1.7528e-012
Po-213	1.8643e-017	6.8981e-007	1.8246e-016	6.7510e-012
Po-214	3.0716e-015	1.1365e-004	3.0062e-014	1.1123e-009
Po-215	1.7732e-015	6.5607e-005	1.7354e-014	6.4209e-010

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Po-218	3.0731e-015	1.1371e-004	3.0076e-014	1.1128e-009	
Pr-144	1.3566e-003	5.0195e+007	1.3277e-002	4.9124e+002	
Pr-144m	1.9399e-005	7.1777e+005	1.8986e-004	7.0247e+000	
Pu-238	1.5998e-002	5.9191e+008	1.5657e-001	5.7929e+003	
Pu-239	1.7398e-001	6.4371e+009	1.7027e+000	6.2999e+004	
Ra-223	1.7732e-015	6.5607e-005	1.7354e-014	6.4209e-010	
Ra-225	1.9561e-017	7.2375e-007	1.9144e-016	7.0832e-012	
Ra-226	3.1029e-015	1.1481e-004	3.0368e-014	1.1236e-009	
Rh-106	3.6700e-004	1.3579e+007	3.5918e-003	1.3289e+002	
Rn-219	1.7732e-015	6.5607e-005	1.7354e-014	6.4209e-010	
Rn-222	3.0732e-015	1.1371e-004	3.0076e-014	1.1128e-009	
Ru-106	3.6700e-004	1.3579e+007	3.5917e-003	1.3289e+002	
Sb-125	5.4889e-003	2.0309e+008	5.3719e-002	1.9876e+003	
Sr-90	2.9641e+000	1.0967e+011	2.9009e+001	1.0733e+006	
Te-125m	1.3450e-003	4.9766e+007	1.3164e-002	4.8705e+002	
Th-227	1.7987e-015	6.6553e-005	1.7604e-014	6.5134e-010	
Th-229	2.0319e-017	7.5182e-007	1.9886e-016	7.3579e-012	
Th-230	4.5806e-012	1.6948e-001	4.4829e-011	1.6587e-006	
Th-231	8.0336e-010	2.9724e+001	7.8623e-009	2.9091e-004	
Tl-207	1.7682e-015	6.5423e-005	1.7305e-014	6.4028e-010	
Tl-209	4.1159e-019	1.5229e-008	4.0281e-018	1.4904e-013	
U-233	1.4095e-013	5.2153e-003	1.3795e-012	5.1041e-008	
U-234	2.1617e-007	7.9984e+003	2.1156e-006	7.8279e-002	
U-235	8.0408e-010	2.9751e+001	7.8693e-009	2.9117e-004	
Y-90	2.9648e+000	1.0970e+011	2.9016e+001	1.0736e+006	
Buildup: The material reference is Source Integration Parameters					
Radial				20	
Circumferential				20	
Y Direction (axial)				40	
Results - Dose Point # 1 - (8.375,29.5,0) in					
Energy (MeV)	Activity (Photons/sec)	Fluence Rate MeV/cm ² /sec No Buildup	Fluence Rate MeV/cm ² /sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.015	1.470e+09	2.117e-75	1.376e-23	1.816e-76	1.180e-24
0.02	5.300e-06	1.557e-48	7.796e-38	5.394e-50	2.700e-39
0.03	5.360e+09	6.868e-10	7.427e-10	6.807e-12	7.361e-12

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0.04	1.313e+09	6.565e-04	7.557e-04	2.903e-06	3.342e-06
0.05	4.288e+07	1.074e-02	1.324e-02	2.861e-05	3.527e-05
0.06	1.347e+08	8.178e-01	1.078e+00	1.624e-03	2.140e-03
0.08	1.777e+08	2.430e+01	3.605e+01	3.846e-02	5.704e-02
0.1	1.943e+08	1.107e+02	1.798e+02	1.694e-01	2.751e-01
0.15	5.931e+06	1.444e+01	2.624e+01	2.378e-02	4.320e-02
0.2	2.770e+07	1.242e+02	2.327e+02	2.191e-01	4.106e-01
0.3	9.174e+05	7.854e+00	1.429e+01	1.490e-02	2.710e-02
0.4	6.487e+07	8.289e+02	1.433e+03	1.615e+00	2.793e+00
0.5	2.710e+07	4.658e+02	7.660e+02	9.142e-01	1.504e+00
0.6	7.133e+10	1.553e+06	2.445e+06	3.031e+03	4.772e+03
0.8	2.787e+08	8.757e+03	1.290e+04	1.666e+01	2.453e+01
1.0	3.526e+10	1.466e+06	2.058e+06	2.702e+03	3.794e+03
1.5	3.527e+10	2.413e+06	3.134e+06	4.059e+03	5.272e+03
2.0	3.885e+05	3.734e+01	4.658e+01	5.775e-02	7.204e-02
Totals	1.510e+11	5.442e+06	7.652e+06	9.812e+03	1.387e+04
Results - Dose Point # 2 - (246.375,29.5,0) in					
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	1.470e+09	1.746e-77	3.945e-26	1.497e-78	3.384e-27
0.02	5.300e-06	2.219e-50	2.236e-40	7.686e-52	7.745e-42
0.03	5.360e+09	8.580e-12	9.275e-12	8.503e-14	9.192e-14
0.04	1.313e+09	6.258e-06	7.199e-06	2.768e-08	3.184e-08
0.05	4.288e+07	8.243e-05	1.015e-04	2.196e-07	2.703e-07
0.06	1.347e+08	5.332e-03	6.997e-03	1.059e-05	1.390e-05
0.08	1.777e+08	1.270e-01	1.863e-01	2.009e-04	2.948e-04
0.1	1.943e+08	5.039e-01	8.022e-01	7.709e-04	1.227e-03
0.15	5.931e+06	5.580e-02	9.728e-02	9.189e-05	1.602e-04
0.2	2.770e+07	4.518e-01	7.989e-01	7.974e-04	1.410e-03
0.3	9.174e+05	2.731e-02	4.625e-02	5.181e-05	8.773e-05
0.4	6.487e+07	2.824e+00	4.526e+00	5.502e-03	8.819e-03
0.5	2.710e+07	1.566e+00	2.388e+00	3.074e-03	4.686e-03
0.6	7.133e+10	5.170e+03	7.560e+03	1.009e+01	1.476e+01
0.8	2.787e+08	2.873e+01	3.951e+01	5.464e-02	7.514e-02
1.0	3.526e+10	4.756e+03	6.272e+03	8.767e+00	1.156e+01
1.5	3.527e+10	7.685e+03	9.460e+03	1.293e+01	1.592e+01

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2.0	3.885e+05	1.177e-01	1.399e-01	1.820e-04	2.164e-04
Totals	1.510e+11	1.765e+04	2.334e+04	3.185e+01	4.232e+01
Results - Dose Point # 3 - (366.375,29.5,0) in					
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	1.470e+09	5.352e-78	1.788e-26	4.590e-79	1.534e-27
0.02	5.300e-06	8.397e-51	1.014e-40	2.909e-52	3.511e-42
0.03	5.360e+09	3.539e-12	3.827e-12	3.508e-14	3.792e-14
0.04	1.313e+09	2.628e-06	3.024e-06	1.162e-08	1.338e-08
0.05	4.288e+07	3.487e-05	4.294e-05	9.288e-08	1.144e-07
0.06	1.347e+08	2.265e-03	2.977e-03	4.499e-06	5.912e-06
0.08	1.777e+08	5.425e-02	7.990e-02	8.586e-05	1.264e-04
0.1	1.943e+08	2.161e-01	3.463e-01	3.306e-04	5.297e-04
0.15	5.931e+06	2.408e-02	4.259e-02	3.965e-05	7.013e-05
0.2	2.770e+07	1.957e-01	3.531e-01	3.455e-04	6.231e-04
0.3	9.174e+05	1.190e-02	2.062e-02	2.258e-05	3.911e-05
0.4	6.487e+07	1.236e+00	2.026e+00	2.408e-03	3.948e-03
0.5	2.710e+07	6.875e-01	1.071e+00	1.350e-03	2.101e-03
0.6	7.133e+10	2.275e+03	3.394e+03	4.441e+00	6.624e+00
0.8	2.787e+08	1.269e+01	1.775e+01	2.413e-02	3.377e-02
1.0	3.526e+10	2.106e+03	2.820e+03	3.882e+00	5.199e+00
1.5	3.527e+10	3.418e+03	4.258e+03	5.751e+00	7.164e+00
2.0	3.885e+05	5.249e-02	6.302e-02	8.117e-05	9.746e-05
Totals	1.510e+11	7.815e+03	1.049e+04	1.410e+01	1.903e+01
Results - Dose Point # 4 - (486.375,29.5,0) in					
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	1.470e+09	1.849e-78	1.016e-26	1.586e-79	8.711e-28
0.02	5.300e-06	3.765e-51	5.756e-41	1.304e-52	1.994e-42
0.03	5.360e+09	1.797e-12	1.943e-12	1.780e-14	1.925e-14
0.04	1.313e+09	1.373e-06	1.580e-06	6.072e-09	6.990e-09
0.05	4.288e+07	1.842e-05	2.269e-05	4.906e-08	6.046e-08
0.06	1.347e+08	1.203e-03	1.584e-03	2.390e-06	3.146e-06
0.08	1.777e+08	2.901e-02	4.289e-02	4.591e-05	6.787e-05
0.1	1.943e+08	1.160e-01	1.871e-01	1.775e-04	2.863e-04
0.15	5.931e+06	1.301e-02	2.334e-02	2.142e-05	3.844e-05

