Appendix B

Bounding Source Term Calculation

ORIGINAL

GPU NUCLEAR

CALCULATION COVER SHEET

Subject:	Calculation No.	Revision Number
Multiple Source Term Bounding Calculation	6900-02-025	0

DESCRIPTION OF REVISION

	Signature	Date
Originator	B. Brosey/ B. Brosey	10/6/02
Reviewer	J.P. Donnachie/	10/7/02
Additional Reviewer		
Additional Reviewer		
Additional Reviewer		
Management Approval	AF Paynter	07Oct02

GPU NUCLEAR

Calculation Sheet

Subject	Calc. No.	Rev. No.	Sheet No.
Multiple Source Term Bounding Calculation	6900-02-025	0	1 of 44

Originator	Date	Reviewed by	Date
Barry H. Brosey B. Brosey	October 6, 2002	J. P. Donnachie	10/7/02

1.0 PROBLEM STATEMENT

1.1 The purpose of this calculation is to provide a bounding estimate of dose from multiple source terms found on and/or in remediated structures and plant piping at the SNEC site.

1.2 Areas are assumed to have residual contamination residing on the surface and be volumetrically contaminated. Doses are assumed to be additive, producing an upper bounding estimate of dose within the SSGS area. Areas reviewed include the following:

- Dose from activation products found in the steel of the SNEC CV is augmented with dose from residual surface contamination.
- Concrete surfaces in the SSGS area are described as a two component source term, with a surface contamination component and a volumetric component.
- Volumetrically contaminated piping is treated as a separate dose contributor.

2.0 SUMMARY OF RESULTS

2.1 The results of this evaluation demonstrate that the dose from residual pipe sections will be extremely small when compared with the 25 mrem/y limit imposed by 10 CFR 20. In addition, the dose from activated steel within the SNEC CV when added to the dose resulting from surface contamination in this structure will be controlled by the equation shown in Section 4.1.

3.0 REFERENCES

3.1 Microsoft Excel 97, Microsoft Corporation Inc., SR-2, 1985-1997.

3.2 GPU Nuclear Calculation No. 6900-02-011, "CV Stiffener Region Radionuclide Mix – Pre-Survey", 3/12/02.

3.3 SNEC License Termination Plan Draft (LTP), Revision 1, 2002.

3.4 GPU Nuclear Calculation No. 6900-02-019, "Interior CV Weld Ring Areas @ 792.5 ft. El – Survey Plan", 6/24/02.

3.5 "Embedded Pipe Radiation Survey Report", for GPU Nuclear, Saxton Nuclear Experimental Corporation, Saxton, PA, by CoPhysics Corporation, 1242 Route 208, Monroe, NY, 10950, October 2001 to January 2002.

4.0 ASSUMPTIONS AND BASIC DATA

4.1 This estimate considers applicable radionuclide concentrations found at the SNEC site, and applies the sum of fractions methodology presented in Chapter 6, Revision 1 of the SNEC License Termination Plan, when summing multiple source term dose. The equation for this type of summation process is shown below.

Equation 6-1 from SNEC LTP (Reference 3.3)

$$\sum_{i=1}^{n}\left(\frac{C_{si}}{DCGL_{si}}+\frac{C_{vi}}{DCGL_{vi}}\right)+\left[\frac{Direct\ \gamma\ Dose}{25}\right]\leq 1$$

Where: C_{si} = Surface contamination of radionuclide i (dpm/100 cm^2).

C_{vi} = Specific volume concentration of radionuclide i (pCi/g).

$DCGL_{si}$ = Surface contamination DCGL of radionuclide i from Table 6-2 of **Reference 3.3**.

$DCGL_{vi}$ = Volumetric DCGL (25 mrem/yr) of radionuclide i from Table 6-2 of **Reference 3.3**.

Direct γ Dose = MicroShield (or equivalent) shielding code calculation (mrem/yr).

4.2 SNEC sample analysis results for a sample taken in the area of the 792' El support ring survey, indicated that a gross survey unit limit of 3700 dpm/100 cm2 (for Cs-137) would be the maximum limit for that support ring location (SNEC Sample No. SXSD3055). See Attachment 1-1 & 1-2. This surface source mix is a conservative estimate for the entire interior surface of the CV steel shell.

4.3 Activation samples from the SNEC CV steel structure were examined by an off-site laboratory and the results of these analysis are provided in Attachment 2-1 to 2-10.

4.4 The SSGS footprint area including the Discharge Tunnel is contaminated with radionuclide concentrations similar to that found in the following samples. Sample identification numbers are shown below. See Attachments 3-1 to 3-12. In general, these sample materials indicate that the effective DCGL is near 6 pCi/g for Cs-137 (as the surrogate).

1) SXSD723 2) SXCF828 3) SX10SD00366 4) SXSD1377

4.5 The SSGS Discharge Tunnel is assumed to be contaminated with the materials found in sample SX10SD990033, which was taken from the nuclear plant effluent discharge line. This material is similar to that found in the SSGS area. See **Attachment 4-1 to 4-3**.

4.6 For purposes of this bounding analysis, radioactive decay is not considered.

4.7 For purposes of this calculation, it is assumed that a person spends 50% of the time on-site and 50% of the time at point "A" on **Attachment 5-1**. This location is 0.5 meters from the CV shell wall at the center of the activated region.

4.8 The thickness of the CV steel shell is assumed to be 11/16 inches (1.75 cm). Steel is assumed to have a density of 7.86 g/cc. The Co-60 concentration input to the MicroShield computer shielding code is (1.95 pCi/g x 7.86 g/cc)/1E+06 pCi/uCi = <u>1.5327E-05 uCi/cc</u>.

5.0 CALCULATION

5.1 Two scenarios have been evaluated within this calculation. They are:

5.1.1 Bounding Limit 1 - Dose from an activated region of the SNEC CV steel shell is coupled with the dose from surface contamination.

5.1.2 Bounding Limit 2 - Dose from post remediation surface contamination and volumetric contamination of concrete surfaces within the SSGS Discharge Tunnel are combined with several hypothetical direct exposures from pipe sections.

5.2 Bounding Limit 1

5.2.1 Sampling of the SNEC CV steel shell in the region where activation has occurred, has shown that the average concentration of Co-60 in the sampled region is ~1.95 pCi/g ± 0.74 pCi/g (for purposes of this bounding estimate MDA values are included in the average). See **Attachment 2.**

5.2.2 On **Attachment 5-1,** the activated region of the CV shell is assumed to be made up of three individual plates X, Y and Z, with a Co-60 concentration as described in 5.2.1 above. Each plate is 30 degrees of circumference or ~39.2 feet/3 = 13 feet wide. The height of these plates is assumed to be 20 feet.

5.2.3 Three models were run in MicroShield. The first run (CVSHELL.MS5) was for plate Y and yielded an exposure rate of 2.541E-03 mR/h (2.541 uR/h). The second run (CVXPLUS.MS5) was for plate X and Z and yielded an exposure rate of 9.474E-04 mR/h (0.9474 uR/h). The third run (CVMINUS.MS5) yielded an exposure rate of 5.724E-04 mR/h (0.5724 uR/h) which must be subtracted from the previous run to adjust for the off center characteristics of plates X and Z. Then the exposure rate at the center of the activated region is estimated to be 2.541 + 2 x (0.9474 – 0.5724) = <u>3.291 uR/h</u>. See **Attachments 5-2** to **5-7.**

5.2.4 3.291 uR/h x 8766 hrs/year x 0.5 site occupancy x 0.5 occupancy at dose point A in **Attachment 5-1,** yields 7.2 mR which is approximately <u>7.2 mrem</u>. Residual surface contamination on the CV shell can therefore not contribute more than 25 mrem - 7.2 mrem = 17.8 mrem.

5.2.5 Contamination on the CV surface is assumed to have a maximum effective DCGL (using Cs-137 as a surrogate) of ~3700 dpm/100 cm^2 (see Section 4.2). This represents a 25 mrem dose from residual surface contamination and must be adjusted downward because of the direct exposure rate from the activated metal. Therefore, the residual surface contamination should not be more than (17.8/25) x 3700 = ~ 2600 dpm/100 cm^2 in the region of the activated steel. The equation used to combine dose is:

$$\frac{2600\,dpm/100\,cm^2}{3700\,dpm/100\,cm^2}+\frac{7.2\,mrem}{25\,mrem}\leq 1$$

5.3 Bounding Limit 2

5.3.1 The SSGS area has similar radionuclide mix characteristics. See **Attachments 3-1** to **3-12**. Using the source term and effective DCGLs provided on **Attachment 4-1** and **4-2**, it can be seen that surface contamination in the Discharge Tunnel cannot be more than ~8150 dpm/100 cm^2 for Cs-137 on concrete and steel surfaces, and volumetric contamination would have to be below 6.38 pCi/g (Cs-137). As an example, if residual surface contamination was remediated to ~20% of the 8150 dpm/100 cm^2 (or about 1630 dpm/100 cm^2), then volumetric contamination within the Discharge Tunnel would be maintained below 80% of the 6.38 pCi/g limit or about 5.1 pCi/g. Additionally, any dose resulting from remaining contaminated pipe sections would be considered using the equation presented in Section 4.1, and may result in an additional reduction in the above values. However, most contaminated pipe runs have been removed from the SSGS area including those in the Discharge Tunnel, leaving only short pipe stubs less than ~2 foot in length and one 18" tie line that connects the Intake Tunnel and Discharge Tunnels.

5.3.2 From **Reference 3.5**, the maximum contamination level found in remaining piping located in the SSGS area, is approximately 5.6 pCi/g (Cs-137) (see Table 4.10, **Reference 3.5**). This is very near the maximum permissible limit of 6.38 pCi/g (for Cs-137 as a surrogate) listed above for the SSGS area in general (assumes sample number SX10SD990033 has been chosen to represent the SSGS area).

Note that the cross-over sump piping in the SSGS footprint was more highly contaminated but was completely remediated from the SSGS facility (see Table 4.3, **Reference 3.5**).

5.3.3 To estimate an upper bounding dose contribution from one pipe end in the SSGS area or Discharge Tunnel, it is assumed that the pipe end is completely filled with contaminated materials. It is also assumed that the pipe is 2 feet long and jutting out perpendicularly from one wall. An 8 inch diameter pipe size from **Reference 3.5** was used as the model. The mix is assumed to contain 6.38 pCi/g Cs-137 and 0.04 pCi/g Co-60 (the effective DCGL). The impact of pipe wall shielding was ignored and the density of the fill materials is assumed to be 1.4 g/cc. The dose point is assumed to be 0.5 meters from the pipe stub end. MicroShield input concentrations are shown below.

Cs-137 concentration = (6.38 pCi/g x 1.4 g/cc)/1E+06 pCi/uCi = 8.932E-06 uCi/cc

Co-60 concentration = (0.04 pCi/g x 1.4 g/cc)/1E+06 pCi/uCi = 5.6E-08 uCi/cc.

5.3.4 The results from the MicroShield run indicates that a dose rate of 5.107E-05 mR/h (0.051 uR/h) would be generated from this model. See **Attachments 6-1** and **6-2**. Using the same assumptions of Section 5.2.4, the yearly dose from this pipe model is 8766 hrs/yr x 0.5 x 0.5 x 0.051 uR/h = 112 uR = 0.112 mR = ~0.112 mrem. This evaluation would be performed for relevant pipe sections remaining in the SSGS area and any residual dose would be considered within the equation listed in Section 4.1. This bounding estimate is an exaggerated case since the pipe is assumed to be completely filled with contaminated materials at the maximum concentration allowed.

