

Appendix A
Downcomer Assessment



SNEC CALCULATION COVER SHEET

CALCULATION DESCRIPTION

Calculation Number E900-04-018	Revision Number 0	Effective Date 9/14/04	Page Number 1 of 5
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Subject

Assessment of Survey Results from Seal Chamber 3 Downcomers

Question 1 - Is this calculation defined as "In QA Scope"? Refer to definition 3.5. Yes No




Question 2 - Is this calculation defined as a "Design Calculation"? Refer to definitions 3.2 and 3.3. Yes No

Question 3 - Does the calculation have the potential to affect an SSC as described in the USAR? Yes No

NOTES: If a "Yes" answer is obtained for Question 1, the calculation must meet the requirements of the SNEC Facility Decommissioning Quality Assurance Plan. If a "Yes" answer is obtained for Question 2, the Calculation Originator's immediate supervisor should not review the calculation as the Technical Reviewer. If a "YES" answer is obtained for Question 3, SNEC Management approval is required to implement the calculation. Calculations that do not have the potential to affect SSC's may be implemented by the TR.

DESCRIPTION OF REVISION

APPROVAL SIGNATURES

Calculation Originator	B. Brosey/ 	Date	9/14/04
Technical Reviewer	P. Donnachie/ 	Date	9/14/04
Additional Review	A. Paynter/ 	Date	16 Sep 04
Additional Review		Date	
SNEC Management Approval		Date	

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Subject Assessment of Survey Results from Seal Chamber 3 Downcomers		

1.0 PURPOSE

1.1 The purpose of this calculation is to review several survey results from four (4) steel Downcomers that extend into Seal Chamber 3 (SC3) through the concrete ceiling. These four pieces of hardware are shown in Attachments 1-1 and 1-2. These units were surveyed at various times by CoPhysics corporation and then by SNEC personnel (see Reference 3.1). Each survey effort is reviewed with the results provided in Section 2.0.

2.0 SUMMARY OF RESULTS

2.1 CoPhysics Report Results

2.1.1 Gamma-ray spectroscopy measurements were performed internal to these downcomers by placing a 1" by 4" NaI detector at several vertical locations within each Downcomer. The detector was attached to a portable multi-channel analyzer that monitored a Cs-137 ROI.

2.1.2 Results were modeled using the MicroShield computer code and indicated a maximum Cs-137 surface concentration of approximately 4,696 dpm/100 cm². All the activity is assumed to be a surface deposit located in the Downcomers.

2.1.3 The CoPhysics report stressed the need to re-assess Downcomer contamination levels (see Table 1 results), when remediation of the concrete in Seal Chamber 3 was complete.

2.1.4 From Reference 3.2, the Cs-137 fraction of the DCGLw value is 85.12%.

Table 1, CoPhysics Report - Cs-137 Concentrations in SC3 Downcomers (dpm/100 cm²)

Measurement Location No.	Downcomer 1	Downcomer 2	Downcomer 3	Downcomer 4
1	759	1013	607	504
2	2633	3713	3257	3116
3	4118	3594	4238	4696
4	3777	2285	2449	4259
Mean⇒	2822	2651	2638	3144
GA DCGLw Fraction⇒	0.58	0.54	0.54	0.64

NOTE 1: GA DCGLw results are in fractions of the Cs-137 administrative limit of 4,883 dpm/100 cm².

NOTE 2: Results from Reference 3.1, page 27.

2.1.5 The DCGLw values for this area were determined in Reference 3.2 to be as follows:

Table 2, Summary Of DCGLw Values

Surface DCGLw (dpm/100 cm ²)	Volumetric DCGLw (pCi/g)
GA = 7,650 (5,737 A.L.)	3.19 (2.39 A.L.) for Cs-137
Cs-137 A.L. = 4,883	

A.L. = the administrative limit.

Subject

Assessment of Survey Results from Seal Chamber 3 Downcomers

2.2 Survey Request SR-0098 Results for Downcomers - Post-Remediation of SC3 Concrete

2.2.1 After concrete remediation efforts were finished in Seal Chamber 3, additional fixed point measurements were performed IAW the SNEC RSO's instructions (see **Attachment 2-1 to 2-3**). In this measurement series a Ludlum 44-10, 2" by 2" NaI gamma detector, with a conversion efficiency of 221,028 cpm/mR/h (for a Cs-137 window setting – **Attachment 3-1**) was used to re-measure the interior and exterior surface of each Downcomer at select locations. These results are summarized in **Attachment 4-1**. The locations where these measurements were taken are shown in SR-0098 and on **Attachment 2-3**. In addition, scrape samples were obtained from the interior surface of each Downcomer.

The highest scrape sample result obtained indicated 1.5 pCi/g Cs137 (SNEC sample No. SXOT4308). This result is much less than the 22 pCi/g Cs-137 result predicted by the CoPhysics report based solely on gamma measurements of the interior of these components. Thus the surrounding concrete background significantly impacted CoPhysics measurement efforts in SC3.

2.2.2 MicroShield models (**Attachment 5-1 to 5-4**, partial pipe density calculation is **Attachment 5-5**) of these measurement locations has been used to estimate the maximum surface concentrations present on the interior and exterior surface of each Downcomer based on the gross count rate indicated at each location. The results are provided below:

Table 3, Concentrations of Cs-137 (in dpm/100 cm²) – Interior Measurements

No.	Downcomer 1	Downcomer 2	Downcomer 3	Downcomer 4
A	584	860	427	446
B	1269	1719	946	790
C	1142	1092	1054	1167
Mean⇒	998	1224	809	801
GA DCGLw Fraction⇒	0.20	0.25	0.17	0.16

NOTE 1: Results assume no background contribution from surrounding concrete.

NOTE 2: GA DCGLw results are in fractions of the Cs-137 administrative limit of 4,883 dpm/100 cm².

Table 4, Concentrations of Cs-137 (in dpm/100 cm²) – Exterior Measurements

No.	Downcomer 1	Downcomer 2	Downcomer 3	Downcomer 4
A	1886	2083	1599	1312
B	1823	2118	1443	1497
C	1747	1435	1321	1304
Mean⇒	1819	1879	1454	1371
GA DCGLw Fraction⇒	0.37	0.38	0.30	0.28

NOTE 1: Results assume no background contribution from surrounding concrete.

NOTE 2: GA DCGLw results are in fractions of the Cs-137 administrative limit of 4,883 dpm/100 cm².