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0.2	2.770e+07	1.062e-01	1.954e-01	1.875e-04	3.448e-04
0.3	9.174e+05	6.499e-03	1.151e-02	1.233e-05	2.183e-05
0.4	6.487e+07	6.775e-01	1.135e+00	1.320e-03	2.212e-03
0.5	2.710e+07	3.780e-01	6.011e-01	7.421e-04	1.180e-03
0.6	7.133e+10	1.254e+03	1.907e+03	2.448e+00	3.723e+00
0.8	2.787e+08	7.019e+00	9.991e+00	1.335e-02	1.900e-02
1.0	3.526e+10	1.168e+03	1.589e+03	2.153e+00	2.928e+00
1.5	3.527e+10	1.904e+03	2.401e+03	3.204e+00	4.040e+00
2.0	3.885e+05	2.932e-02	3.556e-02	4.534e-05	5.499e-05
Totals	1.510e+11	4.335e+03	5.909e+03	7.821e+00	1.071e+01
Results - Dose Point # 5 - (606.375,29.5,0) in					
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	1.470e+09	6.981e-79	6.537e-27	5.988e-80	5.607e-28
0.02	5.300e-06	1.881e-51	3.705e-41	6.514e-53	1.283e-42
0.03	5.360e+09	1.028e-12	1.112e-12	1.019e-14	1.102e-14
0.04	1.313e+09	8.115e-07	9.343e-07	3.589e-09	4.132e-09
0.05	4.288e+07	1.102e-05	1.358e-05	2.935e-08	3.619e-08
0.06	1.347e+08	7.244e-04	9.547e-04	1.439e-06	1.896e-06
0.08	1.777e+08	1.758e-02	2.609e-02	2.782e-05	4.128e-05
0.1	1.943e+08	7.059e-02	1.146e-01	1.080e-04	1.753e-04
0.15	5.931e+06	7.965e-03	1.449e-02	1.312e-05	2.387e-05
0.2	2.770e+07	6.532e-02	1.225e-01	1.153e-04	2.161e-04
0.3	9.174e+05	4.021e-03	7.273e-03	7.627e-06	1.380e-05
0.4	6.487e+07	4.209e-01	7.206e-01	8.201e-04	1.404e-03
0.5	2.710e+07	2.356e-01	3.823e-01	4.624e-04	7.505e-04
0.6	7.133e+10	7.834e+02	1.215e+03	1.529e+00	2.371e+00
0.8	2.787e+08	4.401e+00	6.370e+00	8.370e-03	1.212e-02
1.0	3.526e+10	7.344e+02	1.014e+03	1.354e+00	1.869e+00
1.5	3.527e+10	1.202e+03	1.534e+03	2.023e+00	2.582e+00
2.0	3.885e+05	1.856e-02	2.273e-02	2.871e-05	3.516e-05
Totals	1.510e+11	2.725e+03	3.771e+03	4.916e+00	6.836e+00
Results - Dose Point # 6 - (726.375,29.5,0) in					
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	1.470e+09	2.812e-79	4.556e-27	2.412e-80	3.908e-28

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0.02	5.300e-06	1.010e-51	2.582e-41	3.500e-53	8.945e-43
0.03	5.360e+09	6.363e-13	6.882e-13	6.306e-15	6.820e-15
0.04	1.313e+09	5.191e-07	5.979e-07	2.296e-09	2.644e-09
0.05	4.288e+07	7.135e-06	8.804e-06	1.901e-08	2.345e-08
0.06	1.347e+08	4.722e-04	6.232e-04	9.379e-07	1.238e-06
0.08	1.777e+08	1.154e-02	1.718e-02	1.826e-05	2.719e-05
0.1	1.943e+08	4.651e-02	7.597e-02	7.116e-05	1.162e-04
0.15	5.931e+06	5.282e-03	9.741e-03	8.697e-06	1.604e-05
0.2	2.770e+07	4.350e-02	8.309e-02	7.678e-05	1.467e-04
0.3	9.174e+05	2.694e-03	4.978e-03	5.110e-06	9.442e-06
0.4	6.487e+07	2.832e-01	4.951e-01	5.517e-04	9.646e-04
0.5	2.710e+07	1.590e-01	2.632e-01	3.121e-04	5.167e-04
0.6	7.133e+10	5.300e+02	8.374e+02	1.034e+00	1.635e+00
0.8	2.787e+08	2.988e+00	4.398e+00	5.683e-03	8.365e-03
1.0	3.526e+10	4.999e+02	7.004e+02	9.216e-01	1.291e+00
1.5	3.527e+10	8.221e+02	1.062e+03	1.383e+00	1.786e+00
2.0	3.885e+05	1.273e-02	1.574e-02	1.968e-05	2.434e-05
Totals	1.510e+11	1.856e+03	2.605e+03	3.346e+00	4.722e+00

2. Waste Container N-20, Liner LL-41 – Decayed to July 1, 2009 (11682 Days)

MicroShield 7.02 INL (7.02-0000)					
Date		By		Checked	
Filename			Run Date	Run Time	Duration
Waste Container N-20, Liner LL-41 - Decayed 11682 Days.ms7			May 27, 2009	1:05:39 PM	00:00:16
Project Info					
Case Title	RSWF - RHTRU				
Description	Waste Container N-20, Liner LL-41 - Decayed 11682 Days				
Geometry	7 - Cylinder Volume - Side Shields				

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Source Dimensions			
Height	164.308 cm (5 ft 4.7 in)		
Radius	14.732 cm (5.8 in)		
Dose Points			
A	X	Y	Z
#1	21.273 cm (8.4 in)	82.154 cm (2 ft 8.3 in)	0.0 cm (0.0 in)
#2	625.793 cm (20 ft 6.4 in)	82.154 cm (2 ft 8.3 in)	0.0 cm (0.0 in)
#3	930.593 cm (30 ft 6.4 in)	82.154 cm (2 ft 8.3 in)	0.0 cm (0.0 in)
#4	1.2e+3 cm (40 ft 6.4 in)	82.154 cm (2 ft 8.3 in)	0.0 cm (0.0 in)
#5	1.5e+3 cm (50 ft 6.4 in)	82.154 cm (2 ft 8.3 in)	0.0 cm (0.0 in)
#6	1.8e+3 cm (60 ft 6.4 in)	82.154 cm (2 ft 8.3 in)	0.0 cm (0.0 in)
Shields			
Shield N	Dimension	Material	Density
Source	6836.433 in ³	Iron	0.292
Shield 1	.075 in	Iron	7.86
Shield 2	.425 in	Air	0.00122
Shield 3	.075 in	Iron	7.86
Transition		Air	0.00122
Air Gap		Air	0.00122



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/cm ³	Bq/cm ³
Ac-227	1.0940e-008	4.0479e+002	9.7655e-008	3.6132e-003
Ac-228	2.4928e-017	9.2233e-007	2.2251e-016	8.2329e-012
Ba-137m	1.3248e+000	4.9017e+010	1.1825e+001	4.3754e+005
Bi-210	4.1307e-017	1.5284e-006	3.6872e-016	1.3643e-011
Bi-211	1.0871e-008	4.0223e+002	9.7037e-008	3.5904e-003
Bi-212	2.0251e-017	7.4929e-007	1.8077e-016	6.6884e-012
Bi-214	2.0092e-016	7.4339e-006	1.7934e-015	6.6357e-011
Ce-144	3.2504e-013	1.2027e-002	2.9014e-012	1.0735e-007
Co-58	1.7662e-047	6.5348e-037	1.5765e-046	5.8331e-042
Co-60	4.3231e-001	1.5996e+010	3.8589e+000	1.4278e+005
Cr-51	1.7385e-126	6.4326e-116	1.5519e-125	5.7419e-121
Cs-134	2.1180e-006	7.8368e+004	1.8906e-005	6.9953e-001