5.3.5 In case two (2), a 10' section of the 18" cross-over tie line is assumed to be contaminated to the same concentration level as in 5.3.4 above for the pipe stub end. The tie line has been confirmed to be essentially empty with only residual surface deposits remaining at about 4 pCi/g Cs-137 (see **Reference 3.5**), but for purposes of this bounding calculation the assumptions previously stated will be used. Additionally, the contaminant materials are assumed to be held up in a 1" thick layer on the internal surface of the pipe. The wall thickness is assumed to be 0.562" (schedule 40). The dose point is assumed to be 0.5 meters from the pipe at the center of the pipes length.

5.3.6 The results from the MicroShield run indicates that a dose rate of 1.254E-04 mR/h (0.1254 uR/h) would be generated from this model. See **Attachments 6-3** and **6-4**. Using the same assumptions of Section 5.2.4, the yearly dose from this pipe model is 8766 hrs/yr x 0.5 x 0.5 x 0.1254 uR/h = 275 uR = 0.275 mR = ~0.275 mrem. This bounding estimate is an exaggerated case since the pipe is assumed to contain contaminated materials at the maximum concentration allowed.

5.3.7 Assuming that there are three (3) stub end pipe sections and the 18" tie line in the same area, the total gamma dose would be:

(0.112 mrem) x 3 + 0.275 mrem = 0.611 mrem from exposed pipe sections at the maximum allowed concentration. Then the dose controling equation for this area of the SNEC SSGS is:

$$\frac{X\,dpm/100\,cm^2}{8150\,dpm/100\,cm^2}+\frac{Y\,pCi/g}{6.38\,pCi/g\,(Cs-137\,Surrogate)}+\frac{0.611\,mrem}{25\,mrem}\leq 1$$

Since the area has no more than about 2 pCi/g of Cs-137 present in the surrounding concrete volumes, the permissible surface contamination limit on all surfaces in the area cannot be more than:

1 - 0.337 = 0.662 or 66.2% of the 8150 dpm/100 cm^2 surface contamination limit for this area or about 5300 dpm/100 cm^2 (see **Attachment 4-2** for permissible sum of fractions calculation for surface contamination). Thus area dose would be controlled by the bounding conditions.

6.0 LIST OF ATTACHMENTS

6.1 Attachments 1-1 to 1-2, "Sample Results for the Steel CV Shell", Sample No.SXSD3055.

6.2 Attachments 2-1 to 2-10, "CV Steel Shell Samples", Samples SXST3067 to 3087.

6.3 Attachment 3-1 to 3-12, Examples of Sample Materials from the SSGS Footprint Area.

6.4 Attachments 4-1 to 4-3, "Sample Results from the Discharge Tunnel", Sample SX10SD990033.

6.5 Attachments 5-1 to 5-7, Diagram and Layout for the MicroShield runs of the CV Steel Shell.

6.6 Attachments 6-1 to 6-4, MicroShield Run for 8" and 18" Diameter Pipe Models.

Effective DCGL Calculator for Cs-137 (dpm/100 cm^2)

Total Allowable Limit (a + b)		Cs-137 Allowable Limit *	
4256	dpm/100 cm^2	3707	dpm/100 cm^2

25.0 mrem/y TEDE Limit

SNEC AL	75%	SNEC Cs-137 Allowable Limit	
		2780	dpm/100 cm^2

SAMPLE NO(s)⇒ CV Steel Shell Scraping - Interior @ 792' El

	Isotope	Sample Input (pCi/g, uCi, etc.)	% of Total	Individual Limits (dpm/100 cm^2)	Allowed dpm/100 cm^2	mrem/y TEDE	Beta dpm/100 cm^2	Alpha dpm/100 cm^2	
1	Am-241	4.98E-01	0.342%	27	14.54	13.46	N/A	14.54	Am-241
2	C-14	4.90E-01	0.336%	3,700,000	14.30	0.00	14.30	N/A	C-14
3	Co-60	1.21E+00	0.830%	7,100	35.32	0.12	35.32	N/A	Co-60
4	Cs-137	1.27E+02	87.101%	28,000	3707.25	3.31	3707.3	N/A	Cs-137
5	Eu-152		0.000%	13,000	0.00	0.00	0.00	N/A	Eu-152
6	H-3	2.88E+00	1.975%	120,000,000	84.07	0.00	Not Detectable	N/A	H-3
7	NI-63	9.53E+00	6.536%	1,800,000	278.19	0.00	Not Detectable	N/A	NI-63
8	Pu-238	1.12E-01	0.077%	30	3.27	2.72	N/A	3.27	Pu-238
9	Pu-239	8.33E-02	0.057%	28	2.43	2.17	N/A	2.43	Pu-239
10	Pu-241	3.85E+00	2.640%	880	112.39	3.19	Not Detectable	N/A	Pu-241
11	Sr-90	1.55E-01	0.106%	8,700	4.52	0.01	4.52	N/A	Sr-90
			100.000%		4256	25.0	3761	20	
					Maximum Permissible dpm/100 cm^2				

ATTACHMENT 1.1

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SNEC SAMPLE RESULTS

LAB or LAB No.	Location/Description
Teledyne-75451; L18556-2	CV Steel Shell Scrapings - Interior @ ~792' El (C & D QAD)
SNEC Sample No.	Comments:
SXSD3055	
Other Identifier	
CV Dome Other	
Analysis Date=>	***June 18, 2002***

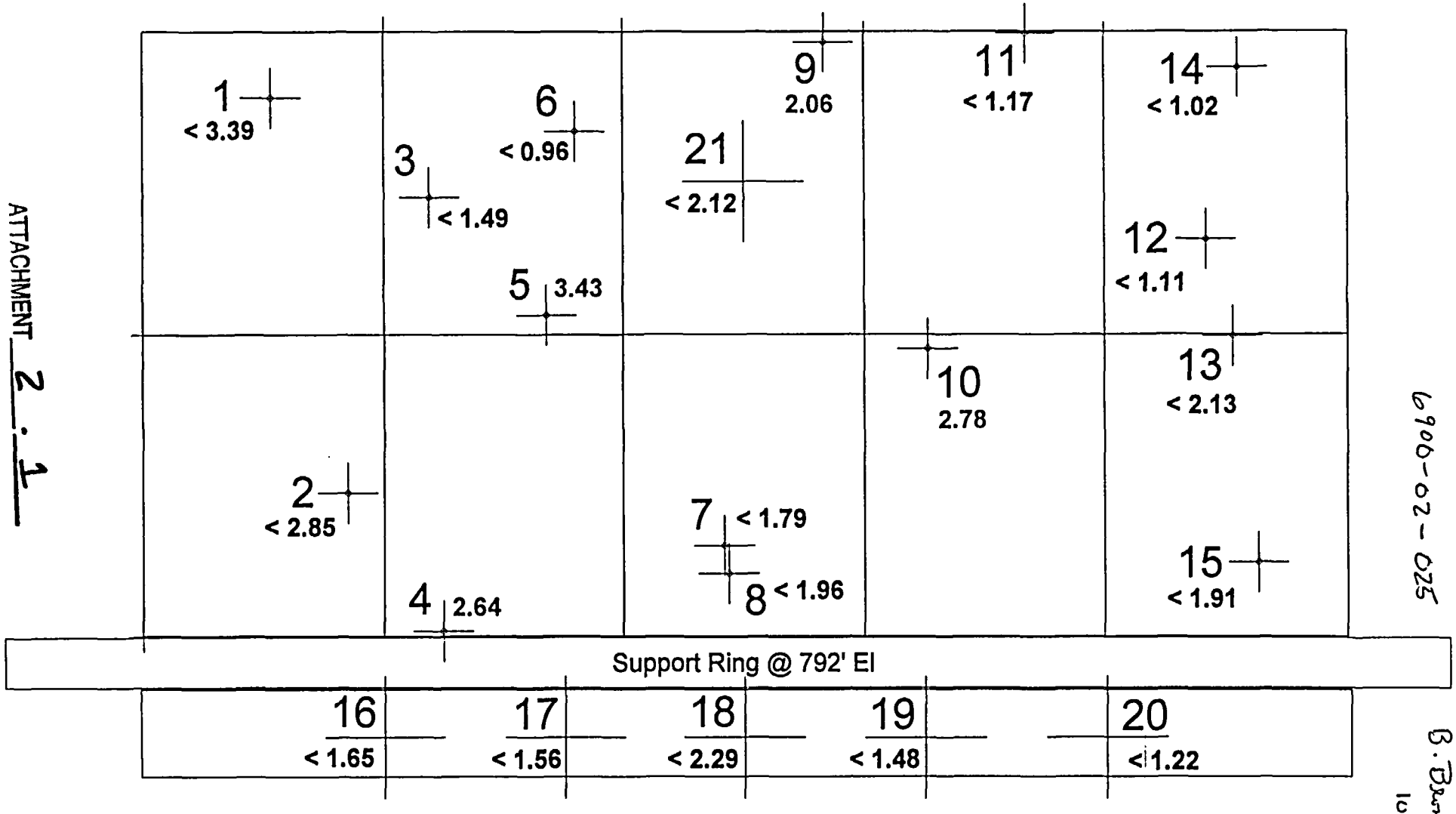
	Isotope	pCi/g (soilids) or pCi/l (if water) or pCi (if smears)
1	Am-241	< 0.498
2	C-14	0.49
3	Cm-243	< 0.179
4	Cm-244	< 0.179
5	Co-60	1.21
6	Cs-134	< 8.99E-02
7	Cs-137	127
8	Eu-152	—
9	Eu-154	—
10	Eu-155	—
11	Fe-55	< 16.1
12	H-3	2.88
13	Nb-94	—
14	Ni-59	—
15	Ni-63	< 9.53
16	Pu-238	< 0.112
17	Pu-239	0.0833
18	Pu-240	0.0833
19	Pu-241	< 3.85
20	Pu-242	—
21	Sb-125	—
22	Sr-90	0.155
23	Tc-99	< 0.322
24	U-234	0.824
25	U-235	< 1.28E-02
26	U-238	0.754
	Other Isotopes	**pCi/g (soilids) or pCi/l (if water) or pCi (if smears)**
	On-site Analysis for Cs-137	—
	On-site Analysis for Co-60	—
	On-site Analysis for H-3	—
	I-129	< 0.0692
	Gross Alpha	—
	Gross Beta	—
	K-40	2.6
	Ra-226	< 3.5
	Th-232	—
	Cm-242	< 0.196
	Th-228	< 0.837
	Np-237	0.293
	Ce-144	< 6.75E-01

ATTACHMENT 1.2

Sample Plan - Activation Zone

20' by 10' AREA of CV Shell - Ten 20 ft^2 Zones

(Co-60 Concentrations in pCi/g)



ATTACHMENT 2.1

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BWX Technologies, Incorporated
BWXT Services, Inc.

Nuclear & Environmental Operations
2016 Mt. Athos Road
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FAX Number: (434) 522-6860

FAX TRANSMITTAL COVER PAGE

To: Barry Brosey Fax No.: 717-948-8878

To: — Fax No.: —

From: Jim Clark Phone: 434-522-6738

Message: DATA REPORT – ^{59,63}Ni RESULTS ADDED.