2.2.3 The NaI background count rate for this area is taken from the Seal Chamber 1 area (**Attachment 6-1 to 6-3**) to be approximately 50 cpm. However, even when background is not considered as in Table 3 and 4 above, the results still show contamination levels well below the administrative limit for these four units. When a realistic background for the area is incorporated into the calculations, the resulting residual contamination levels are lower than those estimated in Table 3 and 4. Calculations used to determine Table 3 and 4 values are performed in Microsoft

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spreadsheets (see **Attachment 7-1**, which assumes a zero background for the area, and **7-2**, which assumes 50 cpm as an area background value).

2.3 Gas Flow Proportional Counter (GFPC) Measurements of External Surface of Downcomers

2.3.1 As Part of the Final Status Survey measurement effort in Seal Chamber 3, the exterior surface area of the Downcomers was measured using a GFPC beta counter (see **Reference 3.3**). All results were reported to be less than the action level for this area. The action level was set at 300 cpm above background. Background was determined to be about 158 cpm (**Reference 3.4**). The MDCscan value developed for this survey effort was 1,174 dpm/100 cm². Therefore, the NaI measurements and the GFPC measurements of the exterior surface of these components are in reasonably good agreement showing that conservatively calculated contamination levels are below the GA DCGLw.

3.0 REFERENCES

- 3.1 Embedded Pipe Radiation Survey by CoPhysics Corporation, 1242 Route 208, Monroe, N.Y. 10950 for GPU Nuclear Corporation, Saxton Nuclear Experimental Corporation, Saxton, Pa., August, 2003, Final Report April, 2004.
- 3.2 SNEC Calculation No. E900-04-004, Assessment of E900-03-030, Rev 0 – Seal Chambers Survey Plan.
- 3.3 SNEC Survey Request SR-103, SSGS SC # 3 (results from FSS-455, 456, & 458), 11/03.
- 3.4 SNEC Calculation No. E900-03-030, Seal Chambers – Survey Plan, 11/03.
- 3.5 SNEC Survey Request SR-0098, SSGS Seal Chamber # 3 Downcomers, 11/11/03.
- 3.6 SNEC Survey Request SR-0078, CoPhysics Support SR, 7/21/03.
- 3.7 Plan SNEC Facility License Termination Plan.
- 3.8 SNEC Procedure E900-IMP-4500.59, "Final Site Survey Planning and DQA".
- 3.9 MicroShield, Computer Radiation Shielding Code, Version 5.05-00121, Grove Engineering.
- 3.10 NUREG-1507, "Minimum Detectable Concentrations With Typical Radiation Survey Instruments for Various Contaminants and Field Conditions," June 1998.
- 3.11 Microsoft Excel 97, Microsoft Corporation Inc., SR-2, 1985-1997.

4.0 ASSUMPTIONS AND BASIC DATA

4.1 From the CoPhysics report, an assumed 1.5 g/cc density and a ¼" thickness yields a surface concentration of:

$$1.5 \text{ g/cc} \times 0.625 \text{ cm} = 0.9525 \text{ g/cm}^2 \times 22 \text{ pCi/g} = \sim 21 \text{ pCi/cm}^2 \times 2.22 \text{ dpm/pCi} = 46.5 \text{ dpm/cm}^2 \times 100 \text{ cm}^2 = \sim 4700 \text{ dpm/100 cm}^2.$$

The Downcomers were thoroughly decontaminated before the CoPhysics measurement series was made. Thus no significant surface scale was encountered in/on these units except for a thin residual layer of iron oxide. Therefore, the calculated volumetric concentration (in pCi/g) is inappropriate, leaving only the surface concentration in dpm/100 cm² as a suitable estimate of residual activity for these components.

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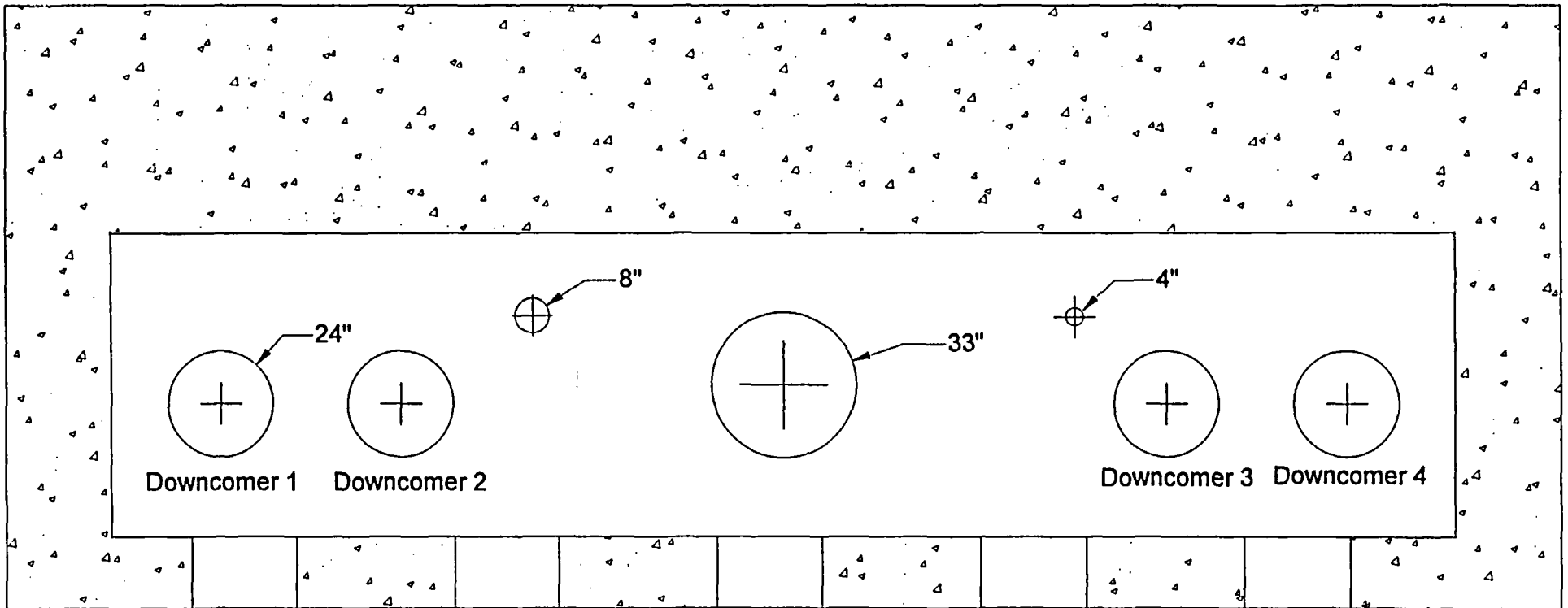
Assessment of Survey Results from Seal Chamber 3 Downcomers**5.0 CALCULATIONS**

- 5.1 All calculations are performed internal to applicable computer codes or within an Excel spreadsheet previously identified.