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Cs-137	1.4004e+000	5.1815e+010	1.2500e+001	4.6252e+005
Eu-154	9.4209e-004	3.4857e+007	8.4094e-003	3.1115e+002
Eu-155	2.7598e-003	1.0211e+008	2.4635e-002	9.1150e+002
Fe-59	9.6137e-079	3.5571e-068	8.5815e-078	3.1751e-073
Fr-223	1.5097e-010	5.5860e+000	1.3476e-009	4.9862e-005
Mn-54	5.5332e-009	2.0473e+002	4.9391e-008	1.8275e-003
Pa-231	2.9357e-008	1.0862e+003	2.6205e-007	9.6958e-003
Pa-234	5.4080e-009	2.0010e+002	4.8273e-008	1.7861e-003
Pa-234m	3.3800e-006	1.2506e+005	3.0171e-005	1.1163e+000
Pb-210	4.1406e-017	1.5320e-006	3.6960e-016	1.3675e-011
Pb-211	1.0871e-008	4.0223e+002	9.7037e-008	3.5904e-003
Pb-212	2.0251e-017	7.4930e-007	1.8077e-016	6.6885e-012
Pb-214	2.0092e-016	7.4340e-006	1.7934e-015	6.6357e-011
Po-210	3.8723e-017	1.4328e-006	3.4565e-016	1.2789e-011
Po-211	2.9678e-011	1.0981e+000	2.6491e-010	9.8017e-006
Po-212	1.2975e-017	4.8007e-007	1.1582e-016	4.2852e-012
Po-214	2.0087e-016	7.4324e-006	1.7931e-015	6.6343e-011
Po-215	1.0871e-008	4.0223e+002	9.7038e-008	3.5904e-003
Po-216	2.0254e-017	7.4941e-007	1.8080e-016	6.6894e-012
Po-218	2.0096e-016	7.4355e-006	1.7938e-015	6.6371e-011
Pr-144	3.2506e-013	1.2027e-002	2.9015e-012	1.0736e-007
Pr-144m	4.6482e-015	1.7198e-004	4.1491e-014	1.5352e-009
Pu-239	1.1190e-001	4.1402e+009	9.9882e-001	3.6956e+004
Pu-240	5.4316e-002	2.0097e+009	4.8484e-001	1.7939e+004
Ra-223	1.0871e-008	4.0223e+002	9.7038e-008	3.5904e-003
Ra-224	2.0254e-017	7.4941e-007	1.8080e-016	6.6894e-012
Ra-226	2.0124e-016	7.4460e-006	1.7964e-015	6.6465e-011
Ra-228	2.4930e-017	9.2240e-007	2.2253e-016	8.2336e-012
Rh-106	9.9289e-012	3.6737e-001	8.8628e-011	3.2792e-006
Rn-219	1.0871e-008	4.0223e+002	9.7038e-008	3.5904e-003
Rn-220	2.0254e-017	7.4941e-007	1.8080e-016	6.6894e-012
Rn-222	2.0096e-016	7.4355e-006	1.7938e-015	6.6371e-011
Ru-106	9.9289e-012	3.6737e-001	8.8627e-011	3.2792e-006
Sb-125	4.2795e-006	1.5834e+005	3.8200e-005	1.4134e+000
Sr-90	1.4925e+000	5.5221e+010	1.3322e+001	4.9292e+005
Te-125m	1.0487e-006	3.8801e+004	9.3608e-006	3.4635e-001

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Th-227	1.0746e-008	3.9762e+002	9.5926e-008	3.5493e-003	
Th-228	2.0278e-017	7.5030e-007	1.8101e-016	6.6974e-012	
Th-230	4.3851e-014	1.6225e-003	3.9143e-013	1.4483e-008	
Th-231	4.3404e-005	1.6059e+006	3.8743e-004	1.4335e+001	
Th-232	4.0664e-017	1.5046e-006	3.6298e-016	1.3430e-011	
Th-234	3.3800e-006	1.2506e+005	3.0171e-005	1.1163e+000	
Tl-207	1.0841e-008	4.0113e+002	9.6772e-008	3.5806e-003	
Tl-208	7.2762e-018	2.6922e-007	6.4949e-017	2.4031e-012	
U-234	3.0555e-010	1.1305e+001	2.7274e-009	1.0091e-004	
U-235	4.3404e-005	1.6059e+006	3.8743e-004	1.4335e+001	
U-236	5.1514e-008	1.9060e+003	4.5982e-007	1.7013e-002	
U-238	3.3800e-006	1.2506e+005	3.0171e-005	1.1163e+000	
Y-90	1.4928e+000	5.5235e+010	1.3325e+001	4.9304e+005	
Buildup: The material reference is Source Integration Parameters					
Radial				20	
Circumferential				20	
Y Direction (axial)				40	
Results - Dose Point # 1 - (8.375,32.344,0) in					
Energy (MeV)	Activity (Photons/sec)	Fluence Rate MeV/cm ² /sec No Buildup	Fluence Rate MeV/cm ² /sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.015	9.254e+08	8.314e-76	8.026e-24	7.131e-77	6.885e-25
0.02	4.639e+00	8.240e-43	6.325e-32	2.854e-44	2.191e-33
0.03	2.888e+09	2.252e-10	2.435e-10	2.232e-12	2.413e-12
0.04	7.070e+08	2.155e-04	2.480e-04	9.529e-07	1.097e-06
0.05	8.877e+06	1.354e-03	1.670e-03	3.607e-06	4.448e-06
0.06	1.337e+06	4.957e-03	6.533e-03	9.846e-06	1.298e-05
0.08	3.190e+07	2.767e+00	4.125e+00	4.379e-03	6.527e-03
0.1	3.736e+07	1.434e+01	2.363e+01	2.194e-02	3.616e-02
0.15	2.506e+05	4.510e-01	8.491e-01	7.427e-04	1.398e-03
0.2	3.384e+06	1.164e+01	2.295e+01	2.055e-02	4.051e-02
0.3	9.987e+02	6.777e-03	1.311e-02	1.286e-05	2.487e-05
0.4	2.984e+05	3.071e+00	5.661e+00	5.984e-03	1.103e-02
0.5	9.303e+04	1.302e+00	2.280e+00	2.556e-03	4.475e-03
0.6	4.411e+10	7.885e+05	1.319e+06	1.539e+03	2.575e+03
0.8	1.367e+07	3.570e+02	5.558e+02	6.791e-01	1.057e+00

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1.0	1.601e+10	5.585e+05	8.253e+05	1.030e+03	1.521e+03
1.5	1.601e+10	9.335e+05	1.265e+06	1.571e+03	2.129e+03
2.0	3.613e+00	2.987e-04	3.869e-04	4.620e-07	5.982e-07
3.0	2.687e-07	3.558e-11	4.379e-11	4.827e-14	5.940e-14
Totals	8.074e+10	2.281e+06	3.410e+06	4.140e+03	6.226e+03
Results - Dose Point # 2 - (246.375,32.344,0) in					
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	9.254e+08	6.855e-78	2.481e-26	5.879e-79	2.128e-27
0.02	4.639e+00	1.254e-44	1.955e-34	4.345e-46	6.772e-36
0.03	2.888e+09	3.048e-12	3.295e-12	3.021e-14	3.266e-14
0.04	7.070e+08	2.237e-06	2.574e-06	9.895e-09	1.138e-08
0.05	8.877e+06	1.136e-05	1.399e-05	3.027e-08	3.726e-08
0.06	1.337e+06	3.542e-05	4.650e-05	7.035e-08	9.236e-08
0.08	3.190e+07	1.602e-02	2.366e-02	2.535e-05	3.743e-05
0.1	3.736e+07	7.307e-02	1.184e-01	1.118e-04	1.811e-04
0.15	2.506e+05	1.964e-03	3.558e-03	3.235e-06	5.859e-06
0.2	3.384e+06	4.770e-02	8.882e-02	8.419e-05	1.568e-04
0.3	9.987e+02	2.647e-05	4.749e-05	5.021e-08	9.009e-08
0.4	2.984e+05	1.173e-02	1.991e-02	2.285e-05	3.879e-05
0.5	9.303e+04	4.898e-03	7.886e-03	9.614e-06	1.548e-05
0.6	4.411e+10	2.933e+03	4.516e+03	5.725e+00	8.815e+00
0.8	1.367e+07	1.305e+00	1.879e+00	2.483e-03	3.573e-03
1.0	1.601e+10	2.016e+03	2.769e+03	3.715e+00	5.103e+00
1.5	1.601e+10	3.295e+03	4.195e+03	5.543e+00	7.058e+00
2.0	3.613e+00	1.041e-06	1.274e-06	1.609e-09	1.970e-09
3.0	2.687e-07	1.223e-13	1.433e-13	1.659e-16	1.944e-16
Totals	8.074e+10	8.245e+03	1.148e+04	1.499e+01	2.098e+01
Results - Dose Point # 3 - (366.375,32.344,0) in					
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	9.254e+08	2.158e-78	1.125e-26	1.851e-79	9.652e-28
0.02	4.639e+00	4.828e-45	8.868e-35	1.672e-46	3.072e-36
0.03	2.888e+09	1.266e-12	1.369e-12	1.255e-14	1.357e-14
0.04	7.070e+08	9.429e-07	1.085e-06	4.170e-09	4.799e-09
0.05	8.877e+06	4.816e-06	5.931e-06	1.283e-08	1.580e-08

ENGINEERING CALCULATIONS AND ANALYSIS REPORT

ECAR No.: 651 ECAR Rev. No.: 0 Project File No.: 0409-C.R-10-000935 Date: 6/10/2009