Number of Pages: 7 Including Cover Page

Date: 8/27/02

ATTACHMENT 2.2

A N A L Y S I S R E P O R T

BWXT Services, Inc. - NEL Services • 2016 Mt. Athos Rd. • Lynchburg, VA 24504-5447 • (434) 522-5165 • Fax (434) 522-6860

Report Date:	August 27, 2002	**Report #:**	0207047	**NELS Contract #:**	1030-003-10-01
Customer:	GPU Nuclear/Saxton	**Customer Contact:**	Barry Brosey	**Customer Authorization #:**	0760084 (CN-1)
Project Description:	SNEC Metal Samples	**Sample Description:**		See Attached Cust COC	
Sample Receipt Date:	July 18, 2002	**Sample Collection/Reference Date:**		See Attached Cust COC	
		Total pages in this report:		6 including 2 page(s) of attachments	

Comments: Co-60 and Cs-137 MDA's elevated as the result of limited sample quantity.
Note: Some Ni-59 / Ni-63 MDA's elevated due to matrix interference.

Customer Sample ID	NELS Sample ID	Analysis Method	Analyte	Result	2 Sigma Uncertainty	MDA	Units [1]	Preperation Date	Analysis Date	Comments
SX-ST-3067	0207047-01	EPA 901.1	Co-60	MDA	NA	[illegible]	pCi/g	07/25/02	07/25/02	
SX-ST-3067	0207047-01	EPA 901.1	Cs-137	16.90	2.48	2.76	pCi/g	07/25/02	07/25/02	
SX-ST-3067	0207047-01	LEPS	Ni-59	MDA	NA	281.60	pCi/g	08/20/02	08/21/02	Note
SX-ST-3068	0207047-01	Liq Scint	Ni-63	MDA	NA	[illegible]	pCi/g	08/20/02	08/26/02	Note
SX-ST-3068	0207047-02	EPA 901.1	Co-60	MDA	NA	[illegible]	pCi/g	07/25/02	07/25/02	
SX-ST-3068	0207047-02	EPA 901.1	Cs-137	59.00	3.80	2.30	pCi/g	07/25/02	07/25/02	
SX-ST-3068	0207047-02	LEPS	Ni-59	MDA	NA	25.89	pCi/g	08/20/02	08/21/02	
SX-ST-3069	0207047-02	Liq Scint	Ni-63	MDA	NA	[illegible]	pCi/g	08/20/02	08/26/02	
SX-ST-3069	0207047-03	EPA 901.1	Co-60	MDA	NA	[illegible]	pCi/g	07/25/02	07/25/02	
SX-ST-3069	0207047-03	EPA 901.1	Cs-137	2.28	0.64	0.92	pCi/g	07/25/02	07/25/02	
SX-ST-3069	0207047-03	LEPS	Ni-59	MDA	NA	85.12	pCi/g	08/20/02	08/21/02	Note
SX-ST-3070	0207047-03	Liq Scint	Ni-63	MDA	NA	[illegible]	pCi/g	08/20/02	08/26/02	
SX-ST-3070	0207047-04	EPA 901.1	Co-60	[illegible]	1.07	1.52	pCi/g	07/25/02	07/25/02	
SX-ST-3070	0207047-04	EPA 901.1	Cs-137	180.00	5.84	1.83	pCi/g	07/25/02	07/25/02	
SX-ST-3070	0207047-04	LEPS	Ni-59	MDA	NA	72.84	pCi/g	08/20/02	08/21/02	Note
SX-ST-3071	0207047-04	Liq Scint	Ni-63	[illegible]	7.57	10.80	pCi/g	08/20/02	08/26/02	
SX-ST-3071	0207047-05	EPA 901.1	Co-60	[illegible]	1.07	1.56	pCi/g	07/25/02	07/26/02	
SX-ST-3071	0207047-05	EPA 901.1	Cs-137	9.26	1.09	1.34	pCi/g	07/25/02	07/26/02	
SX-ST-3071	0207047-05	LEPS	Ni-59	MDA	NA	182.82	pCi/g	08/20/02	08/21/02	Note
SX-ST-3072	0207047-05	Liq Scint	Ni-63	MDA	NA	[illegible]	pCi/g	08/20/02	08/26/02	Note

[1] All results are reported "as received" unless otherwise specified: (d) = dry weight, (w) = wet weight

ATTACHMENT 2.3

6906-02-025

11 B. Brosey 10/16/02

A N A L Y S I S R E P O R T

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Customer Sample ID	NELS Sample ID	Analysis Method	Analyte	Result	2 Sigma Uncertainty	MDA	Units [1]	Preparation Date	Analysis Date	Comments
SX-ST-3072	0207047-06	EPA 901.1	Co-60	MDA	NA	[illegible]	pCi/g	07/25/02	07/26/02	
SX-ST-3072	0207047-06	EPA 901.1	Cs-137	1.12	0.43	0.60	pCi/g	07/25/02	07/26/02	
SX-ST-3072	0207047-06	LEPS	Ni-59	MDA	NA	61.62	pCi/g	08/20/02	08/21/02	Note
SX-ST-3073	0207047-06	Liq Scint	Ni-63	MDA	NA	[illegible]	pCi/g	08/20/02	08/26/02	
SX-ST-3073	0207047-07	EPA 901.1	Co-60	MDA	NA	[illegible]	pCi/g	07/25/02	07/29/02	
SX-ST-3073	0207047-07	EPA 901.1	Cs-137	3.03	0.77	1.04	pCi/g	07/25/02	07/29/02	
SX-ST-3073	0207047-07	LEPS	Ni-59	MDA	NA	33.15	pCi/g	08/20/02	08/21/02	
SX-ST-3074	0207047-07	Liq Scint	Ni-63	MDA	NA	[illegible]	pCi/g	08/20/02	08/26/02	
SX-ST-3074	0207047-08	EPA 901.1	Co-60	MDA	NA	[illegible]	pCi/g	07/25/02	07/31/02	
SX-ST-3074	0207047-08	EPA 901.1	Cs-137	3.36	1.15	1.67	pCi/g	07/25/02	07/31/02	
SX-ST-3074	0207047-08	LEPS	Ni-59	MDA	NA	31.51	pCi/g	08/20/02	08/23/02	
SX-ST-3075	0207047-08	Liq Scint	Ni-63	MDA	NA	[illegible]	pCi/g	08/20/02	08/26/02	
SX-ST-3075	0207047-09	EPA 901.1	Co-60	[illegible]	0.68	0.94	pCi/g	07/25/02	07/29/02	
SX-ST-3075	0207047-09	EPA 901.1	Cs-137	1.37	0.53	0.79	pCi/g	07/25/02	07/29/02	
SX-ST-3075	0207047-09	LEPS	Ni-59	MDA	NA	9.21	pCi/g	08/20/02	08/21/02	
SX-ST-3076	0207047-09	Liq Scint	Ni-63	MDA	NA	[illegible]	pCi/g	08/20/02	08/26/02	
SX-ST-3076	0207047-10	EPA 901.1	Co-60	[illegible]	0.85	1.17	pCi/g	07/25/02	07/31/02	
SX-ST-3076	0207047-10	EPA 901.1	Cs-137	24.80	1.49	1.02	pCi/g	07/25/02	07/31/02	
SX-ST-3076	0207047-10	LEPS	Ni-59	MDA	NA	24.35	pCi/g	08/20/02	08/21/02	
SX-ST-3077	0207047-10	Liq Scint	Ni-63	MDA	NA	[illegible]	pCi/g	08/20/02	08/26/02	
SX-ST-3077	0207047-11	EPA 901.1	Co-60	MDA	NA	[illegible]	pCi/g	07/25/02	07/29/02	
SX-ST-3077	0207047-11	EPA 901.1	Cs-137	MDA	NA	1.16	pCi/g	07/25/02	07/29/02	
SX-ST-3077	0207047-11	LEPS	Ni-59	MDA	NA	32.61	pCi/g	08/20/02	08/22/02	
SX-ST-3078	0207047-11	Liq Scint	Ni-63	MDA	NA	[illegible]	pCi/g	08/20/02	08/26/02	
SX-ST-3078	0207047-12	EPA 901.1	Co-60	MDA	NA	[illegible]	pCi/g	07/25/02	07/26/02	
SX-ST-3078	0207047-12	EPA 901.1	Cs-137	2.30	0.52	0.72	pCi/g	07/25/02	07/26/02	
SX-ST-3078	0207047-12	LEPS	Ni-59	MDA	NA	186.79	pCi/g	08/20/02	08/22/02	Note
SX-ST-3079	0207047-12	Liq Scint	Ni-63	MDA	NA	[illegible]	pCi/g	08/20/02	08/26/02	Note

[1] All results are reported "as received" unless otherwise specified: (d) = dry weight, (w) = wet weight

ATTACHMENT 2.4

6960-02-025

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B. Brown 10/6/02

A N A L Y S I S R E P O R T

BWXT Services, Inc. - NEL Services • 2016 Mt. Athos Rd. • Lynchburg, VA 24504-5447 • (434) 522-5165 • Fax (434) 522-6860

Customer Sample ID	NELS Sample ID	Analysis Method	Analyte	Result	2 Sigma Uncertainty	MDA	Units [1]	Preparation Date	Analysis Date	Comments
SX-ST-3079	0207047-13	EPA 901.1	Co-60	MDA	NA	[illegible]	pCi/g	07/25/02	07/29/02	
SX-ST-3079	0207047-13	EPA 901.1	Cs-137	5.08	1.09	1.41	pCi/g	07/25/02	07/29/02	
SX-ST-3079	0207047-13	LEPS	Ni-59	MDA	NA	38.84	pCi/g	08/20/02	08/26/02	
SX-ST-3080	0207047-13	Liq Scint	Ni-63	MDA	NA	[illegible]	pCi/g	08/20/02	08/26/02	
SX-ST-3080	0207047-14	EPA 901.1	Co-60	MDA	NA	[illegible]	pCi/g	07/25/02	07/29/02	
SX-ST-3080	0207047-14	EPA 901.1	Cs-137	1.90	0.52	0.65	pCi/g	07/25/02	07/29/02	
SX-ST-3080	0207047-14	LEPS	Ni-59	MDA	NA	42.97	pCi/g	08/20/02	08/26/02	
SX-ST-3081	0207047-14	Liq Scint	Ni-63	MDA	NA	[illegible]	pCi/g	08/20/02	08/26/02	
SX-ST-3081	0207047-15	EPA 901.1	Co-60	MDA	NA	[illegible]	pCi/g	07/25/02	07/29/02	
SX-ST-3081	0207047-15	EPA 901.1	Cs-137	3.44	0.96	1.45	pCi/g	07/25/02	07/29/02	
SX-ST-3081	0207047-15	LEPS	Ni-59	MDA	NA	13.20	pCi/g	08/20/02	08/26/02	
SX-ST-3082	0207047-15	Liq Scint	Ni-63	MDA	NA	[illegible]	pCi/g	08/20/02	08/26/02	
SX-ST-3082	0207047-16	EPA 901.1	Co-60	MDA	NA	[illegible]	pCi/g	07/25/02	07/30/02	
SX-ST-3082	0207047-16	EPA 901.1	Cs-137	3.00	0.86	1.15	pCi/g	07/25/02	07/30/02	
SX-ST-3082	0207047-16	LEPS	Ni-59	MDA	NA	37.40	pCi/g	08/20/02	08/26/02	
SX-ST-3083	0207047-16	Liq Scint	Ni-63	MDA	NA	[illegible]	pCi/g	08/20/02	08/26/02	
SX-ST-3083	0207047-17	EPA 901.1	Co-60	MDA	NA	[illegible]	pCi/g	07/25/02	07/30/02	
SX-ST-3083	0207047-17	EPA 901.1	Cs-137	MDA	NA	1.69	pCi/g	07/25/02	07/30/02	
SX-ST-3083	0207047-17	LEPS	Ni-59	MDA	NA	39.32	pCi/g	08/20/02	08/26/02	
SX-ST-3084	0207047-17	Liq Scint	Ni-63	MDA	NA	[illegible]	pCi/g	08/20/02	08/26/02	
SX-ST-3084	0207047-18	EPA 901.1	Co-60	MDA	NA	[illegible]	pCi/g	07/25/02	07/26/02	
SX-ST-3084	0207047-18	EPA 901.1	Cs-137	2.55	0.94	1.38	pCi/g	07/25/02	07/26/02	
SX-ST-3084	0207047-18	LEPS	Ni-59	MDA	NA	97.43	pCi/g	08/20/02	08/23/02	Note
SX-ST-3085	0207047-18	Liq Scint	Ni-63	MDA	NA	[illegible]	pCi/g	08/20/02	08/26/02	
SX-ST-3085	0207047-19	EPA 901.1	Co-60	MDA	NA	[illegible]	pCi/g	07/25/02	07/30/02	
SX-ST-3085	0207047-19	EPA 901.1	Cs-137	MDA	NA	1.38	pCi/g	07/25/02	07/30/02	
SX-ST-3085	0207047-19	LEPS	Ni-59	MDA	NA	41.33	pCi/g	08/20/02	08/26/02	