6.0 APPENDICES

- 6.1 **Attachment 1-1 to 1-2**, diagrams of Seal Chamber 3 Downcomers.
- 6.2 **Attachment 2-1 to 2-3**, is results of Survey Request No. "SR-0098", FSS-427.
- 6.3 **Attachment 3-1**, is the NaI instrument cpm per mR/h conversion data sheet.
- 6.4 **Attachment 4-1**, is the summarized data from SR-0098.
- 6.5 **Attachment 5-1 to 5-4**, are the MicroShield model output sheets for SR-0098 survey data.
- 6.5.1 **Attachment 5-5**, is the pipe partial density calculation sheet used to support MicroShield modeling.
- 6.6 **Attachment 6-1 to 6-3**, is a NaI survey result from SC1 used as a background estimate.
- 6.7 **Attachment 7-1 to 7-2**, is the calculation sheets for conversion of the SR-0098 survey results to surface contamination estimates.

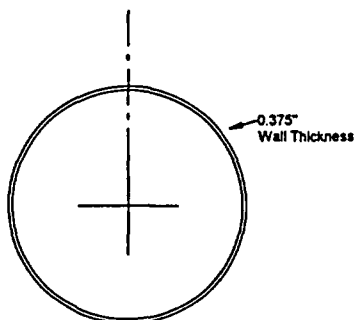
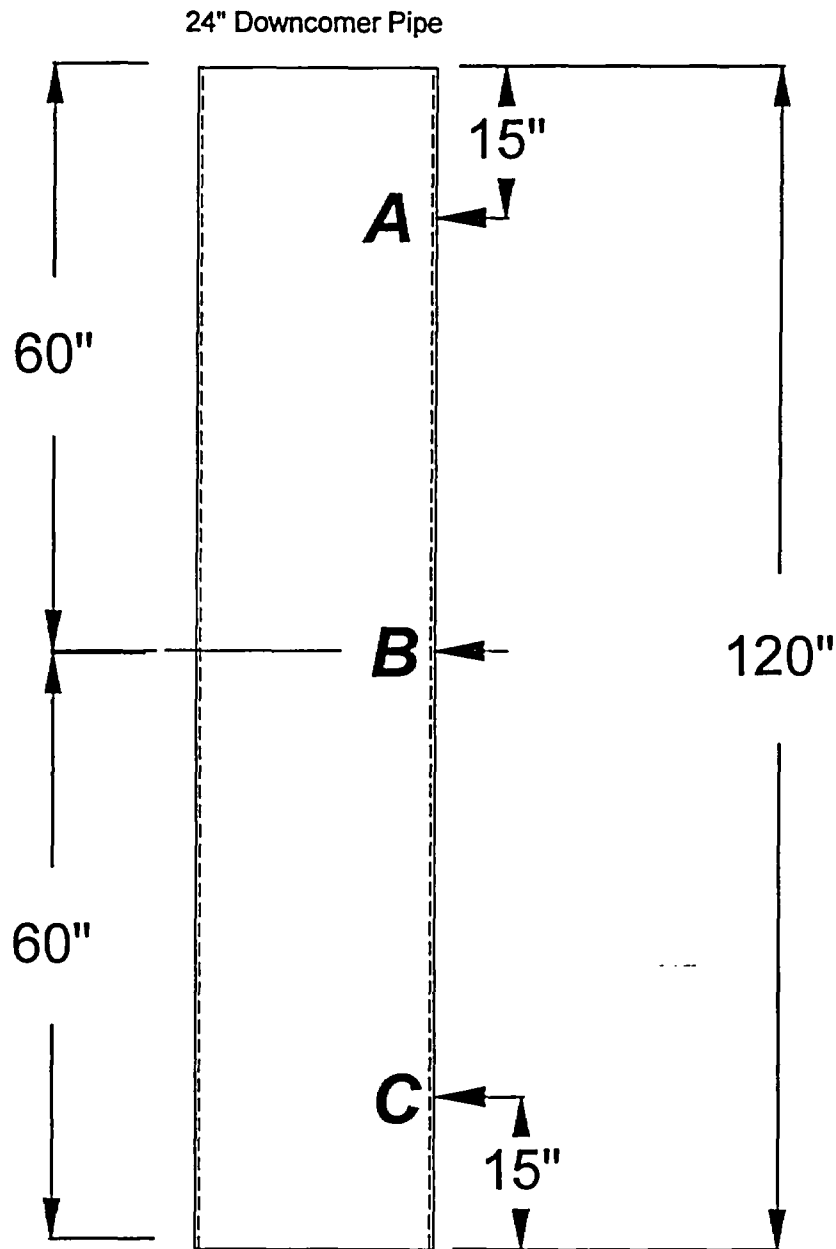
Seal Chamber 3 Top Exterior View



Seal Chamber 3 Downcomers (4 ea)

24" Downcomer Pipe - Exterior View

Measurement Locations (A, B, & C)