Title: RSWF REMOTE HANDLED TRANSURANIC WASTE DOSE RATE EVALUATION

0.06	1.337e+06	1.507e-05	1.981e-05	2.992e-08	3.934e-08
0.08	3.190e+07	6.849e-03	1.015e-02	1.084e-05	1.606e-05
0.1	3.736e+07	3.135e-02	5.111e-02	4.796e-05	7.820e-05
0.15	2.506e+05	8.479e-04	1.557e-03	1.396e-06	2.564e-06
0.2	3.384e+06	2.068e-02	3.923e-02	3.650e-05	6.923e-05
0.3	9.987e+02	1.154e-05	2.116e-05	2.190e-08	4.014e-08
0.4	2.984e+05	5.135e-03	8.907e-03	1.001e-05	1.735e-05
0.5	9.303e+04	2.151e-03	3.535e-03	4.223e-06	6.939e-06
0.6	4.411e+10	1.292e+03	2.027e+03	2.521e+00	3.956e+00
0.8	1.367e+07	5.769e-01	8.440e-01	1.097e-03	1.605e-03
1.0	1.601e+10	8.931e+02	1.245e+03	1.646e+00	2.295e+00
1.5	1.601e+10	1.466e+03	1.889e+03	2.467e+00	3.177e+00
2.0	3.613e+00	4.644e-07	5.740e-07	7.181e-10	8.876e-10
3.0	2.687e-07	5.474e-14	6.461e-14	7.427e-17	8.765e-17
Totals	8.074e+10	3.651e+03	5.161e+03	6.635e+00	9.429e+00

Results - Dose Point # 4 - (486.375,32.344,0) in

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	9.254e+08	7.550e-79	6.392e-27	6.476e-80	5.483e-28
0.02	4.639e+00	2.180e-45	5.037e-35	7.550e-47	1.745e-36
0.03	2.888e+09	6.443e-13	6.967e-13	6.385e-15	6.904e-15
0.04	7.070e+08	4.932e-07	5.677e-07	2.181e-09	2.511e-09
0.05	8.877e+06	2.545e-06	3.136e-06	6.780e-09	8.355e-09
0.06	1.337e+06	8.006e-06	1.054e-05	1.590e-08	2.094e-08
0.08	3.190e+07	3.663e-03	5.448e-03	5.796e-06	8.621e-06
0.1	3.736e+07	1.683e-02	2.762e-02	2.575e-05	4.225e-05
0.15	2.506e+05	4.582e-04	8.527e-04	7.545e-07	1.404e-06
0.2	3.384e+06	1.122e-02	2.168e-02	1.981e-05	3.827e-05
0.3	9.987e+02	6.303e-06	1.180e-05	1.196e-08	2.238e-08
0.4	2.984e+05	2.815e-03	4.987e-03	5.486e-06	9.717e-06
0.5	9.303e+04	1.183e-03	1.984e-03	2.322e-06	3.894e-06
0.6	4.411e+10	7.120e+02	1.139e+03	1.390e+00	2.222e+00
0.8	1.367e+07	3.192e-01	4.748e-01	6.071e-04	9.031e-04
1.0	1.601e+10	4.955e+02	7.008e+02	9.133e-01	1.292e+00
1.5	1.601e+10	8.170e+02	1.065e+03	1.375e+00	1.791e+00
2.0	3.613e+00	2.595e-07	3.238e-07	4.013e-10	5.008e-10

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3.0	2.687e-07	3.068e-14	3.648e-14	4.163e-17	4.950e-17
Totals	8.074e+10	2.025e+03	2.904e+03	3.678e+00	5.306e+00
Results - Dose Point # 5 - (606.375,32.344,0) in					
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	9.254e+08	2.870e-79	4.115e-27	2.462e-80	3.529e-28
0.02	4.639e+00	1.092e-45	3.242e-35	3.784e-47	1.123e-36
0.03	2.888e+09	3.692e-13	3.993e-13	3.659e-15	3.957e-15
0.04	7.070e+08	2.916e-07	3.358e-07	1.290e-09	1.485e-09
0.05	8.877e+06	1.523e-06	1.878e-06	4.057e-09	5.002e-09
0.06	1.337e+06	4.820e-06	6.354e-06	9.573e-09	1.262e-08
0.08	3.190e+07	2.219e-03	3.313e-03	3.512e-06	5.243e-06
0.1	3.736e+07	1.024e-02	1.691e-02	1.567e-05	2.587e-05
0.15	2.506e+05	2.806e-04	5.290e-04	4.620e-07	8.711e-07
0.2	3.384e+06	6.903e-03	1.358e-02	1.218e-05	2.396e-05
0.3	9.987e+02	3.900e-06	7.452e-06	7.397e-09	1.413e-08
0.4	2.984e+05	1.749e-03	3.163e-03	3.408e-06	6.163e-06
0.5	9.303e+04	7.373e-04	1.261e-03	1.447e-06	2.475e-06
0.6	4.411e+10	4.448e+02	7.246e+02	8.682e-01	1.414e+00
0.8	1.367e+07	2.001e-01	3.026e-01	3.806e-04	5.755e-04
1.0	1.601e+10	3.115e+02	4.469e+02	5.741e-01	8.238e-01
1.5	1.601e+10	5.159e+02	6.799e+02	8.679e-01	1.144e+00
2.0	3.613e+00	1.643e-07	2.070e-07	2.540e-10	3.202e-10
3.0	2.687e-07	1.949e-14	2.334e-14	2.644e-17	3.167e-17
Totals	8.074e+10	1.272e+03	1.852e+03	2.311e+00	3.383e+00
Results - Dose Point # 6 - (726.375,32.344,0) in					
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	9.254e+08	1.160e-79	2.868e-27	9.953e-81	2.460e-28
0.02	4.639e+00	5.880e-46	2.260e-35	2.037e-47	7.829e-37
0.03	2.888e+09	2.286e-13	2.473e-13	2.266e-15	2.450e-15
0.04	7.070e+08	1.866e-07	2.149e-07	8.254e-10	9.506e-10
0.05	8.877e+06	9.865e-07	1.217e-06	2.628e-09	3.243e-09
0.06	1.337e+06	3.142e-06	4.148e-06	6.241e-09	8.239e-09
0.08	3.190e+07	1.457e-03	2.182e-03	2.305e-06	3.453e-06
0.1	3.736e+07	6.748e-03	1.121e-02	1.032e-05	1.715e-05

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0.15	2.506e+05	1.860e-04	3.553e-04	3.064e-07	5.850e-07
0.2	3.384e+06	4.597e-03	9.201e-03	8.113e-06	1.624e-05
0.3	9.987e+02	2.613e-06	5.095e-06	4.956e-09	9.664e-09
0.4	2.984e+05	1.177e-03	2.171e-03	2.293e-06	4.231e-06
0.5	9.303e+04	4.976e-04	8.677e-04	9.767e-07	1.703e-06
0.6	4.411e+10	3.009e+02	4.993e+02	5.874e-01	9.746e-01
0.8	1.367e+07	1.359e-01	2.088e-01	2.584e-04	3.971e-04
1.0	1.601e+10	2.120e+02	3.087e+02	3.909e-01	5.690e-01
1.5	1.601e+10	3.527e+02	4.702e+02	5.935e-01	7.911e-01
2.0	3.613e+00	1.126e-07	1.433e-07	1.742e-10	2.216e-10
3.0	2.687e-07	1.341e-14	1.618e-14	1.819e-17	2.195e-17
Totals	8.074e+10	8.659e+02	1.278e+03	1.572e+00	2.335e+00

3. Waste Container B259, Liner V-18 – Decayed to July 1, 2009 (11128 Days)

MicroShield 7.02 INL (7.02-0000)			
Date	By	Checked	
Filename		Run Date	Run Time
Waste Container B259, Liner V-18 - Decayed 11128 Days.ms7		May 27, 2009	3:36:19 PM
Project Info			
Case Title	RSWF - RHTRU		
Description	Waste Container B259, Liner V-18 - Decayed 11128 Days		
Geometry	7 - Cylinder Volume - Side Shields		

Source Dimensions	
Height	164.308 cm (5 ft 4.7 in)
Radius	14.732 cm (5.8 in)
Dose Points	
A	Z
X	Y
#1	21.273 cm (8.4 in)
#2	625.793 cm (20 ft 6.4 in)
#3	930.593 cm (30 ft 6.4 in)
#4	1.2e+3 cm (40 ft 6.4 in)
#5	1.5e+3 cm (50 ft 6.4 in)
#6	1.8e+3 cm (60 ft 6.4 in)



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Shields			
Shield N	Dimension	Material	Density
Source	1.12e+05 cm ³	Iron	0.675
Shield 1	.191 cm	Iron	7.86
Shield 2	1.08 cm	Air	0.00122
Shield 3	.191 cm	Iron	7.86
Transition		Air	0.00122
Air Gap		Air	0.00122