[1] All results are reported "as received" unless otherwise specified: (d) = dry weight, (w) = wet weight

ATTACHMENT 2.5

6960-02-025

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B. Brown 10/6/02

A N A L Y S I S R E P O R T

BWXT Services, Inc. - NEL Services • 2016 Mt. Athos Rd. • Lynchburg, VA 24504-5447 • (434) 522-5165 • Fax (434) 522-6860

Customer Sample ID	NELS Sample ID	Analysis Method	Analyte	Result	2 Sigma Uncertainty	MDA	Units [1]	Preparation Date	Analysis Date	Comments
SX-ST-3086	0207047-19	Liq Scint	Ni-63	MDA	NA	[redacted]	pCi/g	08/20/02	08/26/02	
SX-ST-3086	0207047-20	EPA 901.1	Co-60	MDA	NA	[redacted]	pCi/g	07/25/02	07/26/02	
SX-ST-3086	0207047-20	EPA 901.1	Cs-137	MDA	NA	1.13	pCi/g	07/25/02	07/26/02	
SX-ST-3086	0207047-20	LEPS	Ni-59	MDA	NA	280.85	pCi/g	08/20/02	08/26/02	Note
SX-ST-3087	0207047-20	Liq Scint	Ni-63	MDA	NA	[redacted]	pCi/g	08/20/02	08/26/02	Note
SX-ST-3087	0207047-21	EPA 901.1	Co-60	MDA	NA	[redacted]	pCi/g	07/25/02	07/31/02	
SX-ST-3087	0207047-21	EPA 901.1	Cs-137	MDA	NA	1.45	pCi/g	07/25/02	07/31/02	
SX-ST-3087	0207047-21	LEPS	Ni-59	MDA	NA	14.65	pCi/g	08/20/02	08/26/02	
SX-ST-3087	0207047-21	Liq Scint	Ni-63	MDA	NA	[redacted]	pCi/g	08/20/02	08/26/02	

ATTACHMENT 2.6

6906-02-025

Data Released By: James L. Clark Date: 8/27/02

Name /Title: James L. Clark / Project Manager

Unless noted as a comment, this report meets all requirements of NELAC

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B. Bruce 10/6/02

[1] All results are reported "as received" unless otherwise specified: (d) = dry weight, (w) = wet weight

ANALYSIS REPORT

BWXT Services, Inc. - NEL Services • 2016 Mt. Athos Rd. • Lynchburg, VA 24504-5447 • (434) 522-5165 • Fax (434) 522-6860

ATTACHMENT 2.7

6900-02-025

0207047

BWXT M-4300.30 (Rev. 0)
Exhibit

SNEC SAMPLE ANALYSIS REQUEST SHEET

DESTINATION : BWXT

Sample Description/Sample Location	Lab ID Number *	Start Date/Time	Stop Date/Time	Sample Volume (ml)	Timer Reading	Analysis Requested/Comments	LLD required
SX-ST-3067		N/A	7/12 1000	~10cc	N/A	Co-60, Ni-63, Ni-59, γ-scan	Cs137-0.1pCi/g, Co-60-0.05pCi/g, Ni-63-1.0pCi/g, Ni-59-40pCi/g
3068			7/12 0905				
3069			7/12 0930				
3070			7/12 0912				
3071			7/12 0925				
3072			7/12 1340				
3073			7/12 0940				
3074			7/12 0950				
3075			7/12 1350				
3076			7/12 1025				
3077		N/A	7/12 1306				

* To be completed by Lab Staff upon receipt

Send Results To: D. Sorge Phone: (804) 635-2829 Collected By: Marquette/Law Date: 7/12/02

Delivered By: _____ Date: _____ Received By: [signature] Date: 7/15/02 0940

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B. Bruno 10/6/02

(1) All results are reported "as received" unless otherwise specified: (d) = dry weight, (w) = wet weight

A N A L Y S I S R E P O R T

BWXT Services, Inc. - NEL Services • 2016 Mt. Athos Rd. • Lynchburg, VA 24504-5447 • (434) 522-5165 • Fax (434) 522-6860

EVR 34-4900.10 (REV. 0)
Effective:

0207047

SNEC SAMPLE ANALYSIS REQUEST SHEET

DESTINATION : BWXT

Sample Description/Sample Location	Lab ID Number *	Start Date/Time	Stop Date/Time	Sample Volume (Wt)	Timer Reading	Analysis Requested/Comments		LLD required
Sx-ST-3078		N/A	7/12 1345	10cc	N/A	γ-Scan, Co-60, Ni-63 Sr-90 Ni-63 Sr-90		Cs-137: 0.1 pCi/g Co-60: 0.05 pCi/g
3079		N/A	7/12 1040	10cc	N/A			Sr-90: 4.0 pCi/g Ni-63: 16.0 pCi/g
3080		N/A	7/12 1300	10cc	N/A			
3081		N/A	7/12 1010	10cc	N/A			
3082		N/A	7/12 1030	10cc	N/A			
3083		N/A	7/12 1059	10cc	N/A			
3084		N/A	7/12 1055	10cc	N/A			
3085		N/A	7/12 1049	10cc	N/A			
3086		N/A	7/12 1049	10cc	N/A			
3087		N/A	7/12 1350	10cc	N/A			

* To be completed by Lab Staff upon receipt

Send Results To: D Singer Phone: (814) 635-2827 Collected By: Margaretha Lee Date: 7/17/02

Delivered By: _____ Date: _____ Received By: [signature] Date: 7/18/02 1240

6900-02-025

16 2 44
B. Bunge 10/6/02

ATTACHMENT 2.8

(1) All results are reported "as received" unless otherwise specified: (d) = dry weight, (w) = wet weight

6900-02-025 17 of 44
B. Bruny 10/6/02

StatMost for Windows Saturday, October 05, 2002 2:46:53 PM

********** Statistics Report **********

Co-60 Steel Activation of SNEC CV

Sample size (N)	21
Num missings	0
Minimum	0.9600
Maximum	3.4300
Std deviation	**0.7356**
Variance	0.5411
Mean	**1.9529**
Geometric mean	1.8248
Quadratic mean	2.0806
Harmonic mean	1.7041
Sum	41.0100
Absolute Sum	41.0100
Median	1.9100
Percentiles:	
10	1.0380
25	1.3500
50	1.9100
75	2.4650
90	3.2820
Quartiles:	
First quartile:	1.3500
Second quartile:	1.9100
Third quartile:	2.4650
95.00% Confidence Interval:	
lower limit	1.6180
upper limit	2.2877

********** The End **********

ATTACHMENT 2.9

6900-02-025 18 of 44
B. Bowing 10/6/02

Activated Steel.dmd Saturday, October 05, 2002 2:57:53 PM

	Sample Names	Co-60 Steel Activation (pCi/g)	Ni-59 pCi/g	Ni-63 pCi/g	Cs-137 pCi/g	Grams
1	SXST3067-1	< 3.39	< 261.6	< 30.35	16.9	2.1
2	SXST3068-2	< 2.85	< 25.89	< 10.38	59	2.535
3	SXST3069-3	< 1.49	<85.12	< 10.96	2.28	4.226
4	SXST3070-4	2.64	< 72.84	20.23	180	2.749
5	SXST3071-5	3.43	< 182.82	< 27.11	9.26	1.515
6	SXST3072-6	< 0.96	< 61.62	< 12.8	1.12	6.685
7	SXST3073-7	< 1.79	< 33.15	< 3.8	3.03	2.749
8	SXST3074-8	< 1.96	< 31.51	< 5.25	3.36	3.163
9	SXST3075-9	2.06	< 9.21	< 4.46	1.37	3.591
10	SXST3067-1	2.78	< 24.35	< 8.54	24.8	3.248
11	SXST3077-11	< 1.17	< 32.61	< 4.84	< 1.16	4.712
12	SXST3078-12	< 1.11	< 186.79	< 20.46	2.3	5.674
13	SXST3079-13	< 2.13	< 38.84	< 4.29	5.08	2.198
14	SXST3080-14	< 1.02	< 42.97	< 4.99	1.9	4.76
15	SXST3081-15	< 1.91	< 13.2	< 4.02	3.44	2.129
16	SXST3082-16	< 1.65	< 37.4	< 4.33	3	3.492
17	SXST3083-17	< 1.56	< 39.32	< 5.11	< 1.69	3.292
18	SXST3084-18	< 2.29	< 97.43	< 9.46	2.55	1.808
19	SXST3085-19	< 1.48	< 41.33	< 5.9	< 1.38	2.798
20	SXST3086-20	< 1.22	< 280.85	< 36.21	< 1.13	5.881
21	SXST3087-21	< 2.12	< 14.65	< 3.89	< 1.45	3.046

ATTACHMENT 2.10

Effective DCGL Calculator for Cs-137 (in pCi/g)

Total Allowable pCi/g		Cs-137 Allowable Limit	
6.95	pCi/g	6.02	pCi/g

SAMPLE NUMBER(s)⇒ SSGS SE Sump. Au-133

SNEC AL	75%	SNEC Cs-137 Allowable Limit	
		4.51	pCi/g

2641.42%	25.0	mrem/y TEDE Limit
163.71%	4.0	mrem/y Drinking Water (DW) Limit

☑ Check for 25 mrem/y

	Isotope	Sample Input (pCi/g, uCi, etc.)	% of Total	25 mrem/y TEDE Limits (pCi/g)	4 mrem/y DW Limits (pCi/g)	A - Allowed pCi/g for 25 mrem/y TEDE	B - Allowed pCi/g for 4 mrem/y DW	Value Checked from Column A or B	This Sample mrem/y TEDE	This Sample mrem/y DW	
1	Am-241	0.014	0.008%	9.9	2.3	0.00	0.01	0.00	0.04	0.02	Am-241
2	C-14	4.07	2.217%	2.0	6.4	0.15	2.49	0.15	50.88	1.01	C-14
3	Co-60	0.54	0.294%	3.5	67.0	0.02	0.33	0.02	3.86	0.03	Co-60
4	Cs-137	159	86.623%	6.6	397	6.02	87.12	6.02	602.27	1.60	Cs-137
5	Eu-152	0.04	0.022%	10.1	1440	0.00	0.02	0.00	0.10	0.00	Eu-152
6	H-3	12.1	6.592%	132	31.1	0.46	7.39	0.46	2.29	1.56	H-3
7	Ni-63	7.2	3.923%	747	19000	0.27	4.40	0.27	0.24	0.00	Ni-63
8	Pu-238	0.003	0.002%	1.8	0.21	0.00	0.00	0.00	0.04	0.03	Pu-238
9	Pu-239	0.004	0.002%	1.6	0.37	0.00	0.00	0.00	0.06	0.04	Pu-239
10	Pu-241	0.562	0.306%	86	19.8	0.02	0.34	0.02	0.16	0.11	Pu-241
11	Sr-90	0.02	0.011%	1.2	0.61	0.00	0.01	0.00	0.42	0.13	Sr-90
		1.84E+02	100.000%			6.95	112.12	6.95	660.356	6.649	
						Maximum Permissible pCi/g (25 mrem/y)	Maximum Permissible pCi/g (4 mrem/y)		To Use This Information, Sample Input Units Must Be in pCi/g		