ATTACHMENT 1.2

SNEC FSS RADIOLOGICAL SURVEY			Survey Unit #	SS8-3	Survey #	FSS-427	
Location		SSGS Seal Chamber # 3 Downcomers					
Grid #	N/A		Area Classification	1	SR #	0098	
Reason For Survey	Final post remediation 4410 static points		Date of Survey	11/11/03	Time of Survey	0907	
Technician	B. Brownsberger <i>[Signature]</i>		Technician	N/A			
GRCS Review	R. Sheehar <i>[Signature]</i>		Date Of Review	11-12-03			
Radiological Instrument Data		Radiological Instrument Data		Radiological Instrument Data			
Inst./Probe Type	2350 / 4410		Inst./Probe Type	N/A		Inst./Probe Type	N/A
Serial Number(s)	126182 / 196021 Pk		Serial Number(s)			Serial Number(s)	
Cal. Due Date(s)	1/30/04 / 7/22/04		Cal. Due Date(s)			Cal. Due Date(s)	
Efficiency %	N/A		Efficiency (%)	B.y:		Efficiency (%)	B.y:
ABCR (cpm)	N/A		ABCR (cpm)			ABCR (cpm)	
BRA Average	N/A		BRA Average			BRA Average	
BRA Location	N/A		BRA Location	↓		BRA Location	↓
Source Checks	Sat. <input checked="" type="checkbox"/>	Unsat. <input type="checkbox"/>	Source Checks	Sat. <input type="checkbox"/>	Unsat. <input type="checkbox"/>	Source Checks	Sat. <input type="checkbox"/> Unsat. <input type="checkbox"/>
Comments							
<p>Ambient air temperature at survey location was 48 degrees Fahrenheit. Scrape samples were taken inside the downcomers. 4410 Static readings were taken inside and outside the downcomers. <i>44-10 static readings performed per the direction of the R.S.O.</i></p>							
Survey Map							
Please refer to page three.							
Notes : Numbers designate area where static readings were taken							

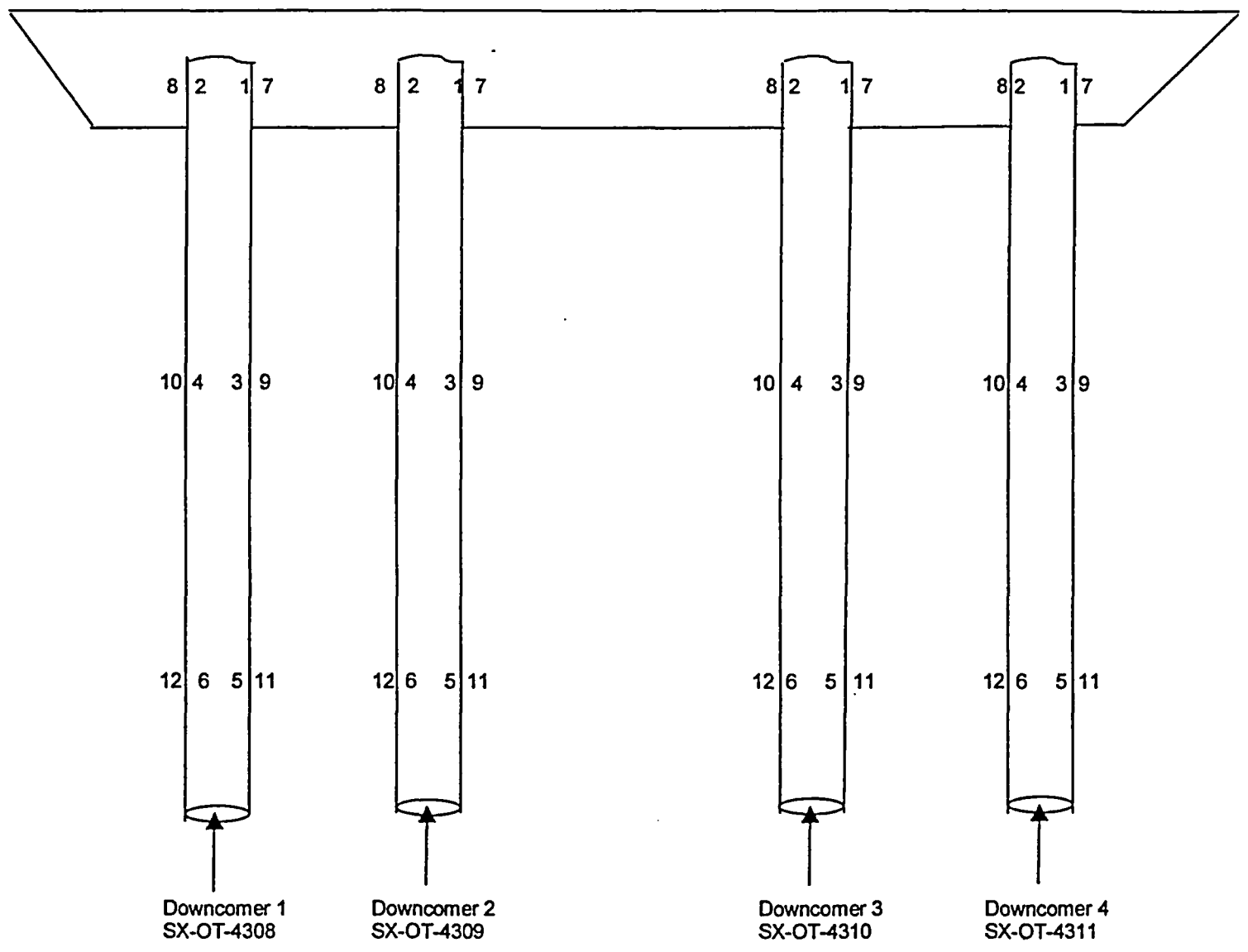
Instrument #	126182	Technician	BB7173					Survey #	FSS-427
Log #	Location	Date	Time	Det.	Reading (cpm)	Count Time (sec)	Mode	Comments	