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
Ac-227	6.0760e-009	2.2481e+002	5.4236e-008	2.0067e-003
Ac-228	3.6887e-018	1.3648e-007	3.2926e-017	1.2183e-012
Ba-137m	4.1059e+001	1.5192e+012	3.6651e+002	1.3561e+007
Bi-210	2.9507e-015	1.0918e-004	2.6339e-014	9.7454e-010
Bi-211	6.0354e-009	2.2331e+002	5.3873e-008	1.9933e-003
Bi-212	2.9633e-018	1.0964e-007	2.6451e-017	9.7870e-013
Bi-214	1.4947e-014	5.5302e-004	1.3342e-013	4.9364e-009
Ce-144	3.7592e-011	1.3909e+000	3.3555e-010	1.2416e-005
Co-58	4.3826e-044	1.6216e-033	3.9121e-043	1.4475e-038
Co-60	1.3285e+000	4.9153e+010	1.1858e+001	4.3875e+005
Cr-51	1.4070e-118	5.2057e-108	1.2559e-117	4.6468e-113
Cs-134	1.0555e-004	3.9054e+006	9.4218e-004	3.4861e+001
Cs-137	4.3403e+001	1.6059e+012	3.8743e+002	1.4335e+007
Eu-154	3.1849e-002	1.1784e+009	2.8430e-001	1.0519e+004
Eu-155	1.0206e-001	3.7762e+009	9.1102e-001	3.3708e+004
Fe-59	6.5545e-074	2.4252e-063	5.8507e-073	2.1648e-068
Fr-223	8.3849e-011	3.1024e+000	7.4846e-010	2.7693e-005
Mn-54	7.7316e-008	2.8607e+003	6.9015e-007	2.5535e-002
Pa-231	1.6886e-008	6.2478e+002	1.5073e-007	5.5769e-003
Pa-234	4.6560e-007	1.7227e+004	4.1561e-006	1.5377e-001
Pa-234m	2.9100e-004	1.0767e+007	2.5975e-003	9.6109e+001
Pb-210	2.9582e-015	1.0945e-004	2.6405e-014	9.7699e-010
Pb-211	6.0354e-009	2.2331e+002	5.3874e-008	1.9933e-003

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Pb-212	2.9634e-018	1.0964e-007	2.6452e-017	9.7871e-013
Pb-214	1.4947e-014	5.5303e-004	1.3342e-013	4.9365e-009
Po-210	2.7570e-015	1.0201e-004	2.4610e-014	9.1056e-010
Po-211	1.6477e-011	6.0964e-001	1.4707e-010	5.4418e-006
Po-212	1.8986e-018	7.0248e-008	1.6947e-017	6.2705e-013
Po-214	1.4943e-014	5.5291e-004	1.3339e-013	4.9354e-009
Po-215	6.0354e-009	2.2331e+002	5.3874e-008	1.9933e-003
Po-216	2.9638e-018	1.0966e-007	2.6456e-017	9.7886e-013
Po-218	1.4950e-014	5.5314e-004	1.3345e-013	4.9375e-009
Pr-144	3.7593e-011	1.3909e+000	3.3557e-010	1.2416e-005
Pr-144m	5.3757e-013	1.9890e-002	4.7985e-012	1.7754e-007
Pu-239	4.6559e-001	1.7227e+010	4.1560e+000	1.5377e+005
Pu-240	9.0509e-003	3.3488e+008	8.0790e-002	2.9892e+003
Ra-223	6.0354e-009	2.2331e+002	5.3874e-008	1.9933e-003
Ra-224	2.9638e-018	1.0966e-007	2.6456e-017	9.7886e-013
Ra-226	1.4972e-014	5.5396e-004	1.3364e-013	4.9448e-009
Ra-228	3.6890e-018	1.3649e-007	3.2929e-017	1.2184e-012
Rh-106	8.3801e-010	3.1006e+001	7.4803e-009	2.7677e-004
Rn-219	6.0354e-009	2.2331e+002	5.3874e-008	1.9933e-003
Rn-220	2.9638e-018	1.0966e-007	2.6456e-017	9.7886e-013
Rn-222	1.4950e-014	5.5314e-004	1.3345e-013	4.9375e-009
Ru-106	8.3801e-010	3.1006e+001	7.4803e-009	2.7677e-004
Sb-125	1.8716e-004	6.9250e+006	1.6706e-003	6.1814e+001
Sr-90	4.6307e+001	1.7134e+012	4.1335e+002	1.5294e+007
Te-125m	4.5863e-005	1.6969e+006	4.0939e-004	1.5147e+001
Th-227	5.9671e-009	2.2078e+002	5.3264e-008	1.9708e-003
Th-228	2.9675e-018	1.0980e-007	2.6489e-017	9.8009e-013
Th-230	3.4248e-012	1.2672e-001	3.0570e-011	1.1311e-006
Th-231	2.6214e-005	9.6992e+005	2.3399e-004	8.6577e+000
Th-232	6.1479e-018	2.2747e-007	5.4877e-017	2.0305e-012
Th-234	2.9100e-004	1.0767e+007	2.5975e-003	9.6109e+001
Tl-207	6.0189e-009	2.2270e+002	5.3726e-008	1.9879e-003
Tl-208	1.0647e-018	3.9394e-008	9.5039e-018	3.5165e-013
U-234	2.5055e-008	9.2702e+002	2.2364e-007	8.2748e-003
U-235	2.6214e-005	9.6992e+005	2.3399e-004	8.6577e+000
U-236	8.1761e-009	3.0252e+002	7.2982e-008	2.7003e-003

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U-238	2.9100e-004	1.0767e+007	2.5975e-003	9.6109e+001	
Y-90	4.6319e+001	1.7138e+012	4.1345e+002	1.5298e+007	
Buildup: The material reference is Source Integration Parameters					
Radial				20	
Circumferential				20	
Y Direction (axial)				40	
Results - Dose Point # 1 - (21.2725,82.15376,0) cm					
Energy (MeV)	Activity (Photons/sec)	Fluence Rate MeV/cm ² /sec No Buildup	Fluence Rate MeV/cm ² /sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.015	1.696e+10	4.777e-75	1.471e-22	4.098e-76	1.262e-23
0.02	2.652e+00	2.023e-43	3.615e-32	7.009e-45	1.252e-33
0.03	8.950e+10	3.006e-09	3.251e-09	2.980e-11	3.222e-11
0.04	2.204e+10	2.910e-03	3.350e-03	1.287e-05	1.481e-05
0.05	2.837e+08	1.872e-02	2.308e-02	4.987e-05	6.149e-05
0.06	4.940e+07	7.926e-02	1.045e-01	1.574e-04	2.075e-04
0.08	1.173e+09	4.469e+01	6.678e+01	7.071e-02	1.057e-01
0.1	1.266e+09	2.251e+02	3.768e+02	3.444e-01	5.765e-01
0.15	1.739e+05	1.677e-01	3.369e-01	2.762e-04	5.548e-04
0.2	8.161e+07	1.632e+02	3.571e+02	2.880e-01	6.303e-01
0.3	3.168e+04	1.349e-01	3.007e-01	2.559e-04	5.703e-04
0.4	1.058e+07	7.118e+01	1.531e+02	1.387e-01	2.982e-01
0.5	3.327e+06	3.133e+01	6.419e+01	6.150e-02	1.260e-01
0.6	1.367e+12	1.682e+07	3.285e+07	3.282e+04	6.412e+04
0.8	4.633e+08	8.620e+03	1.554e+04	1.640e+01	2.956e+01
1.0	4.952e+10	1.263e+06	2.141e+06	2.329e+03	3.946e+03
1.5	4.961e+10	2.213e+06	3.373e+06	3.724e+03	5.674e+03
2.0	3.110e+02	2.022e-02	2.908e-02	3.127e-05	4.497e-05
3.0	3.932e-08	4.219e-12	5.677e-12	5.724e-15	7.702e-15
Totals	1.598e+12	2.030e+07	3.838e+07	3.890e+04	7.377e+04
Results - Dose Point # 2 - (625.7925,82.15376,0) cm					
Energy (MeV)	Activity (Photons/sec)	Fluence Rate MeV/cm ² /sec No Buildup	Fluence Rate MeV/cm ² /sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.015	1.696e+10	3.929e-77	4.548e-25	3.370e-78	3.901e-26
0.02	2.652e+00	3.065e-45	1.118e-34	1.062e-46	3.871e-36
0.03	8.950e+10	4.088e-11	4.419e-11	4.052e-13	4.380e-13

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0.04	2.204e+10	3.020e-05	3.474e-05	1.336e-07	1.537e-07
0.05	2.837e+08	1.574e-04	1.937e-04	4.192e-07	5.161e-07
0.06	4.940e+07	5.679e-04	7.455e-04	1.128e-06	1.481e-06
0.08	1.173e+09	2.612e-01	3.872e-01	4.134e-04	6.127e-04
0.1	1.266e+09	1.176e+00	1.944e+00	1.799e-03	2.975e-03
0.15	1.739e+05	7.710e-04	1.509e-03	1.270e-06	2.485e-06
0.2	8.161e+07	7.126e-01	1.495e+00	1.258e-03	2.639e-03
0.3	3.168e+04	5.641e-04	1.180e-03	1.070e-06	2.239e-06
0.4	1.058e+07	2.912e-01	5.816e-01	5.674e-04	1.133e-03
0.5	3.327e+06	1.263e-01	2.390e-01	2.478e-04	4.690e-04
0.6	1.367e+12	6.697e+04	1.206e+05	1.307e+02	2.353e+02
0.8	4.633e+08	3.368e+01	5.595e+01	6.406e-02	1.064e-01
1.0	4.952e+10	4.863e+03	7.607e+03	8.964e+00	1.402e+01
1.5	4.961e+10	8.293e+03	1.175e+04	1.395e+01	1.977e+01
2.0	3.110e+02	7.452e-05	1.002e-04	1.152e-07	1.550e-07
3.0	3.932e-08	1.526e-14	1.936e-14	2.071e-17	2.626e-17
Totals	1.598e+12	8.016e+04	1.400e+05	1.537e+02	2.692e+02
Results - Dose Point # 3 - (930.5925,82.15376,0) 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	1.696e+10	1.238e-77	2.063e-25	1.061e-78	1.769e-26
0.02	2.652e+00	1.180e-45	5.069e-35	4.087e-47	1.756e-36
0.03	8.950e+10	1.698e-11	1.836e-11	1.683e-13	1.819e-13
0.04	2.204e+10	1.272e-05	1.464e-05	5.628e-08	6.476e-08
0.05	2.837e+08	6.666e-05	8.210e-05	1.776e-07	2.187e-07
0.06	4.940e+07	2.413e-04	3.173e-04	4.793e-07	6.302e-07
0.08	1.173e+09	1.115e-01	1.659e-01	1.765e-04	2.625e-04
0.1	1.266e+09	5.039e-01	8.382e-01	7.708e-04	1.282e-03
0.15	1.739e+05	3.325e-04	6.590e-04	5.476e-07	1.085e-06
0.2	8.161e+07	3.087e-01	6.584e-01	5.448e-04	1.162e-03
0.3	3.168e+04	2.459e-04	5.243e-04	4.665e-07	9.946e-07
0.4	1.058e+07	1.275e-01	2.594e-01	2.484e-04	5.055e-04
0.5	3.327e+06	5.544e-02	1.068e-01	1.088e-04	2.097e-04
0.6	1.367e+12	2.948e+04	5.399e+04	5.753e+01	1.054e+02
0.8	4.633e+08	1.488e+01	2.509e+01	2.830e-02	4.773e-02
1.0	4.952e+10	2.154e+03	3.415e+03	3.971e+00	6.296e+00