ATTACHMENT 3.1

6900-02-025 19 of 44

B. Brown 10/6/02

Effective DCGL Calculator for Cs-137 (dpm/100 cm^2)

Total Allowable Limit (a + b)		Cs-137 Allowable Limit	
25617	dpm/100 cm^2	22191	dpm/100 cm^2

SNEC AL	75%	SNEC Cs-137 Allowable Limit	
		16643	dpm/100 cm^2

25.0 mrem/y TEDE Limit

SAMPLE NO(s)⇒ SSGS SE Sump, Au-133

	Isotope	Sample Input (pCi/g, uCi, etc.)	% of Total	Individual Limits (dpm/100 cm^2)	Allowed dpm/100 cm^2	mrem/y TEDE	Beta dpm/100 cm^2	Alpha dpm/100 cm^2	
1	Am-241	1.40E-02	0.008%	27	1.95	1.81	N/A	1.95	Am-241
2	C-14	4.07E+00	2.217%	3,700,000	568.02	0.00	568.02	N/A	C-14
3	Co-60	5.40E-01	0.294%	7,100	75.36	0.27	75.36	N/A	Co-60
4	Cs-137	1.59E+02	86.623%	28,000	22190.54	19.81	22190.5	N/A	Cs-137
5	Eu-152	4.00E-02	0.022%	13,000	5.58	0.01	5.58	N/A	Eu-152
6	H-3	1.21E+01	6.592%	120,000,000	1688.71	0.00	Not Detectable	N/A	H-3
7	Ni-63	7.20E+00	3.923%	1,800,000	1004.85	0.01	Not Detectable	N/A	Ni-63
8	Pu-238	3.00E-03	0.002%	30	0.42	0.35	N/A	0.42	Pu-238
9	Pu-239	4.00E-03	0.002%	28	0.56	0.50	N/A	0.56	Pu-239
10	Pu-241	5.62E-01	0.306%	880	78.43	2.23	Not Detectable	N/A	Pu-241
11	Sr-90	2.00E-02	0.011%	8,700	2.79	0.01	2.79	N/A	Sr-90
			100.000%		25617	25.0	22842	3	
					Maximum Permissible dpm/100 cm^2				

ATTACHMENT 3.2

6900-02-025 20 of 44
B. Bump 10/6/02

6900-02-025 21 & 44
B. Brown 10/6/02

SNEC SAMPLE RESULTS

LAB or LAB No.	Location/Description
BWXT, 0111056-02	SSGS SE Sump, AU-133, SR-0003
SNEC Sample No.	Comments:
SXSD723	
Other Identifier	
SSGS/DT/IT Area Sample	
Analysis Date=>	***February 20, 2001***

	Isotope	pCi/g (soilids) or pCi/l (if water) or pCi (if smears)
1	Am-241	< 0.014
2	C-14	< 4.07
3	Cm-243	---
4	Cm-244	< 0.004
5	Co-60	0.54
6	Cs-134	< 0.05
7	Cs-137	159
8	Eu-152	< 0.04
9	Eu-154	< 0.03
10	Eu-155	< 0.17
11	Fe-55	< 28.3
12	H-3	< 12.1
13	Nb-94	< 0.01
14	Ni-59	< 16
15	Ni-63	< 7.2
16	Pu-238	< 0.003
17	Pu-239	< 0.004
18	Pu-240	< 0.004
19	Pu-241	< 0.562
20	Pu-242	< 0.003
21	Sb-125	< 0.23
22	Sr-90	< 0.02
23	Tc-99	< 0.37
24	U-234	0.26
25	U-235	0.011
26	U-238	0.209
	Other Isotopes	pCi/g (soilids) or pCi/l (if water) or pCi (if smears)
	On-site Analysis for Cs-137	---
	On-site Analysis for Co-60	---
	On-site Analysis for H-3	---
	I-129	< 1.68
	Gross Alpha	---
	Gross Beta	---
	K-40	---
	Ra-226	---
	Th-232	---
	Cm-242	< 0.019
	Th-228	---
	Np-237	< 0.005
	Ce-144	< 0.57

ATTACHMENT 3.3

Effective DCGL Calculator for Cs-137 (in pCi/g)

Total Allowable pCi/g		Cs-137 Allowable Limit	
6.74	pCi/g	6.42	pCi/g

SAMPLE NUMBER(s)⇒ SSGS East Disk # 1

SNEC AL	75%	SNEC Cs-137 Allowable Limit	
		4.81	pCi/g

10281.04%	25.0	mrem/y TEDE Limit
380.73%	4.0	mrem/y Drinking Water (DW) Limit

☑ Check for 25 mrem/y

	Isotope	Sample Input (pCi/g, uCi, etc.)	% of Total	25 mrem/y TEDE Limits (pCi/g)	4 mrem/y DW Limits (pCi/g)	A - Allowed pCi/g for 25 mrem/y TEDE	B - Allowed pCi/g for 4 mrem/y DW	Value Checked from Column A or B	This Sample mrem/y TEDE	This Sample mrem/y DW	
1	Am-241	0.29	0.042%	9.9	2.3	0.00	0.08	0.00	0.73	0.50	Am-241
2	C-14	3.68	0.531%	2.0	6.4	0.04	0.97	0.04	46.00	2.73	C-14
3	Co-60	2.01	0.290%	3.5	67.0	0.02	0.53	0.02	14.36	0.12	Co-60
4	Cs-137	660	95.268%	6.6	397	6.42	173.35	6.42	2500.00	6.65	Cs-137
5	Eu-152	0.31	0.045%	10.1	1440	0.00	0.08	0.00	0.77	0.00	Eu-152
6	H-3	11.7	1.689%	132	31,11	0.11	3.07	0.11	2.22	1.50	H-3
7	Ni-63	7.73	1.116%	747	19000	0.08	2.03	0.08	0.26	0.00	Ni-63
8	Pu-238	0.046	0.007%	1.8	0.41	0.00	0.01	0.00	0.64	0.45	Pu-238
9	Pu-239	0.145	0.021%	1.6	0.37	0.00	0.04	0.00	2.27	1.57	Pu-239
10	Pu-241	6.819	0.984%	86	19.8	0.07	1.79	0.07	1.98	1.38	Pu-241
11	Sr-90	0.05	0.007%	1.2	0.81	0.00	0.01	0.00	1.04	0.33	Sr-90
		6.93E+02	100.000%			6.74	181.96	6.74	2570.260	15.229	
						Maximum Permissible pCi/g (25 mrem/y)	Maximum Permissible pCi/g (4 mrem/y)		To Use This Information, Sample Input Units Must Be in pCi/g		

ATTACHMENT 3.4

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B. Bennett 10/6/02

Effective DCGL Calculator for Cs-137 (dpm/100 cm^2)

Total Allowable Limit (a+b)		Cs-137 Allowable Limit	
14112	dpm/100 cm^2	13444	dpm/100 cm^2

25.0 mrem/y TEDE Limit

SNEC AL	75%	SNEC Cs-137 Allowable Limit	
		10083	dpm/100 cm^2

SAMPLE NO(s)⇒ *SSGS, East, Disk # 1*

	Isotope	Sample Input (pCi/g, uCi, etc.)	% of Total	Individual Limits (dpm/100 cm^2)	Allowed dpm/100 cm^2	mrem/y TEDE	Beta dpm/100 cm^2	Alpha dpm/100 cm^2	
1	Am-241	2.90E-01	0.042%	127	5.91	5.47	N/A	5.91	Am-241
2	C-14	3.68E+00	0.531%	3,700,000	74.96	0.00	74.96	N/A	C-14
3	Co-60	2.01E+00	0.290%	7,100	40.94	0.14	40.94	N/A	Co-60
4	Cs-137	6.60E+02	95.268%	28,000	13444.42	12.00	13444.4	N/A	Cs-137
5	Eu-152	3.10E-01	0.045%	13,000	6.31	0.01	6.31	N/A	Eu-152
6	H-3	1.17E+01	1.689%	120,000,000	238.33	0.00	Not Detectable	N/A	H-3
7	Ni-63	7.73E+00	1.116%	1,800,000	157.46	0.00	Not Detectable	N/A	Ni-63
8	Pu-238	4.60E-02	0.007%	130	0.94	0.78	N/A	0.94	Pu-238
9	Pu-239	1.45E-01	0.021%	28	2.95	2.64	N/A	2.95	Pu-239
10	Pu-241	6.82E+00	0.984%	880	138.91	3.95	Not Detectable	N/A	Pu-241
11	Sr-90	5.00E-02	0.007%	8,700	1.02	0.00	1.02	N/A	Sr-90
			100.000%		14112	25.0	13568	10	
					Maximum Permissible dpm/100 cm^2				

ATTACHMENT 3.5

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B. Brown 10/6/02

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B. Brown 10/6/02

SNEC SAMPLE RESULTS

	LAB or LAB No.	Location/Description
	BWXT, 0111056-04	SSGS, East, Disk # 1
	SNEC Sample No.	Comments:
	SXCF828	
	Other Identifier	
	SSGS/DT/IT Area Sample	
	Analysis Date=>	***May 4, 2001***
	Isotope	**pCi/g (soilids) or pCi/l (if water) or pCi (if smears)**
1	Am-241	0.29
2	C-14	< 3.68
3	Cm-243	—
4	Cm-244	< 0.05
5	Co-60	2.01
6	Cs-134	< 0.33
7	Cs-137	660
8	Eu-152	< 0.31
9	Eu-154	< 0.24
10	Eu-155	< 1.02
11	Fe-55	< 3.41
12	H-3	< 11.7
13	Nb-94	< 0.07
14	Ni-59	< 6.49
15	Ni-63	< 7.73
16	Pu-238	< 0.046
17	Pu-239	0.145
18	Pu-240	0.145
19	Pu-241	< 6.819
20	Pu-242	< 0.046
21	Sb-125	< 1.83
22	Sr-90	< 0.05
23	Tc-99	< 0.67
24	U-234	0.282
25	U-235	0.009
26	U-238	0.263
	Other Isotopes	**pCi/g (soilids) or pCi/l (if water) or pCi (if smears)**
	On-site Analysis for Cs-137	—
	On-site Analysis for Co-60	—
	On-site Analysis for H-3	—
	I-129	< 1.68
	Gross Alpha	—
	Gross Beta	—
	K-40	—
	Ra-226	—
	Th-232	—
	Cm-242	< 0.123
	Th-228	—
	Np-237	< 0.056
	Ce-144	< 2.96

ATTACHMENT 3 . 6

Effective DCGL Calculator for Cs-137 (in pCi/g)

Total Allowable pCi/g		Cs-137 Allowable Limit	
17.16	pCi/g	5.40	pCi/g
SNEC AL	75%	SNEC Cs-137 Allowable Limit	
		4.05	pCi/g