7	DC 1 FP1	11/11/03	9:07	4	38	60	SCL	
8	DC 1 FP2	11/11/03	9:09	4	55	60	SCL	
9	DC 1 FP3	11/11/03	9:11	4	116	60	SCL	
10	DC 1 FP4	11/11/03	9:12	4	104	60	SCL	
11	DC 2 FP1	11/11/03	9:15	4	73	60	SCL	
12	DC 2 FP2	11/11/03	9:16	4	64	60	SCL	
13	DC 2 FP3	11/11/03	9:17	4	139	60	SCL	
14	DC 2 FP4	11/11/03	9:19	4	159	60	SCL	
15	DC3 FP1	11/11/03	9:24	4	30	60	SCL	
16	DC3 FP2	11/11/03	9:25	4	38	60	SCL	
17	DC3 FP3	11/11/03	9:26	4	72	60	SCL	
18	DC3 FP4	11/11/03	9:28	4	92	60	SCL	
19	DC4 FP1	11/11/03	9:30	4	34	60	SCL	
20	DC4 FP2	11/11/03	9:31	4	37	60	SCL	
21	DC4 FP3	11/11/03	9:33	4	83	60	SCL	
22	DC4 FP4	11/11/03	9:34	4	54	60	SCL	
24	DC1 FP5	11/11/03	10:13	4	91	60	SCL	
25	DC1 FP6	11/11/03	10:14	4	91	60	SCL	
26	DC2 FP5	11/11/03	10:16	4	82	60	SCL	
27	DC2 FP6	11/11/03	10:17	4	92	60	SCL	
28	DC3 FP5	11/11/03	10:22	4	86	60	SCL	
29	DC3 FP6	11/11/03	10:23	4	82	60	SCL	
30	DC4 FP5	11/11/03	10:24	4	89	60	SCL	
31	DC4 FP6	11/11/03	10:26	4	97	60	SCL	
32	DC1 FP7	11/11/03	10:28	4	122	60	SCL	
33	DC1 FP8	11/11/03	10:30	4	108	60	SCL	
34	DC1 FP9	11/11/03	10:31	4	127	60	SCL	
35	DC1 FP10	11/11/03	10:32	4	108	60	SCL	
36	DC1 FP11	11/11/03	10:35	4	107	60	SCL	
37	DC1 FP12	11/11/03	10:36	4	106	60	SCL	
38	DC2 FP7	11/11/03	10:39	4	151	60	SCL	
39	DC2 FP8	11/11/03	10:41	4	103	60	SCL	
40	DC2 FP9	11/11/03	10:43	4	145	60	SCL	
41	DC2 FP10	11/11/03	10:44	4	128	60	SCL	
42	DC2 FP11	11/11/03	10:51	4	94	60	SCL	
43	DC2 FP12	11/11/03	10:53	4	81	60	SCL	
44	DC3 FP7	11/11/03	10:55	4	85	60	SCL	
45	DC3 FP8	11/11/03	10:56	4	110	60	SCL	
46	DC3 FP9	11/11/03	10:57	4	86	60	SCL	
47	DC3 FP10	11/11/03	10:59	4	100	60	SCL	
48	DC3 FP11	11/11/03	11:00	4	74	60	SCL	
49	DC3 FP12	11/11/03	11:01	4	87	60	SCL	
50	DC4 FP7	11/11/03	11:03	4	71	60	SCL	
51	DC4 FP8	11/11/03	11:04	4	89	60	SCL	
52	DC4 FP9	11/11/03	11:06	4	102	60	SCL	
53	DC4 FP10	11/11/03	11:07	4	91	60	SCL	
54	DC4 FP11	11/11/03	11:09	4	79	60	SCL	
55	DC4 FP12	11/11/03	11:10	4	80	60	SCL	

DC = Downcomer FP = Fixed point

ORIGINAL

SEAL CHAMBER # 3



Numbers shown inside the downcomer designate readings taken inside the downcomer.
 Numbers shown outside the downcomer designate readings taken outside the downcomer.
 Scrape samples were taken inside the downcomer.

INTERNAL MEASUREMENTS CPM FSS-427

	DC1-1	DC1-2	Mean	DC2-1	DC2-2	Mean	DC3-1	DC3-2	Mean	DC4-1	DC4-2	Mean
A	38	55	46.5	73	64	68.5	30	38	34	34	37	35.5
	DC1-3	DC1-4	Mean	DC2-3	DC2-4	Mean	DC3-3	DC3-4	Mean	DC4-3	DC4-4	Mean
B	116	104	110	139	159	149	72	92	82	83	54	68.5
	DC1-5	DC1-6	Mean	DC2-5	DC2-6	Mean	DC3-5	DC3-6	Mean	DC4-5	DC4-6	Mean
C	91	91	91	82	92	87	86	82	84	89	97	93

EXTERNAL MEASUREMENTS CPM FSS-427

	DC1-7	DC1-8	Mean	DC2-7	DC2-8	Mean	DC3-7	DC3-8	Mean	DC4-7	DC4-8	Mean
A	122	108	115	151	103	127	85	110	97.5	71	89	80
	DC1-9	DC1-10	Mean	DC2-9	DC2-10	Mean	DC3-9	DC3-10	Mean	DC4-9	DC4-10	Mean
B	127	108	117.5	145	128	136.5	86	100	93	102	91	96.5
	DC1-11	DC1-12	Mean	DC2-11	DC2-12	Mean	DC3-11	DC3-12	Mean	DC4-11	DC4-12	Mean
C	107	106	106.5	94	81	87.5	74	87	80.5	79	80	79.5

Case Title: Interior Downcomer
Description: Location A and C - Cs-137 @ 1 pCi/cm²
Geometry: 9 - Cylinder Surface - Internal Dose Point



Source Dimensions		
Height	304.8 cm	10 ft 0.0 in
Radius	29.528 cm	11.6 in

Dose Points			
#	X	Y	Z
# 1	26.9875 cm 10.6 in	38.1 cm 1 ft 3.0 in	0 cm 0.0 in

Shields			
Shield Name	Dimension	Material	Density
Cyl. Core	29.528 in	Air	0.00122

Source Input

Grouping Method : Actual Photon Energies

Nuclide	curies	becquerels	μCi/cm ²	Bq/cm ²
Ba-137m	5.3495e-008	1.9793e+003	9.4600e-007	3.5002e-002
Cs-137	5.6549e-008	2.0923e+003	1.0000e-006	3.7000e-002

Buildup

The material reference is : Cyl. Core

Integration Parameters

Y Direction (axial)	40
Circumferential	40

Results

Energy MeV	Activity photons/sec	Fluence Rate		Exposure Rate	
		No Buildup	With Buildup	No Buildup	With Buildup
0.0318	4.098e+01	4.519e-05	4.580e-05	3.764e-07	3.815e-07
0.0322	7.560e+01	8.438e-05	8.552e-05	6.791e-07	6.882e-07
0.0364	2.751e+01	3.477e-05	3.524e-05	1.975e-07	2.002e-07
0.6616	1.781e+03	4.117e-02	4.127e-02	7.982e-05	8.002e-05
TOTALS:	1.925e+03	4.134e-02	4.144e-02	8.108e-05	8.129e-05

Case Title: Interior Downcomer
Description: Location B - Cs-137 @ 1 pCi/cm²
Geometry: 9 - Cylinder Surface - Internal Dose Point



Source Dimensions		
Height	304.8 cm	10 ft 0.0 in
Radius	29.528 cm	11.6 in

Dose Points			
#	<u>X</u>	<u>Y</u>	<u>Z</u>
# 1	26.9875 cm 10.6 in	152.4 cm 5 ft 0.0 in	0 cm 0.0 in

Shields			
<u>Shield Name</u>	<u>Dimension</u>	<u>Material</u>	<u>Density</u>
Cyl. Core	29.528 in	Air	0.00122