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1.5	4.961e+10	3.689e+03	5.284e+03	6.207e+00	8.890e+00
2.0	3.110e+02	3.324e-05	4.511e-05	5.141e-08	6.976e-08
3.0	3.932e-08	6.832e-15	8.724e-15	9.268e-18	1.184e-17
Totals	1.598e+12	3.534e+04	6.271e+04	6.774e+01	1.206e+02
Results - Dose Point # 4 - (1.24e+03,82.15376,0) 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	1.696e+10	4.332e-78	1.172e-25	3.716e-79	1.005e-26
0.02	2.652e+00	5.327e-46	2.879e-35	1.845e-47	9.973e-37
0.03	8.950e+10	8.639e-12	9.342e-12	8.562e-14	9.258e-14
0.04	2.204e+10	6.655e-06	7.660e-06	2.943e-08	3.388e-08
0.05	2.837e+08	3.522e-05	4.341e-05	9.383e-08	1.156e-07
0.06	4.940e+07	1.282e-04	1.688e-04	2.546e-07	3.352e-07
0.08	1.173e+09	5.960e-02	8.897e-02	9.431e-05	1.408e-04
0.1	1.266e+09	2.703e-01	4.524e-01	4.136e-04	6.922e-04
0.15	1.739e+05	1.796e-04	3.603e-04	2.957e-07	5.932e-07
0.2	8.161e+07	1.675e-01	3.630e-01	2.956e-04	6.407e-04
0.3	3.168e+04	1.342e-04	2.915e-04	2.546e-07	5.530e-07
0.4	1.058e+07	6.987e-02	1.449e-01	1.361e-04	2.823e-04
0.5	3.327e+06	3.048e-02	5.980e-02	5.983e-05	1.174e-04
0.6	1.367e+12	1.625e+04	3.026e+04	3.171e+01	5.907e+01
0.8	4.633e+08	8.231e+00	1.409e+01	1.566e-02	2.680e-02
1.0	4.952e+10	1.195e+03	1.920e+03	2.202e+00	3.539e+00
1.5	4.961e+10	2.056e+03	2.975e+03	3.458e+00	5.006e+00
2.0	3.110e+02	1.857e-05	2.543e-05	2.872e-08	3.932e-08
3.0	3.932e-08	3.829e-15	4.923e-15	5.195e-18	6.679e-18
Totals	1.598e+12	1.951e+04	3.517e+04	3.739e+01	6.764e+01
Results - Dose Point # 5 - (1.54e+03,82.15376,0) 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	1.696e+10	1.647e-78	7.543e-26	1.413e-79	6.470e-27
0.02	2.652e+00	2.670e-46	1.853e-35	9.248e-48	6.420e-37
0.03	8.950e+10	4.951e-12	5.354e-12	4.907e-14	5.306e-14
0.04	2.204e+10	3.935e-06	4.531e-06	1.740e-08	2.004e-08
0.05	2.837e+08	2.107e-05	2.598e-05	5.613e-08	6.922e-08
0.06	4.940e+07	7.715e-05	1.017e-04	1.532e-07	2.020e-07

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0.08	1.173e+09	3.610e-02	5.408e-02	5.712e-05	8.558e-05
0.1	1.266e+09	1.644e-01	2.768e-01	2.515e-04	4.234e-04
0.15	1.739e+05	1.099e-04	2.231e-04	1.810e-07	3.674e-07
0.2	8.161e+07	1.030e-01	2.267e-01	1.817e-04	4.002e-04
0.3	3.168e+04	8.303e-05	1.836e-04	1.575e-07	3.483e-07
0.4	1.058e+07	4.340e-02	9.164e-02	8.456e-05	1.786e-04
0.5	3.327e+06	1.899e-02	3.792e-02	3.728e-05	7.444e-05
0.6	1.367e+12	1.015e+04	1.922e+04	1.981e+01	3.751e+01
0.8	4.633e+08	5.160e+00	8.965e+00	9.814e-03	1.705e-02
1.0	4.952e+10	7.510e+02	1.223e+03	1.384e+00	2.254e+00
1.5	4.961e+10	1.298e+03	1.898e+03	2.183e+00	3.194e+00
2.0	3.110e+02	1.176e-05	1.624e-05	1.818e-08	2.511e-08
3.0	3.932e-08	2.432e-15	3.148e-15	3.299e-18	4.271e-18
Totals	1.598e+12	1.220e+04	2.235e+04	2.339e+01	4.298e+01
Results - Dose Point # 6 - (1.84e+03,82.15376.0) 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	1.696e+10	6.661e-79	5.258e-26	5.713e-80	4.510e-27
0.02	2.652e+00	1.437e-46	1.292e-35	4.978e-48	4.475e-37
0.03	8.950e+10	3.065e-12	3.315e-12	3.038e-14	3.286e-14
0.04	2.204e+10	2.518e-06	2.900e-06	1.114e-08	1.283e-08
0.05	2.837e+08	1.365e-05	1.684e-05	3.636e-08	4.486e-08
0.06	4.940e+07	5.029e-05	6.639e-05	9.988e-08	1.319e-07
0.08	1.173e+09	2.368e-02	3.560e-02	3.747e-05	5.634e-05
0.1	1.266e+09	1.083e-01	1.833e-01	1.657e-04	2.805e-04
0.15	1.739e+05	7.287e-05	1.496e-04	1.200e-07	2.464e-07
0.2	8.161e+07	6.855e-02	1.533e-01	1.210e-04	2.706e-04
0.3	3.168e+04	5.562e-05	1.252e-04	1.055e-07	2.375e-07
0.4	1.058e+07	2.919e-02	6.276e-02	5.688e-05	1.223e-04
0.5	3.327e+06	1.282e-02	2.603e-02	2.516e-05	5.110e-05
0.6	1.367e+12	6.864e+03	1.322e+04	1.340e+01	2.579e+01
0.8	4.633e+08	3.503e+00	6.176e+00	6.663e-03	1.175e-02
1.0	4.952e+10	5.112e+02	8.434e+02	9.424e-01	1.555e+00
1.5	4.961e+10	8.873e+02	1.311e+03	1.493e+00	2.206e+00
2.0	3.110e+02	8.061e-06	1.123e-05	1.247e-08	1.737e-08
3.0	3.932e-08	1.673e-15	2.180e-15	2.269e-18	2.957e-18

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Totals	1.598e+12	8.266e+03	1.538e+04	1.584e+01	2.957e+01
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4. Waste Container B315, Liner Z-20 – Decayed to July 1, 2009 (9557 Days)

MicroShield 7.02 INL (7.02-0000)					
Date		By		Checked	
Filename			Run Date	Run Time	Duration
Waste Container B315, Liner Z-20 - Decayed 9557 Days.ms7			May 27, 2009	3:29:58 PM	00:00:17
Project Info					
Case Title	RSWF - RHTRU				
Description	Waste Container B315, Liner Z-20 - Decayed 9557 Days				
Geometry	7 - Cylinder Volume - Side Shields				

Source Dimensions	
Height	164.308 cm (5 ft 4.7 in)
Radius	14.732 cm (5.8 in)

Dose Points			
A	X	Y	Z
#1	21.273 cm (8.4 in)	82.154 cm (2 ft 8.3 in)	0.0 cm (0.0 in)
#2	625.793 cm (20 ft 6.4 in)	82.154 cm (2 ft 8.3 in)	0.0 cm (0.0 in)
#3	930.593 cm (30 ft 6.4 in)	82.154 cm (2 ft 8.3 in)	0.0 cm (0.0 in)
#4	1.2e+3 cm (40 ft 6.4 in)	82.154 cm (2 ft 8.3 in)	0.0 cm (0.0 in)
#5	1.5e+3 cm (50 ft 6.4 in)	82.154 cm (2 ft 8.3 in)	0.0 cm (0.0 in)
#6	1.8e+3 cm (60 ft 6.4 in)	82.154 cm (2 ft 8.3 in)	0.0 cm (0.0 in)