SAMPLE NUMBER(s)=> SSGS Footprint East Turbine Sump Area

1811.94%	25.0	mrem/y TEDE Limit
978.15%	4.0	mrem/y Drinking Water (DW) Limit

☑ Check for 25 mrem/y

	Isotope	Sample Input (pCi/g, uCi, etc.)	% of Total	25 mrem/y TEDE Limits (pCi/g)	4 mrem/y DW Limits (pCi/g)	A - Allowed pCi/g for 25 mrem/y TEDE	B - Allowed pCi/g for 4 mrem/y DW limit	Value Checked from Column A or B	This Sample mrem/y TEDE	This Sample mrem/y DW	
1	Am-241	0.2	0.064%	9.9	2.3	0.01	0.02	0.01	0.51	0.35	Am-241
2	C-14	2	0.643%	2.0	6.4	0.11	0.20	0.11	25.00	1.48	C-14
3	Co-60	0.37	0.119%	3.5	67.0	0.02	0.04	0.02	2.64	0.02	Co-60
4	Cs-137	98	31.446%	6.6	397	5.40	10.00	5.40	370.45	0.89	Cs-137
5	Eu-152	0.18	0.058%	10.1	1440	0.01	0.02	0.01	0.45	0.00	Eu-152
6	H-3	90	28.938%	132	31.1	4.97	9.20	4.97	17.05	11.58	H-3
7	Ni-63	20	6.431%	747	19000	1.10	2.04	1.10	0.67	0.00	Ni-63
8	Pu-238	0.2	0.064%	1.8	0.41	0.01	0.02	0.01	2.78	1.95	Pu-238
9	Pu-239	0.2	0.064%	1.6	0.37	0.01	0.023	0.01	3.13	2.18	Pu-239
10	Pu-241	100	32.153%	86	19.8	5.52	10.22	5.52	29.07	20.20	Pu-241
11	Sr-90	0.06	0.019%	1.2	0.61	0.00	0.01	0.00	1.25	0.39	Sr-90
		3.11E+02	100.000%			17.16	31.80	17.16	452.985	39.126	
						Maximum Permissible pCi/g (25 mrem/y)	Maximum Permissible pCi/g (4 mrem/y)		To Use This Information, Sample Input Units Must Be In pCi/g		

ATTACHMENT 3.7

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B. Brown 10/6/02

Effective DCGL Calculator for Cs-137 (dpm/100 cm^2)

Total Allowable Limit (a+b)		Cs-137 Allowable Limit	
2247	dpm/100 cm^2	706	dpm/100 cm^2

25.0 mrem/y TEDE Limit

SNEC AL	75%	SNEC Cs-137 Allowable Limit	
		530	dpm/100 cm^2

SAMPLE NO(s)⇒ SSGS Footprint East Turbine Sump Area

	Isotope	Sample Input (pCi/g, uCi, etc.)	% of Total	Individual Limits (dpm/100 cm^2)	Allowed dpm/100 cm^2	mrem/y TEDE	Beta dpm/100 cm^2	Alpha dpm/100 cm^2	
1	Am-241	2.00E-01	0.064%	27	1.44	1.34	N/A	1.44	Am-241
2	C-14	2.00E+00	0.643%	3,700,000	14.45	0.00	14.45	N/A	C-14
3	Co-60	3.70E-01	0.119%	7,100	2.67	0.01	2.67	N/A	Co-60
4	Cs-137	9.78E+01	31.446%	28,000	706.49	0.63	706.5	N/A	Cs-137
5	Eu-152	1.80E-01	0.058%	13,000	1.30	0.00	1.30	N/A	Eu-152
6	H-3	9.00E+01	28.938%	120,000,000	650.14	0.00	Not Detectable	N/A	H-3
7	Ni-63	2.00E+01	6.431%	1,800,000	144.48	0.00	Not Detectable	N/A	Ni-63
8	Pu-238	2.00E-01	0.064%	30	1.44	1.20	N/A	1.44	Pu-238
9	Pu-239	2.00E-01	0.064%	28	1.44	1.29	N/A	1.44	Pu-239
10	Pu-241	1.00E+02	32.153%	880	722.38	20.52	Not Detectable	N/A	Pu-241
11	Sr-90	6.00E-02	0.019%	8,700	0.43	0.00	0.43	N/A	Sr-90
			100.000%		2247	25.0	725	4	
					Maximum Permissible dpm/100 cm^2				

ATTACHMENT 3.8

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B. Brown 10/6/10

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B. Bruny 10/6/02

SNEC SAMPLE RESULTS

LAB or LAB No.	Location/Description
Teledyne-TI#-38253	SSGS Footprint East Turbine Sump Area AV-133 (Pumped)
SNEC Sample No.	Comments:
SX10SD00366	
Other Identifier	
SSGS/DT/IT Area Sample	
Analysis Date=>	***June 5, 2000***

	Isotope	pCi/g (soilids) or pCi/l (if water) or pCi (if smears)
1	Am-241	< 0.2
2	C-14	< 2
3	Cm-243	< 0.1
4	Cm-244	< 0.1
5	Co-60	0.37
6	Cs-134	< 0.0636
7	Cs-137	97.8
8	Eu-152	< 0.18
9	Eu-154	< 0.118
10	Eu-155	< 0.211
11	Fe-55	< 50
12	H-3	< 90
13	Nb-94	< 0.0479
14	Ni-59	< 50
15	Ni-63	< 20
16	Pu-238	< 0.2
17	Pu-239	< 0.2
18	Pu-240	< 0.2
19	Pu-241	< 100
20	Pu-242	< 0.2
21	Sb-125	< 0.401
22	Sr-90	< 0.06
23	Tc-99	< 0.4
24	U-234	1.1
25	U-235	< 0.2
26	U-238	0.57
	Other Isotopes	pCi/g (soilids) or pCi/l (if water) or pCi (if smears)
	On-site Analysis for Cs-137	---
	On-site Analysis for Co-60	---
	On-site Analysis for H-3	---
	I-129	< 0.06
	Gross Alpha	---
	Gross Beta	---
	K-40	2.58
	Ra-226	0.326
	Th-232	< 0.249
	Cm-242	---
	Th-228	---
	Np-237	---
	Ce-144	---

ATTACHMENT 3 . 9

Effective DCGL Calculator for Cs-137 (in pCi/g)

Total Allowable pCi/g		Cs-137 Allowable Limit	
6.62	pCi/g	6.55	pCi/g

SAMPLE NUMBER(s)⇒ SSGS 790' El., East - Debris from Pump Stand Small Pipe

SNEC AL	75%	SNEC Cs-137 Allowable Limit	
		4.91	pCi/g

47776.16%	25.0	mrem/y TEDE Limit
980.61%	4.0	mrem/y Drinking Water (DW) Limit

☑ Check for 25 mrem/y

	Isotope	Sample Input (pCi/g, uCi, etc.)	% of Total	25 mrem/y TEDE Limits (pCi/g)	4 mrem/y DW Limits (pCi/g)	A - Allowed pCi/g for 25 mrem/y TEDE	B - Allowed pCi/g for 4 mrem/y DW	Value Checked from Column A or B	This Sample mrem/y TEDE	This Sample mrem/y DW	
1	Am-241	0.11	0.003%	9.9	2.3	0.00	0.01	0.00	0.28	0.19	Am-241
2	C-14	4.15	0.131%	2.0	5.4	0.01	0.42	0.01	51.88	3.07	C-14
3	Co-60	3.98	0.126%	3.5	67.0	0.01	0.41	0.01	28.43	0.24	Co-60
4	Cs-137	3130	98.956%	6.6	397	6.55	319.19	6.55	11856.06	31.54	Cs-137
5	Eu-152	0.24	0.008%	10.1	140	0.00	0.02	0.00	0.59	0.00	Eu-152
6	H-3	11	0.348%	132	31.1	0.02	1.12	0.02	2.08	1.41	H-3
7	Ni-63	8.61	0.272%	747	19000	0.02	0.88	0.02	0.29	0.00	Ni-63
8	Pu-238	0.07	0.002%	1.8	0.41	0.00	0.01	0.00	0.97	0.88	Pu-238
9	Pu-239	0.08	0.003%	1.6	0.37	0.00	0.01	0.00	1.25	0.86	Pu-239
10	Pu-241	4.74	0.150%	86	19.8	0.01	0.48	0.01	1.38	0.86	Pu-241
11	Sr-90	0.04	0.001%	1.2	0.61	0.00	0.00	0.00	0.83	0.26	Sr-90
		3.16E+03	100.000%			6.62	322.56	6.62	11944.041	39.224	
						Maximum Permissible pCi/g (25 mrem/y)	Maximum Permissible pCi/g (4 mrem/y)		To Use This Information, Sample Input Units Must Be in pCi/g		

ATTACHMENT 3 - 10

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B. Brown 10/6/02

Effective DCGL Calculator for Cs-137 (dpm/100 cm^2)

Total Allowable Limit (a + b)		Cs-137 Allowable Limit	
24901	dpm/100 cm^2	24641	dpm/100 cm^2

25.0 mrem/y TEDE Limit

SNEC AL	75%	SNEC Cs-137 Allowable Limit	
		18480	dpm/100 cm^2

SAMPLE NO(s)⇒ SSGS 790' El., East - Debris from Pump Stand Small Pipe

	Isotope	Sample Input (pCi/g, uCi, etc.)	% of Total	Individual Limits (dpm/100 cm^2)	Allowed dpm/100 cm^2	mrem/y TEDE	Beta dpm/100 cm^2	Alpha dpm/100 cm^2	
1	Am-241	1.10E-01	0.003%	27	0.87	0.80	N/A	0.87	Am-241
2	C-14	4.15E+00	0.131%	3,700,000	32.67	0.00	32.67	N/A	C-14
3	Co-60	3.98E+00	0.126%	7,100	31.33	0.11	31.33	N/A	Co-60
4	Cs-137	3.13E+03	98.956%	28,000	24640.58	22.00	24640.6	N/A	Cs-137
5	Eu-152	2.40E-01	0.008%	13,000	1.89	0.00	1.89	N/A	Eu-152
6	H-3	1.10E+01	0.348%	120,000,000	86.60	0.00	Not Detectable	N/A	H-3
7	Ni-63	8.61E+00	0.272%	1,800,000	67.78	0.00	Not Detectable	N/A	Ni-63
8	Pu-238	7.00E-02	0.002%	30	0.55	0.46	N/A	0.55	Pu-238
9	Pu-239	8.00E-02	0.003%	28	0.63	0.56	N/A	0.63	Pu-239
10	Pu-241	4.74E+00	0.150%	880	37.32	1.06	Not Detectable	N/A	Pu-241
11	Sr-90	4.00E-02	0.001%	8,700	0.31	0.00	0.31	N/A	Sr-90
			100.000%		24901	25.0	24707	2	
					Maximum Permissible dpm/100 cm^2				

ATTACHMENT 3 - 11

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B. Brun 10/6/02
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SNEC SAMPLE RESULTS

LAB or LAB No.	Location/Description
BWXT, 0109078-01	SSGS 790' El., East - Debris From Pump Stand Small Pipe
SNEC Sample No.	Comments:
SXSD1377	
Other Identifier	
SSGS/DT/IT Area Sample	
Analysis Date=>	***September 4, 2001***