Source Input				
Grouping Method : Actual Photon Energies				
<u>Nuclide</u>	<u>curies</u>	<u>becquerels</u>	<u>μCi/cm²</u>	<u>Bq/cm²</u>
Ba-137m	5.3495e-008	1.9793e+003	9.4600e-007	3.5002e-002
Cs-137	5.6549e-008	2.0923e+003	1.0000e-006	3.7000e-002

Buildup
The material reference is : Cyl. Core

Integration Parameters	
Y Direction (axial)	40
Circumferential	40

<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u>		<u>Exposure Rate</u>	
		<u>MeV/cm²/sec</u> <u>No Buildup</u>	<u>MeV/cm²/sec</u> <u>With Buildup</u>	<u>mR/hr</u> <u>No Buildup</u>	<u>mR/hr</u> <u>With Buildup</u>
0.0318	4.098e+01	4.913e-05	4.984e-05	4.092e-07	4.152e-07
0.0322	7.560e+01	9.174e-05	9.307e-05	7.383e-07	7.490e-07
0.0364	2.751e+01	3.780e-05	3.835e-05	2.148e-07	2.179e-07
0.6616	1.781e+03	4.479e-02	4.491e-02	8.683e-05	8.706e-05
TOTALS:	1.925e+03	4.497e-02	4.509e-02	8.820e-05	8.844e-05

Page : 1
 DOS File : EXTERN.MS5
 Run Date : September 13, 2004
 Run Time : 10:32:57 AM
 Duration : 00:00:02

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

Case Title: Downcomer External
 Description: Location A and C - Cs-137 @ 1 pCi/cm²
 Geometry: 10 - Cylinder Surface - External Dose Point



Source Dimensions

Height	304.8 cm	10 ft 0.0 in
Radius	30.48 cm	1 ft

Dose Points

	<u>X</u>	<u>Y</u>	<u>Z</u>
# 1	33.02 cm 1 ft 1.0 in	38.1 cm 1 ft 3.0 in	0 cm 0.0 in

Shields

<u>Shield Name</u>	<u>Dimension</u>	<u>Material</u>	<u>Density</u>
Cyl. Core	30.48 in ²	Iron	0.484
Transition		Air	0.00122
Air Gap		Air	0.00122

Source Input

Grouping Method : Actual Photon Energies

<u>Nuclide</u>	<u>curies</u>	<u>becquerels</u>	<u>μCi/cm²</u>	<u>Bq/cm²</u>
Ba-137m	5.5221e-008	2.0432e+003	9.4600e-007	3.5002e-002
Cs-137	5.8373e-008	2.1598e+003	1.0000e-006	3.7000e-002

Buildup

The material reference is : Cyl. Core

Integration Parameters

Y Direction (axial)	40
Circumferential	40

Results

<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u> <u>No Buildup</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u> <u>With Buildup</u>	<u>Exposure Rate</u> <u>mR/hr</u> <u>No Buildup</u>	<u>Exposure Rate</u> <u>mR/hr</u> <u>With Buildup</u>
0.0318	4.230e+01	2.327e-05	2.328e-05	1.938e-07	1.939e-07
0.0322	7.804e+01	4.345e-05	4.346e-05	3.497e-07	3.497e-07
0.0364	2.840e+01	1.791e-05	1.792e-05	1.018e-07	1.018e-07
0.6616	1.838e+03	2.755e-02	3.158e-02	5.341e-05	6.123e-05
TOTALS:	1.987e+03	2.763e-02	3.167e-02	5.405e-05	6.188e-05

Page : 1
DOS File : EXTERN2.MS5
Run Date : September 13, 2004
Run Time : 10:36:01 AM
Duration : 00:00:01

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

Case Title: Downcomer External
Description: Location B - Cs-137 @ 1 pCi/cm²
Geometry: 10 - Cylinder Surface - External Dose Point



Source Dimensions
Height 304.8 cm 10 ft 0.0 in
Radius 30.48 cm 1 ft

Dose Points
1 X Y Z
 33.02 cm 152.4 cm 0 cm
 1 ft 1.0 in 5 ft 0.0 in 0.0 in

Shields

Shield Name	Dimension	Material	Density
Cyl. Core	30.48 in ²	Iron	0.484
Transition		Air	0.00122
Air Gap		Air	0.00122

Source Input

Grouping Method : Actual Photon Energies

Nuclide	curies	becquerels	μCi/cm ²	Bq/cm ²
Ba-137m	5.5221e-008	2.0432e+003	9.4600e-007	3.5002e-002
Cs-137	5.8373e-008	2.1598e+003	1.0000e-006	3.7000e-002

Buildup

The material reference is : Cyl. Core

Integration Parameters

Y Direction (axial) 40
Circumferential 40

Results

Energy MeV	Activity photons/sec	Fluence Rate		Exposure Rate	
		No Buildup	With Buildup	No Buildup	With Buildup
0.0318	4.230e+01	2.392e-05	2.393e-05	1.993e-07	1.993e-07
0.0322	7.804e+01	4.466e-05	4.467e-05	3.594e-07	3.595e-07
0.0364	2.840e+01	1.841e-05	1.842e-05	1.046e-07	1.046e-07
0.6616	1.838e+03	2.865e-02	3.339e-02	5.554e-05	6.473e-05
TOTALS:	1.987e+03	2.874e-02	3.348e-02	5.620e-05	6.540e-05

PIPE PARTIAL DENSITY CALC.		
Diameter 1 (in)	Diameter 2 (in)	Density (g/cc)
24	23.25	7.86
Area 1 (in²)	Area 2 (in²)	Difference (in²)
452.4	424.6	27.8
Length (in)	Volume (in³)	Volume (cc's)
120	3339.9	54731.2
Grams	Volume 1 (cc's)	g/cc
430187.6	889600.0	0.484