Shields			
Shield N	Dimension	Material	Density
Source	1.12e+05 cm ³	Iron	1.26
Shield 1	.191 cm	Iron	7.86
Shield 2	1.08 cm	Air	0.00122
Shield 3	.191 cm	Iron	7.86
Transition		Air	0.00122
Air Gap		Air	0.00122

Source Input: Grouping Method - Standard Indices

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Number of Groups: 25 Lower Energy Cutoff: 0.015 Photons < 0.015: Included Library: Grove				
Nuclide	Ci	Bq	µCi/cm ³	Bq/cm ³
Ac-227	3.7586e-012	1.3907e-001	3.3550e-011	1.2414e-006
Ac-228	2.6385e-016	9.7623e-006	2.3552e-015	8.7141e-011
Ba-137m	1.1409e+001	4.2212e+011	1.0184e+002	3.7680e+006
Bi-210	1.4429e-015	5.3387e-005	1.2880e-014	4.7655e-010
Bi-211	3.7111e-012	1.3731e-001	3.3126e-011	1.2257e-006
Bi-212	2.0392e-016	7.5449e-006	1.8202e-015	6.7348e-011
Bi-214	8.3184e-015	3.0778e-004	7.4252e-014	2.7473e-009
Ce-144	4.1780e-009	1.5459e+002	3.7294e-008	1.3799e-003
Co-58	1.2265e-037	4.5380e-027	1.0948e-036	4.0507e-032
Co-60	1.5602e+001	5.7729e+011	1.3927e+002	5.1531e+006
Cr-51	7.7021e-103	2.8498e-092	6.8751e-102	2.5438e-097
Cs-134	1.6653e-003	6.1616e+007	1.4865e-002	5.5000e+002
Cs-137	1.2060e+001	4.4622e+011	1.0765e+002	3.9831e+006
Fe-59	8.9716e-064	3.3195e-053	8.0083e-063	2.9631e-058
Fr-223	5.1868e-014	1.9191e-003	4.6299e-013	1.7131e-008
Mn-54	2.9569e-006	1.0941e+005	2.6394e-005	9.7659e-001
Pa-231	1.6465e-011	6.0922e-001	1.4697e-010	5.4381e-006
Pa-234	4.0960e-007	1.5155e+004	3.6562e-006	1.3528e-001
Pa-234m	2.5600e-004	9.4720e+006	2.2851e-003	8.4549e+001
Pb-210	1.4472e-015	5.3546e-005	1.2918e-014	4.7796e-010
Pb-211	3.7111e-012	1.3731e-001	3.3126e-011	1.2257e-006
Pb-212	2.0392e-016	7.5451e-006	1.8202e-015	6.7349e-011
Pb-214	8.3185e-015	3.0778e-004	7.4253e-014	2.7474e-009
Po-210	1.3329e-015	4.9318e-005	1.1898e-014	4.4023e-010
Po-211	1.0131e-014	3.7486e-004	9.0434e-014	3.3461e-009
Po-212	1.3065e-016	4.8340e-006	1.1662e-015	4.3150e-011
Po-214	8.3167e-015	3.0772e-004	7.4237e-014	2.7468e-009
Po-215	3.7111e-012	1.3731e-001	3.3126e-011	1.2257e-006
Po-216	2.0396e-016	7.5465e-006	1.8206e-015	6.7362e-011
Po-218	8.3202e-015	3.0785e-004	7.4268e-014	2.7479e-009
Pr-144	4.1781e-009	1.5459e+002	3.7295e-008	1.3799e-003
Pr-144m	5.9747e-011	2.2106e+000	5.3331e-010	1.9733e-005
Pu-239	2.3083e+000	8.5406e+010	2.0604e+001	7.6235e+005

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Pu-240	9.4339e-001	3.4905e+010	8.4210e+000	3.1158e+005	
Ra-223	3.7111e-012	1.3731e-001	3.3126e-011	1.2257e-006	
Ra-224	2.0396e-016	7.5465e-006	1.8206e-015	6.7362e-011	
Ra-226	8.3346e-015	3.0838e-004	7.4397e-014	2.7527e-009	
Ra-228	2.6387e-016	9.7632e-006	2.3554e-015	8.7149e-011	
Rn-219	3.7111e-012	1.3731e-001	3.3126e-011	1.2257e-006	
Rn-220	2.0396e-016	7.5465e-006	1.8206e-015	6.7362e-011	
Rn-222	8.3202e-015	3.0785e-004	7.4268e-014	2.7479e-009	
Sr-90	1.1669e+001	4.3174e+011	1.0416e+002	3.8538e+006	
Th-227	3.6774e-012	1.3606e-001	3.2825e-011	1.2145e-006	
Th-228	2.0427e-016	7.5579e-006	1.8233e-015	6.7464e-011	
Th-230	2.2200e-012	8.2139e-002	1.9816e-011	7.3320e-007	
Th-231	5.9496e-008	2.2013e+003	5.3108e-007	1.9650e-002	
Th-232	4.7250e-016	1.7483e-005	4.2177e-015	1.5605e-010	
Th-234	2.5600e-004	9.4720e+006	2.2851e-003	8.4549e+001	
Tl-207	3.7009e-012	1.3693e-001	3.3036e-011	1.2223e-006	
Tl-208	7.3267e-017	2.7109e-006	6.5400e-016	2.4198e-011	
U-234	1.8920e-008	7.0004e+002	1.6888e-007	6.2487e-003	
U-235	5.9505e-008	2.2017e+003	5.3116e-007	1.9653e-002	
U-236	7.3174e-007	2.7074e+004	6.5317e-006	2.4167e-001	
U-238	2.5600e-004	9.4720e+006	2.2851e-003	8.4549e+001	
Y-90	1.1671e+001	4.3185e+011	1.0418e+002	3.8548e+006	
Buildup: The material reference is Source Integration Parameters					
Radial				20	
Circumferential				20	
Y Direction (axial)				40	
Results - Dose Point # 1 - (21.2725,82.15376,0) cm					
Energy (MeV)	Activity (Photons/sec)	Fluence Rate MeV/cm ² /sec No Buildup	Fluence Rate MeV/cm ² /sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.015	1.200e+10	6.310e-76	1.041e-22	5.413e-77	8.925e-24
0.02	2.419e-03	8.230e-47	3.298e-35	2.851e-48	1.142e-36
0.03	2.486e+10	4.464e-10	4.828e-10	4.424e-12	4.785e-12
0.04	5.868e+09	4.153e-04	4.781e-04	1.837e-06	2.114e-06
0.05	1.831e+07	6.472e-04	7.981e-04	1.724e-06	2.126e-06
0.06	3.708e+05	3.187e-04	4.200e-04	6.330e-07	8.342e-07

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0.08	1.373e+04	2.803e-04	4.190e-04	4.436e-07	6.630e-07
0.1	4.122e+07	3.945e+00	6.614e+00	6.035e-03	1.012e-02
0.15	5.138e+03	2.765e-03	5.677e-03	4.554e-06	9.348e-06
0.2	4.555e+03	5.268e-03	1.212e-02	9.298e-06	2.140e-05
0.3	2.291e+04	5.902e-02	1.435e-01	1.120e-04	2.723e-04
0.4	9.306e+02	3.898e-03	9.321e-03	7.595e-06	1.816e-05
0.5	9.010e+05	5.397e+00	1.241e+01	1.059e-02	2.435e-02
0.6	3.800e+11	3.027e+06	6.664e+06	5.909e+03	1.301e+04
0.8	5.814e+07	7.215e+02	1.469e+03	1.372e+00	2.795e+00
1.0	5.773e+11	1.006e+07	1.922e+07	1.855e+04	3.542e+04
1.5	5.773e+11	1.838e+07	3.128e+07	3.092e+04	5.262e+04
2.0	2.748e+02	1.312e-02	2.090e-02	2.028e-05	3.233e-05
3.0	2.705e-06	2.202e-10	3.242e-10	2.987e-13	4.399e-13
Totals	1.577e+12	3.147e+07	5.716e+07	5.538e+04	1.011e+05
Results - Dose Point # 2 - (625.7925,82.15376.0) 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	1.200e+10	5.180e-78	3.217e-25	4.443e-79	2.759e-26
0.02	2.419e-03	1.247e-48	1.019e-37	4.319e-50	3.531e-39
0.03	2.486e+10	6.084e-12	6.577e-12	6.029e-14	6.518e-14
0.04	5.868e+09	4.308e-06	4.956e-06	1.905e-08	2.192e-08
0.05	1.831e+07	5.445e-06	6.702e-06	1.450e-08	1.785e-08
0.06	3.708e+05	2.285e-06	3.000e-06	4.539e-09	5.960e-09
0.08	1.373e+04	1.642e-06	2.435e-06	2.599e-09	3.853e-09
0.1	4.122e+07	2.070e-02	3.432e-02	3.168e-05	5.251e-05
0.15	5.138e+03	1.294e-05	2.609e-05	2.131e-08	4.297e-08
0.2	4.555e+03	2.367e-05	5.303e-05	4.177e-08	9.359e-08
0.3	2.291e+04	2.566e-04	5.986e-04	4.868e-07	1.136e-06
0.4	9.306e+02	1.667e-05	3.784e-05	3.248e-08	7.373e-08
0.5	9.010e+05	2.281e-02	4.946e-02	4.478e-05	9.709e-05
0.6	3.800e+11	1.268e+04	2.621e+04	2.474e+01	5.115e+01
0.8	5.814e+07	2.973e+00	5.663e+00	5.655e-03	1.077e-02
1.0	5.773e+11	4.091e+04	7.299e+04	7.541e+01	1.345e+02
1.5	5.773e+11	7.285e+04	1.159e+05	1.226e+02	1.950e+02
2.0	2.748e+02	5.111e-05	7.634e-05	7.904e-08	1.180e-07
3.0	2.705e-06	8.413e-13	1.167e-12	1.141e-15	1.584e-15