	Isotope	pCi/g (solids) or pCi/l (if water) or pCi (if smears)
1	Am-241	< 0.11
2	C-14	< 4.15
3	Cm-243	—
4	Cm-244	< 0.13
5	Co-60	3.98
6	Cs-134	< 0.47
7	Cs-137	3130
8	Eu-152	< 0.24
9	Eu-154	< 0.16
10	Eu-155	< 1.55
11	Fe-55	< 66.8
12	H-3	< 11
13	Nb-94	< 0.07
14	Ni-59	< 6.46
15	Ni-63	< 8.61
16	Pu-238	0.07
17	Pu-239	0.08
18	Pu-240	0.08
19	Pu-241	< 4.74
20	Pu-242	< 0.01
21	Sb-125	< 2.7
22	Sr-90	< 0.04
23	Tc-99	< 0.45
24	U-234	1.42
25	U-235	0.04
26	U-238	0.79
	Other Isotopes	pCi/g (solids) or pCi/l (if water) or pCi (if smears)
	On-site Analysis for Cs-137	—
	On-site Analysis for Co-60	—
	On-site Analysis for H-3	—
	I-129	< 3.46
	Gross Alpha	—
	Gross Beta	—
	K-40	—
	Ra-226	—
	Th-232	—
	Cm-242	< 0.14
	Th-228	—
	Np-237	< 0.01
	Ce-144	< 3.23

ATTACHMENT 3.12

Effective DCGL Calculator for Cs-137 (in pCi/g)

Total Allowable pCi/g		Cs-137 Allowable Limit	
6.77	pCi/g	6.38	pCi/g

SAMPLE NUMBER(s)=> SSGS Discharge Tunnel 6" Drain Line

SNEC AL	75%	SNEC Cs-137 Allowable Limit	
		4.79	pCi/g

76201.67%	25.0	mrem/y TEDE Limit
4603.38%	4.0	mrem/y Drinking Water (DW) Limit

☑ Check for 25 mrem/y

	Isotope	Sample Input (pCi/g, uCi, etc.)	% of Total	25 mrem/y TEDE Limits (pCi/g)	4 mrem/y DW Limits (pCi/g)	A - Allowed pCi/g for 25 mrem/y TEDE	B - Allowed pCi/g for 4 mrem/y DW	Value Checked from Column A or B	This Sample mrem/y TEDE	This Sample mrem/y DW	
1	Am-241	5.4	0.106%	9.9	2.3	0.01	0.12	0.01	13.64	9.39	Am-241
2	C-14	6	0.118%	2.0	5.4	0.01	0.13	0.01	75.00	4.74	C-14
3	Co-60	30	0.590%	3.5	67.0	0.04	0.65	0.04	214.29	1.79	Co-60
4	Cs-137	4800	94.330%	6.6	397.4	6.38	104.27	6.38	18181.82	48.36	Cs-137
5	Eu-152	20	0.393%	10.1	1440	0.03	0.43	0.03	49.50	0.08	Eu-152
6	H-3	100	1.965%	132	31.1	0.13	2.17	0.13	18.94	12.86	H-3
7	Ni-63	55	1.081%	747	19000	0.07	1.19	0.07	1.84	0.01	Ni-63
8	Pu-238	1.6	0.031%	1.8	0.41	0.00	0.03	0.00	22.22	15.61	Pu-238
9	Pu-239	2.5	0.049%	1.6	0.37	0.00	0.05	0.00	39.06	27.03	Pu-239
10	Pu-241	60	1.179%	86	19.8	0.08	1.50	0.08	17.44	12.12	Pu-241
11	Sr-90	8	0.157%	1.2	0.61	0.01	0.17	0.01	166.67	52.46	Sr-90
		5.09E+03	100.000%			6.77	110.54	6.77	18800.419	184.135	
						Maximum Permissible pCi/g (25 mrem/y)	Maximum Permissible pCi/g (4 mrem/y)		To Use This Information, Sample Input Units Must Be in pCi/g		

ATTACHMENT 4.1

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Effective DCGL Calculator for Cs-137 (dpm/100 cm^2)

Total Allowable Limit (a + b)		Cs-137 Allowable Limit	
8640	dpm/100 cm^2	8150	dpm/100 cm^2

25.0 mrem/y TEDE Limit

SNEC Als	75%	SNEC Cs-137 Allowable Limit	
		6113	dpm/100 cm^2

SAMPLE NO(s)⇒ SSGS Diacharge Tunnel 6" Drain Line

	Isotope	Sample Input (pCi/g, uCi, etc.)	% of Total	Individual Limits (dpm/100 cm^2)	Allowed dpm/100 cm^2	mrem/y TEDE	Beta dpm/100 cm^2	Alpha dpm/100 cm^2	
1	Am-241	5.40E+00	0.106%	27	9.17	8.49	N/A	9.17	Am-241
2	C-14	6.00E+00	0.118%	3,700,000	10.19	0.00	10.19	N/A	C-14
3	Co-60	3.00E+01	0.590%	7,100	50.94	0.18	50.94	N/A	Co-60
4	Cs-137	4.80E+03	94.330%	28,000	8150.16	7.28	8150.2	N/A	Cs-137
5	Eu-152	2.00E+01	0.393%	13,000	33.96	0.07	33.96	N/A	Eu-152
6	H-3	1.00E+02	1.965%	120,000,000	169.79	0.00	Not Detectable	N/A	H-3
7	Ni-63	5.50E+01	1.081%	1,800,000	93.39	0.00	Not Detectable	N/A	Ni-63
8	Pu-238	1.60E+00	0.031%	30	2.72	2.26	N/A	2.72	Pu-238
9	Pu-239	2.50E+00	0.049%	28	4.24	3.79	N/A	4.24	Pu-239
10	Pu-241	6.00E+01	1.179%	880	101.88	2.89	Not Detectable	N/A	Pu-241
11	Sr-90	8.00E+00	0.157%	8,700	13.58	0.04	13.58	N/A	Sr-90
			100.000%		8640	25.0	8259	16	
					Maximum Permissible dpm/100 cm^2				

ATTACHMENT 4.2

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B. Brown
10/6/02
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SNEC SAMPLE RESULTS

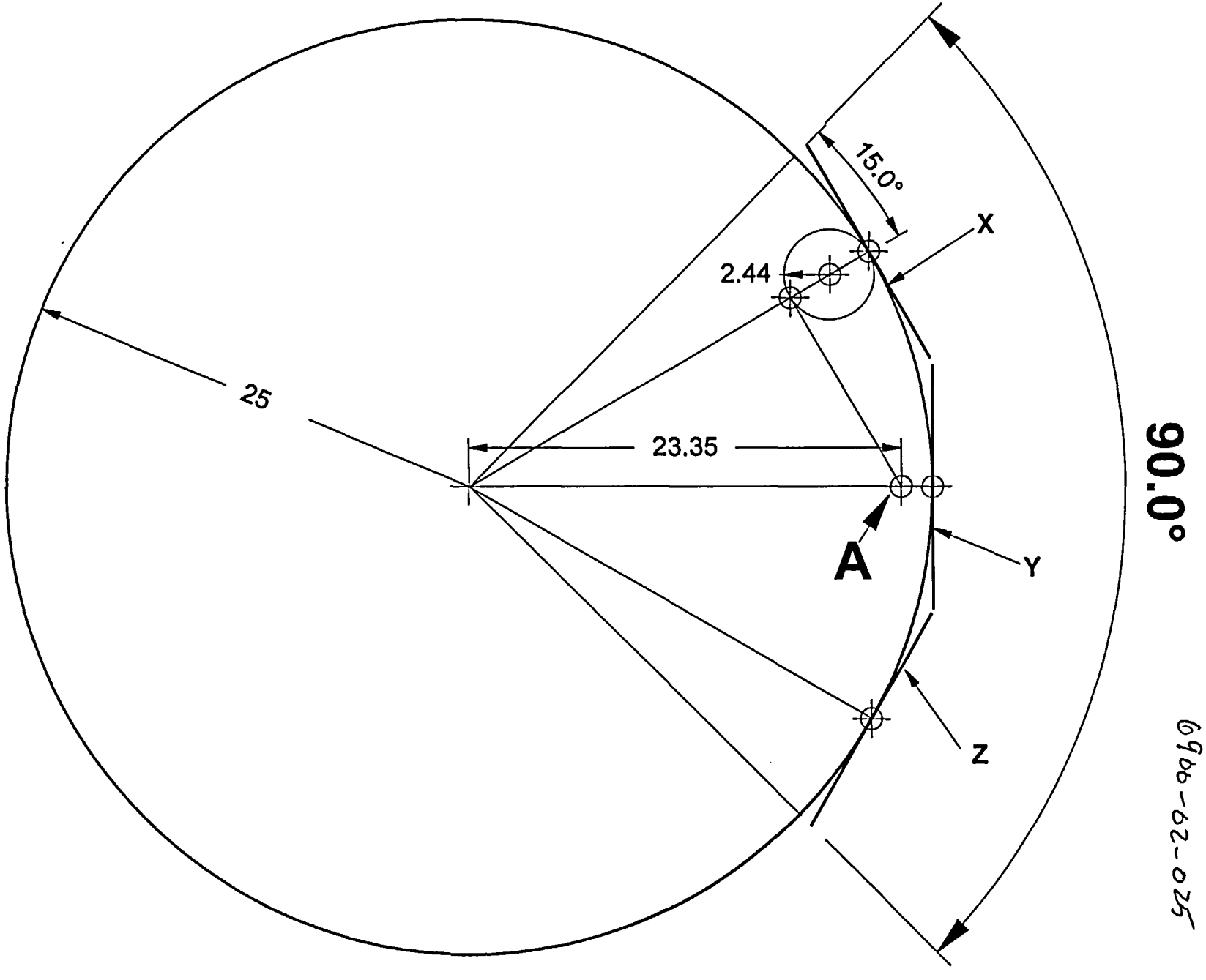
LAB or LAB No.	Location/Description
Teledyne-TI#-16599	Discharge Tunnel 6" Drain Line Scraping
SNEC Sample No.	Comments:
SX10SD990033	
Other Identifier	
SSGS/DT/IT Area Sample	
Analysis Date=>	***July 22, 1999***

	Isotope	pCi/g (soilids) or pCi/l (if water) or pCi (if smears)
1	Am-241	5.4
2	C-14	< 6
3	Cm-243	< 0.4
4	Cm-244	< 0.4
5	Co-60	30
6	Cs-134	< 2
7	Cs-137	4800
8	Eu-152	< 20
9	Eu-154	< 5
10	Eu-155	< 9
11	Fe-55	—
12	H-3	< 100
13	Nb-94	< 2
14	Ni-59	< 100
15	Ni-63	55
16	Pu-238	1.6
17	Pu-239	2.5
18	Pu-240	2.5
19	Pu-241	< 60
20	Pu-242	< 0.4
21	Sb-125	< 20
22	Sr-90	< 8
23	Tc-99	< 10
24	U-234	0.45
25	U-235	< 0.2
26	U-238	0.57
	Other Isotopes	**pCi/g (soilids) or pCi/l (if water) or pCi (if smears)**
	On-site Analysis for Cs-137	—
	On-site Analysis for Co-60	—
	On-site Analysis for H-3	—
	I-129	< 5
	Gross Alpha	—
	Gross Beta	—
	K-40	< 50 (39.8)
	Ra-226	< 70
	Th-232	—
	Cm-242	< 0.4
	Th-228	< 7
	Np-237	—
	Ce-144	—

ATTACHMENT 4.3

SNEC CV STEEL SHELL MODEL

All Dimensions are in Feet



ATTACHMENT 5.1

34 of 44
R. Brown
10/6/02
6900-02-025

MicroShield v5.05 (5.05-00121)
GPU Nuclear

35 + 44

Page : 1
DOS File : CVSHELL.MS5
Run Date : October 5, 2002
Run Time : 4:52:16 PM
Duration : 00:00:15

B. Bruny 10/6/02
6900-02-025

File Ref: _____
Date: _____
By: _____
Checked: _____

Case Title: CV Shell
Description: Y Sector of CV Shell Model
Geometry: 13 - Rectangular Volume