ORIGINAL

SNEC FSS RADIOLOGICAL SURVEY		Survey Unit #	SS8-1	Survey #	F88-411
Location	SSGS Seal Chamber # 1				
Grid #	N/A	Area Classification	1	SR #	0098
Reason For Survey	Final post remediation	Date of Survey	11/03/03	Time of Survey	12:00
Technician	B. Brownsberger <i>[Signature]</i>	Technician	J. Graham <i>[Signature]</i>		
GRCS Review	R. Shepherd <i>[Signature]</i>	Date of Review	11-5-03		
Radiological Instrument Data		Radiological Instrument Data		Radiological Instrument Data	
Inst./Probe Type	2350 / 4410	Inst./Probe Type	N/A	Inst./Probe Type	N/A
Serial Number(s)	1281E2 / 195021 Pk	Serial Number(s)		Serial Number(s)	
Cal. Due Date(s)	1/30/04 / 1/22/04	Cal. Due Date(s)		Cal. Due Date(s)	
Efficiency %	N/A	Efficiency (%)	P.Y.	Efficiency (%)	P.Y.
ABCR (cpm)	52	ABCR (cpm)		ABCR (cpm)	
BRA Average	N/A	BRA Average		BRA Average	
BRA Location	N/A	BRA Location	↓	BRA Location	↓
Source Checks	Sat. <input checked="" type="checkbox"/> Unsat. <input type="checkbox"/>	Source Checks	Sat. <input type="checkbox"/> Unsat. <input type="checkbox"/>	Source Checks	Sat. <input type="checkbox"/> Unsat. <input type="checkbox"/>
Comments					
<p>Ambient air temperature at survey location was 62 degrees Fahrenheit. 4410 Scan of identified areas per SR-99 with results < action level in gross cpm. (240 sq ft)</p>					
Survey Map					
Please refer to page three.					
<p>Notes: <input checked="" type="checkbox"/> = Area surveyed <input checked="" type="checkbox"/> = Background locations</p>					

ATTACHMENT 6-1

1 of 3

ORIGINAL

Instrument #	126182	Technician	887173					Survey #	F33-411
Log #	Location	Date	Time	Det.	Reading (cpm)	Count Time (sec)	Mode	Comments	
24	SS8-1 BCR1	11/3/03	12:58	4	45	60	SCL		
25	SS8-1 BCR2	11/3/03	12:59	4	63	60	SCL		
26	SS8-1 BCR3	11/3/03	13:02	4	48	60	SCL		