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Totals	1.577e+12	1.264e+05	2.151e+05	2.227e+02	3.807e+02
Results - Dose Point # 3 - (930.5925,82.15376,0) 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	1.200e+10	1.634e-78	1.459e-25	1.402e-79	1.251e-26
0.02	2.419e-03	4.803e-49	4.624e-38	1.664e-50	1.602e-39
0.03	2.486e+10	2.527e-12	2.732e-12	2.504e-14	2.707e-14
0.04	5.868e+09	1.815e-06	2.089e-06	8.027e-09	9.237e-09
0.05	1.831e+07	2.306e-06	2.840e-06	6.143e-09	7.566e-09
0.06	3.708e+05	9.710e-07	1.276e-06	1.929e-09	2.535e-09
0.08	1.373e+04	7.007e-07	1.042e-06	1.109e-09	1.650e-09
0.1	4.122e+07	8.863e-03	1.478e-02	1.356e-05	2.261e-05
0.15	5.138e+03	5.575e-06	1.138e-05	9.180e-09	1.873e-08
0.2	4.555e+03	1.024e-05	2.331e-05	1.808e-08	4.114e-08
0.3	2.291e+04	1.118e-04	2.653e-04	2.120e-07	5.033e-07
0.4	9.306e+02	7.292e-06	1.684e-05	1.421e-08	3.282e-08
0.5	9.010e+05	1.001e-02	2.207e-02	1.965e-05	4.332e-05
0.6	3.800e+11	5.576e+03	1.171e+04	1.088e+01	2.286e+01
0.8	5.814e+07	1.313e+00	2.536e+00	2.497e-03	4.823e-03
1.0	5.773e+11	1.811e+04	3.272e+04	3.339e+01	6.032e+01
1.5	5.773e+11	3.240e+04	5.207e+04	5.451e+01	8.760e+01
2.0	2.748e+02	2.279e-05	3.433e-05	3.525e-08	5.309e-08
3.0	2.705e-06	3.765e-13	5.257e-13	5.107e-16	7.132e-16
Totals	1.577e+12	5.609e+04	9.650e+04	9.878e+01	1.708e+02
Results - Dose Point # 4 - (1.24e+03,82.15376,0) 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	1.200e+10	5.724e-79	8.287e-26	4.910e-80	7.108e-27
0.02	2.419e-03	2.169e-49	2.626e-38	7.514e-51	9.097e-40
0.03	2.486e+10	1.286e-12	1.390e-12	1.274e-14	1.378e-14
0.04	5.868e+09	9.492e-07	1.093e-06	4.198e-09	4.832e-09
0.05	1.831e+07	1.218e-06	1.501e-06	3.245e-09	4.000e-09
0.06	3.708e+05	5.157e-07	6.789e-07	1.024e-09	1.349e-09
0.08	1.373e+04	3.743e-07	5.589e-07	5.924e-10	8.845e-10
0.1	4.122e+07	4.753e-03	7.974e-03	7.271e-06	1.220e-05
0.15	5.138e+03	3.009e-06	6.213e-06	4.955e-09	1.023e-08

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0.2	4.555e+03	5.554e-06	1.283e-05	9.802e-09	2.265e-08
0.3	2.291e+04	6.097e-05	1.473e-04	1.157e-07	2.793e-07
0.4	9.306e+02	3.995e-06	9.387e-06	7.784e-09	1.829e-08
0.5	9.010e+05	5.502e-03	1.233e-02	1.080e-05	2.420e-05
0.6	3.800e+11	3.072e+03	6.553e+03	5.996e+00	1.279e+01
0.8	5.814e+07	7.260e-01	1.422e+00	1.381e-03	2.704e-03
1.0	5.773e+11	1.004e+04	1.837e+04	1.851e+01	3.386e+01
1.5	5.773e+11	1.805e+04	2.928e+04	3.036e+01	4.927e+01
2.0	2.748e+02	1.273e-05	1.933e-05	1.969e-08	2.989e-08
3.0	2.705e-06	2.110e-13	2.964e-13	2.862e-16	4.022e-16
Totals	1.577e+12	3.116e+04	5.421e+04	5.487e+01	9.592e+01
Results - Dose Point # 5 - (1.54e+03,82.15376,0) 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	1.200e+10	2.177e-79	5.334e-26	1.867e-80	4.576e-27
0.02	2.419e-03	1.087e-49	1.691e-38	3.766e-51	5.856e-40
0.03	2.486e+10	7.367e-13	7.967e-13	7.301e-15	7.896e-15
0.04	5.868e+09	5.612e-07	6.462e-07	2.482e-09	2.858e-09
0.05	1.831e+07	7.288e-07	8.987e-07	1.941e-09	2.394e-09
0.06	3.708e+05	3.103e-07	4.091e-07	6.164e-10	8.127e-10
0.08	1.373e+04	2.267e-07	3.397e-07	3.587e-10	5.375e-10
0.1	4.122e+07	2.889e-03	4.876e-03	4.421e-06	7.460e-06
0.15	5.138e+03	1.841e-06	3.845e-06	3.032e-09	6.332e-09
0.2	4.555e+03	3.413e-06	8.005e-06	6.024e-09	1.413e-08
0.3	2.291e+04	3.771e-05	9.260e-05	7.152e-08	1.756e-07
0.4	9.306e+02	2.481e-06	5.927e-06	4.834e-09	1.155e-08
0.5	9.010e+05	3.427e-03	7.804e-03	6.727e-06	1.532e-05
0.6	3.800e+11	1.918e+03	4.154e+03	3.744e+00	8.109e+00
0.8	5.814e+07	4.550e-01	9.032e-01	8.655e-04	1.718e-03
1.0	5.773e+11	6.312e+03	1.168e+04	1.164e+01	2.154e+01
1.5	5.773e+11	1.139e+04	1.867e+04	1.917e+01	3.140e+01
2.0	2.748e+02	8.059e-06	1.234e-05	1.246e-08	1.908e-08
3.0	2.705e-06	1.340e-13	1.894e-13	1.818e-16	2.570e-16
Totals	1.577e+12	1.962e+04	3.451e+04	3.455e+01	6.105e+01
Results - Dose Point # 6 - (1.84e+03,82.15376,0) cm					
Energy (MeV)	Activity (Photons/sec)	Fluence Rate	Fluence Rate	Exposure Rate	Exposure Rate

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		MeV/cm²/sec No Buildup	MeV/cm²/sec With Buildup	mR/hr No Buildup	mR/hr With Buildup
0.015	1.200e+10	8.806e-80	3.719e-26	7.553e-81	3.189e-27
0.02	2.419e-03	5.853e-50	1.178e-38	2.027e-51	4.082e-40
0.03	2.486e+10	4.561e-13	4.933e-13	4.520e-15	4.889e-15
0.04	5.868e+09	3.591e-07	4.136e-07	1.588e-09	1.829e-09
0.05	1.831e+07	4.721e-07	5.824e-07	1.258e-09	1.552e-09
0.06	3.708e+05	2.023e-07	2.670e-07	4.017e-10	5.304e-10
0.08	1.373e+04	1.487e-07	2.236e-07	2.353e-10	3.538e-10
0.1	4.122e+07	1.903e-03	3.230e-03	2.911e-06	4.941e-06
0.15	5.138e+03	1.220e-06	2.577e-06	2.009e-09	4.244e-09
0.2	4.555e+03	2.272e-06	5.407e-06	4.010e-09	9.543e-09
0.3	2.291e+04	2.525e-05	6.305e-05	4.790e-08	1.196e-07
0.4	9.306e+02	1.669e-06	4.052e-06	3.251e-09	7.896e-09
0.5	9.010e+05	2.312e-03	5.349e-03	4.538e-06	1.050e-05
0.6	3.800e+11	1.297e+03	2.852e+03	2.532e+00	5.567e+00
0.8	5.814e+07	3.089e-01	6.213e-01	5.875e-04	1.182e-03
1.0	5.773e+11	4.296e+03	8.049e+03	7.919e+00	1.484e+01
1.5	5.773e+11	7.788e+03	1.288e+04	1.310e+01	2.167e+01
2.0	2.748e+02	5.525e-06	8.526e-06	8.544e-09	1.318e-08
3.0	2.705e-06	9.214e-14	1.311e-13	1.250e-16	1.779e-16
Totals	1.577e+12	1.338e+04	2.378e+04	2.356e+01	4.208e+01