Source Dimensions

Length	1.746 cm	0.7 in
Width	399.254 cm	13 ft 1.2 in
Height	609.6 cm	20 ft 0.0 in

Dose Points

	X	Y	Z
# 1	51.74625 cm	304.8 cm	1.99e+02 cm
	1 ft 8.4 in	10 ft 0.0 in	6 ft 6.5 in

Shields

Shield Name	Dimension	Material	Density
Source	15.009 ft³	Iron	7.86
Air Gap		Air	0.00122

Source Input
Grouping Method : Actual Photon Energies

Nuclide	curies	becquerels	µCi/cm³	Bq/cm³
Co-60	6.5141e-006	2.4102e+005	1.5327e-005	5.6710e-001

Buildup
The material reference is : Source

Integration Parameters

X Direction	40
Y Direction	40
Z Direction	40

Results

Energy MeV	Activity photons/sec	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.6938	3.932e+01	3.742e-05	6.093e-05	7.224e-08	1.176e-07
1.1732	2.410e+05	4.559e-01	6.715e-01	8.147e-04	1.200e-03

ATTACHMENT S-2

DOS File : CVSHELL.MS5
Run Date : October 5, 2002
Run Time: 4:52:16 PM
Duration : 00:00:15

36 & 44
B. Bruno 10/6/02
6900-02-025

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
1.3325	2.410e+05	5.372e-01	7.726e-01	9.321e-04	1.340e-03
TOTALS:	4.821e+05	9.932e-01	1.444e+00	1.747e-03	2.541e-03

ATTACHMENT 5 . 3

MicroShield v5.05 (5.05-00121)
GPU Nuclear

37 & 44

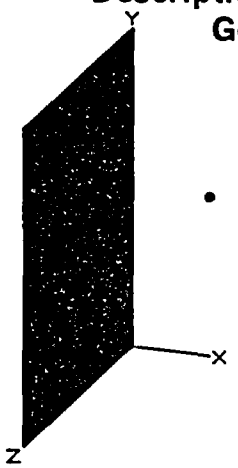
B. Bruno 10/6/02

6900-02-025

File Ref: _____
Date: _____
By: _____
Checked: _____

Page : 1
DOS File : CVXPLUS.MS5
Run Date : October 5, 2002
Run Time: 4:58:39 PM
Duration : 00:00:15

Case Title: CV Shell
Description: X and Z Plus Sector of CV Shell Model
Geometry: 13 - Rectangular Volume



Source Dimensions

Length	1.746 cm	0.7 in
Width	561.2 cm	18 ft 4.9 in
Height	609.6 cm	20 ft 0.0 in

Dose Points

	X	Y	Z
# 1	148.7424 cm	304.8 cm	0 cm
	4 ft 10.6 in	10 ft 0.0 in	0.0 in

Shields

Shield Name	Dimension	Material	Density
Source	5.97e+05 cm³	Iron	7.86
Air Gap		Air	0.00122

Source Input
Grouping Method : Actual Photon Energies

Nuclide	curies	becquerels	µCi/cm³	Bq/cm³
Co-60	9.1564e-006	3.3879e+005	1.5327e-005	5.6710e-001

Buildup
The material reference is : Source

Integration Parameters

X Direction	40
Y Direction	40
Z Direction	40

Results

Energy MeV	Activity photons/sec	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.6938	5.526e+01	1.467e-05	2.314e-05	2.833e-08	4.468e-08
1.1732	3.388e+05	1.765e-01	2.509e-01	3.154e-04	4.484e-04
1.3325	3.388e+05	2.072e-01	2.876e-01	3.595e-04	4.990e-04

ATTACHMENT 5.4

DOS File : CVXPLUS.MS5
Run Date : October 5, 2002
Run Time: 4:58:39 PM
Duration : 00:00:15

38 & 44
B. Bring 10/6/02
6900-02-025

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
TOTALS:	6.776e+05	3.837e-01	5.385e-01	6.749e-04	9.474e-04

ATTACHMENT 5.5

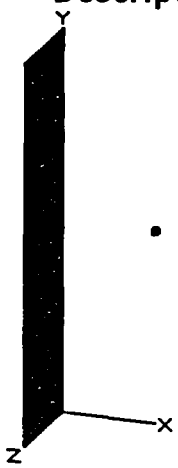
MicroShield v5.05 (5.05-00121)
GPU Nuclear

Page : 1
DOS File : CVMINUS.MS5
Run Date : October 5, 2002
Run Time : 5:01:03 PM
Duration : 00:00:15

B. Bruno 10/6/02
6900-02-025

File Ref: _____
Date: _____
By: _____
Checked: _____

Case Title: CV Shell
Description: X and Z Minus Sector of CV Shell Model
Geometry: 13 - Rectangular Volume



Source Dimensions

Length	1.746 cm	0.7 in
Width	162.218 cm	5 ft 3.9 in
Height	609.6 cm	20 ft 0.0 in

Dose Points

	X	Y	Z
# 1	148.7424 cm	304.8 cm	0 cm
	4 ft 10.6 in	10 ft 0.0 in	0.0 in

Shields

Shield Name	Dimension	Material	Density
Source	1.73e+05 cm³	Iron	7.86
Air Gap		Air	0.00122

Source Input
Grouping Method : Actual Photon Energies

Nuclide	curies	becquerels	µCi/cm³	Bq/cm³
Co-60	2.6467e-006	9.7929e+004	1.5327e-005	5.6710e-001

Buildup
The material reference is : Source

Integration Parameters

X Direction	40
Y Direction	40
Z Direction	40

Results

Energy MeV	Activity photons/sec	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.6938	1.597e+01	9.526e-06	1.424e-05	1.839e-08	2.749e-08
1.1732	9.793e+04	1.122e-01	1.518e-01	2.006e-04	2.714e-04
1.3325	9.793e+04	1.311e-01	1.735e-01	2.275e-04	3.010e-04

ATTACHMENT 5.6

DOS File : CVMINUS.MS5
Run Date : October 5, 2002
Run Time : 5:01:03 PM
Duration : 00:00:15

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B. Bruce 10/6/02
6900-02-025

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
TOTALS:	1.959e+05	2.434e-01	3.254e-01	4.281e-04	5.724e-04

ATTACHMENT 5.7

MicroShield v5.05 (5.05-00121)
GPU Nuclear

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B. Brown 10/6/02

Page : 1
DOS File : DTMODEL.MS5
Run Date : October 5, 2002
Run Time: 8:22:10 PM
Duration : 00:00:02

6900-02-025

File Ref: _____
Date: _____
By: _____
Checked: _____

Case Title: 8" Pipe End
Description: Discharge Tunnel Pipe Model
Geometry: 8 - Cylinder Volume - End Shields

Source Dimensions

Height	60.96 cm	2 ft
Radius	10.16 cm	4.0 in

Dose Points

	X	Y	Z
# 1	0 cm	110.998 cm	0 cm
	0.0 in	3 ft 7.7 in	0.0 in

Shields

Shield Name	Dimension	Material	Density
Source	1206.372 in³	Concrete	1.4
Air Gap		Air	0.00122

Source Input
Grouping Method : Actual Photon Energies

Nuclide	curies	becquerels	µCi/cm³	Bq/cm³
Ba-137m	1.6704e-007	6.1805e+003	8.4497e-006	3.1264e-001
Co-60	1.1071e-009	4.0961e+001	5.6000e-008	2.0720e-003
Cs-137	1.7658e-007	6.5333e+003	8.9320e-006	3.3048e-001

Buildup
The material reference is : Source

Integration Parameters

Radial	40
Circumferential	40
Y Direction (axial)	40

Results

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
0.0318	1.280e+02	1.432e-06	1.735e-06	1.193e-08	1.445e-08

ATTACHMENT 6.1

DOS File : DTMODEL.MS5
Run Date : October 5, 2002
Run Time : 8:22:10 PM
Duration : 00:00:02

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B. Bruny 10/6/02
6900-02-025

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
0.0322	2.361e+02	2.754e-06	3.355e-06	2.216e-08	2.700e-08
0.0364	8.591e+01	1.520e-06	1.984e-06	8.638e-09	1.127e-08
0.6616	5.561e+03	1.301e-02	2.562e-02	2.522e-05	4.967e-05
0.6938	6.682e-03	1.667e-08	3.241e-08	3.218e-11	6.258e-11
1.1732	4.096e+01	2.089e-04	3.566e-04	3.734e-07	6.372e-07
1.3325	4.096e+01	2.487e-04	4.117e-04	4.315e-07	7.143e-07
TOTALS:	6.093e+03	1.347e-02	2.640e-02	2.607e-05	5.107e-05

ATTACHMENT 6.2

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B. Brown 10/6/02

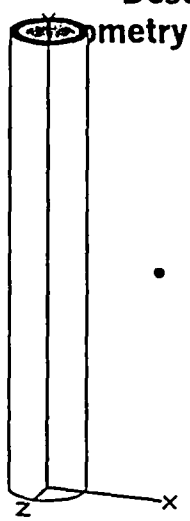
MicroShield v5.05 (5.05-00121)
GPU Nuclear

Page : 1
DOS File : 18LINE.MS5
Run Date : October 6, 2002
Run Time : 9:22:01 PM
Duration : 00:00:44

6900-02-625

File Ref: _____
Date: _____
By: _____
Checked: _____

Case Title: Tie Line
Description: 18" Line Between Intake & DT
Geometry: 12 - Annular Cylinder - External Dose Point



Source Dimensions

Height	304.8 cm	10 ft 0.0 in
Radius	20.32 cm	8.0 in

Dose Points

	X	Y	Z
# 1	74.168 cm	152.4 cm	0 cm
	2 ft 5.2 in	5 ft 0.0 in	0.0 in

Shields

Shield Name	Dimension	Material	Density
Cyl. Core	20.32 m³	Air	0.00122
Source	.025 m	Concrete	1.4
Shield 3	.014 m	Iron	7.86
Transition		Air	0.00122
Air Gap		Air	0.00122

Source Input
Grouping Method : Actual Photon Energies

Nuclide	curies	becquerels	µCi/cm³	Bq/cm³
Ba-137m	8.8740e-007	3.2834e+004	8.4497e-006	3.1264e-001
Co-60	5.8812e-009	2.1761e+002	5.6000e-008	2.0720e-003
Cs-137	9.3806e-007	3.4708e+004	8.9320e-006	3.3048e-001

Buildup
The material reference is : Shield 3

Integration Parameters

Radial	40
Circumferential	40
Y Direction (axial)	40

Results

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
0.0318	6.798e+02	6.912e-40	1.700e-30	5.758e-42	1.416e-32

ATTACHMENT 6.3

Page : 2
DOS File : 18LINE.MS5
Run Date : October 6, 2002
Run Time : 9:22:01 PM
Duration : 00:00:44

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B. Brungs 10/6/02
6900-02-025

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
0.0322	1.254e+03	1.671e-38	3.187e-30	1.345e-40	2.565e-32
0.0364	4.564e+02	3.005e-29	3.653e-29	1.707e-31	2.075e-31
0.6616	2.954e+04	2.394e-02	6.275e-02	4.642e-05	1.217e-04
0.6938	3.550e-02	3.125e-08	8.044e-08	6.033e-11	1.553e-10
1.1732	2.176e+02	4.670e-04	9.774e-04	8.346e-07	1.747e-06
1.3325	2.176e+02	5.751e-04	1.146e-03	9.978e-07	1.989e-06
TOTALS:	3.237e+04	2.499e-02	6.488e-02	4.825e-05	1.254e-04

ATTACHMENT 6.4