SS = Saxton steam

ATTACHMENT 6-2

2 of 3

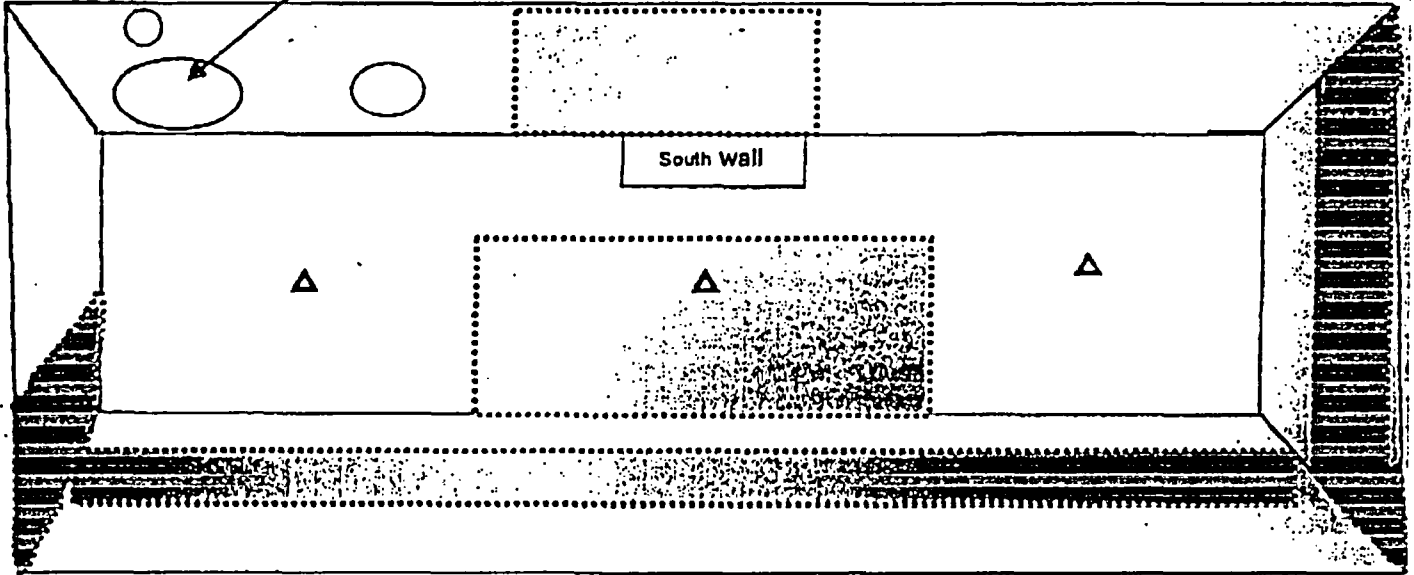
SS 8-1

FSS- 411

SEAL CHAMBER # 1

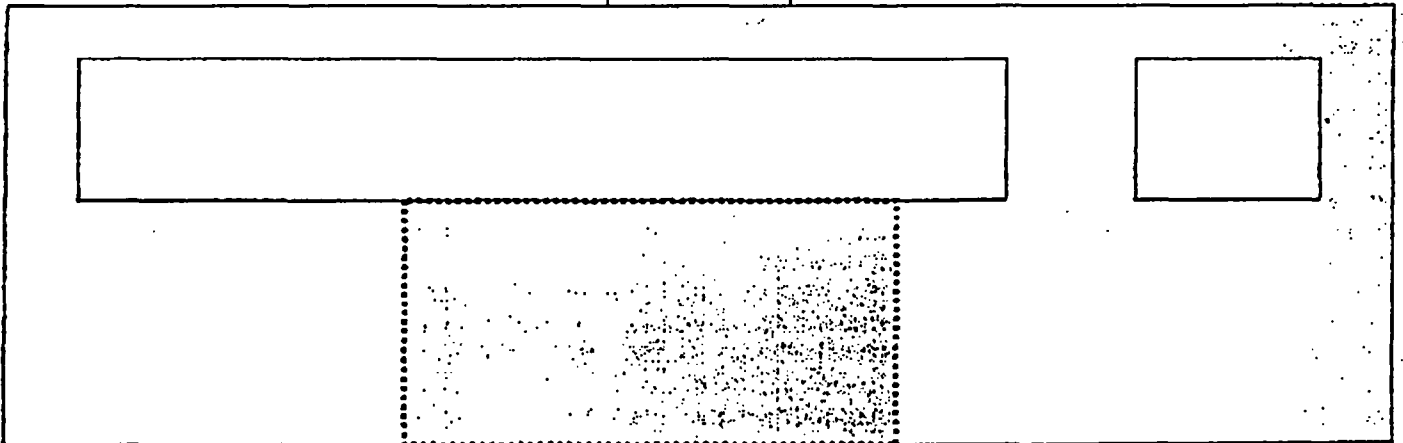
ORIGINAL

Scanned inside penetrallon



Floor

North Wall



ATTACHMENT 6.3

3 of 3

INTERNAL MEASUREMENTS CPM				INTERNAL MEASUREMENTS NCPM				INTERNAL EXPOSURE RATES (mR/h)				INTERNAL pCi/cm ²				INTERNAL dpm/100 cm ²				
Mean 1	Mean 2	Mean 3	Mean 4	Mean 1	Mean 2	Mean 3	Mean 4	Mean 1	Mean 2	Mean 3	Mean 4	Mean 1	Mean 2	Mean 3	Mean 4	Mean 1	Mean 2	Mean 3	Mean 4	
A	46.5	68.5	34	35.5	46.5	68.5	34	35.5	2.10E-04	3.10E-04	1.54E-04	1.61E-04	2.83E+00	3.87E+00	1.92E+00	2.01E+00	583.7	859.8	428.8	445.6
B	110	149	82	68.5	110	149	82	68.5	4.98E-04	6.74E-04	3.71E-04	3.10E-04	5.72E+00	7.74E+00	4.26E+00	3.56E+00	1289.1	1719.0	946.0	790.3
C	91	87	84	93	91	87	84	93	4.12E-04	3.94E-04	3.80E-04	4.21E-04	5.15E+00	4.92E+00	4.75E+00	5.26E+00	1142.2	1092.0	1054.4	1167.3

EXTERNAL MEASUREMENTS CPM FSS-427				EXTERNAL MEASUREMENTS NCPM				EXTERNAL EXPOSURE RATES (mR/h)				EXTERNAL pCi/cm ²				EXTERNAL dpm/100 cm ²				
Mean 1	Mean 2	Mean 3	Mean 4	Mean 1	Mean 2	Mean 3	Mean 4	Mean 1	Mean 2	Mean 3	Mean 4	Mean 1	Mean 2	Mean 3	Mean 4	Mean 1	Mean 2	Mean 3	Mean 4	
A	115	127	97.5	80	115	127	97.5	80	5.20E-04	5.75E-04	4.41E-04	3.62E-04	8.50E+00	9.38E+00	7.20E+00	5.91E+00	1886.4	2083.3	1599.4	1312.3
B	117.5	136.5	93	96.5	117.5	136.5	93	96.5	5.32E-04	6.18E-04	4.21E-04	4.37E-04	8.21E+00	9.54E+00	6.50E+00	6.74E+00	1823.2	2118.0	1443.1	1497.4
C	106.5	87.5	80.5	79.5	106.5	87.5	80.5	79.5	4.82E-04	3.96E-04	3.64E-04	3.60E-04	7.87E+00	6.47E+00	5.95E+00	5.87E+00	1747.0	1435.3	1320.5	1304.1

Background => cpm

Conversion Efficiency => cpm/mR/h

Internal MicroShield Model A & C => mR/h/pCi/cm²

Internal MicroShield Model B => mR/h/pCi/cm²

External MicroShield Model A & C => mR/h/pCi/cm²

External MicroShield Model B => mR/h/pCi/cm²

ATTACHMENT 7 - 1

INTERNAL MEASUREMENTS CPM				INTERNAL MEASUREMENTS NCPM				INTERNAL EXPOSURE RATES (mR/h)				INTERNAL pCi/cm ²				INTERNAL dpm/100 cm ²				
Mean 1	Mean 2	Mean 3	Mean 4	Mean 1	Mean 2	Mean 3	Mean 4	Mean 1	Mean 2	Mean 3	Mean 4	Mean 1	Mean 2	Mean 3	Mean 4	Mean 1	Mean 2	Mean 3	Mean 4	
A	46.5	68.5	34	35.5	-3.5	18.5	-16	-14.5	-1.58E-05	8.37E-05	-7.24E-05	-6.56E-05	-1.98E-01	1.05E+00	-9.05E-01	-8.20E-01	-43.9	232.2	-200.8	-182.0
B	110	149	82	68.5	60	99	32	18.5	2.71E-04	4.48E-04	1.45E-04	8.37E-05	3.12E+00	5.14E+00	1.66E+00	9.61E-01	692.2	1142.1	369.2	213.4
C	91	87	84	93	41	37	34	43	1.85E-04	1.67E-04	1.54E-04	1.95E-04	2.32E+00	2.09E+00	1.92E+00	2.43E+00	514.6	464.4	426.8	539.7

EXTERNAL MEASUREMENTS CPM FSS-427				EXTERNAL MEASUREMENTS NCPM				EXTERNAL EXPOSURE RATES (mR/h)				EXTERNAL pCi/cm ²				EXTERNAL dpm/100 cm ²				
Mean 1	Mean 2	Mean 3	Mean 4	Mean 1	Mean 2	Mean 3	Mean 4	Mean 1	Mean 2	Mean 3	Mean 4	Mean 1	Mean 2	Mean 3	Mean 4	Mean 1	Mean 2	Mean 3	Mean 4	
A	115	127	97.5	80	65	77	47.5	30	2.94E-04	3.48E-04	2.15E-04	1.36E-04	4.80E+00	5.69E+00	3.51E+00	2.22E+00	1066.2	1263.1	779.2	492.1
B	117.5	136.5	93	96.5	67.5	86.5	43	46.5	3.05E-04	3.91E-04	1.95E-04	2.10E-04	4.72E+00	6.05E+00	3.01E+00	3.25E+00	1047.4	1342.2	667.2	721.5
C	106.5	87.5	80.5	79.5	56.5	37.5	30.5	29.5	2.56E-04	1.70E-04	1.38E-04	1.33E-04	4.17E+00	2.77E+00	2.25E+00	2.18E+00	926.8	615.1	500.3	483.9

Background => cpm

Conversion Efficiency=> cpm/mR/h

Internal MicroShield Model A & C=> mR/h/pCi/cm²

Internal MicroShield Model B=> mR/h/pCi/cm²

External MicroShield Model A & C=> mR/h/pCi/cm²

External MicroShield Model B=> mR/h/pCi/cm²

ATTACHMENT 7.2