Appendix E

Assessment of Results
SS14-1 and SS14-2

ORIGINAL

FirstEnergy

SNEC CALCULATION COVER SHEET

CALCULATION DESCRIPTION

Calculation Number	Revision Number	Effective Date	Page Number
E900-05-008	0	5·12·05	1 of 9

Subject

Assessment of Survey Results from SSGS Footprint – SS14-1 & SS14-2

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 ☒

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.

DESCRIPTION OF REVISION

APPROVAL SIGNATURES

Calculation Originator	B. Brosey/ B. Brosey	Date	2/24/05
Technical Reviewer	R. Holmes/ R. Holmes	Date	5/11/05
Additional Review	A. Paynter/ [signature]	Date	12 May 2005
Additional Review		Date	

1.0 PURPOSE

1.1 The purpose of this calculation is to review final status survey results for two (2) survey units SS14-1 & SS14-2, which are sections of the basement floor in the Saxton Steam Generating Station (SSGS). The SSGS basement is at the 790' El (grade is at the 812' El), and includes walls and floor areas. There is no ceiling since the upper portion of the building was demolished between 1975 and 1977 (**Reference 3.1**).

1.2 The reason for this assessment is the complexity of this area with respect to the number of final status surveys (FSS) performed, and the residual volumetric contamination that was identified mainly in SS14-1 and SS14-2.

1.3 Applicable survey data was taken from survey requests (SR) developed from the following survey designs (SD).

- E900-03-019, "Shonka SSGS Footprint & CV Steam Pipe Tunnel (SSGS Side) FSS Survey Design,
- E900-03-025, "SSGS Area Trench & Sump Survey Design",
- E900-03-027, "Balance of SSGS Footprint – Survey Plan",
- E900-03-029, "Balance of SSGS Footprint 2 – Survey Plan",
- E900-04-003, "Assessment of E900-03-025, Rev 0 – SSGS Trench & Sump Area

1.4 Survey units are shown in **Attachments 1-1** and **1-2**, and in photos of **Attachment 2-1** through **2-4**. Results and conclusions are provided in Section 2.0.

2.0 SUMMARY OF RESULTS

2.1 SRA Results (SD E900-03-019)

2.1.1 Portions of the SSGS footprint floor were surveyed using an automated large area gas flow proportional counter (GFPC). This instrumentation was developed and operated by Shonka Research Associates (SRA).

2.1.2 The following DCGLw values (Table 1) were assigned during the SRA survey process.

Table 1, DCGLw Values Applicable to SRA Surveys (SR-84)

SRA No.	SD	Survey Unit	Location	Area (m^2)	Area Surveyed (m^2)	GA DCGLw (dpm/100 cm^2)
SCS7066Z	E900-03-019	SS14-1	Floor	~75	49	13,124 (99.8% Cs-137) A.L.
SCS7067Z	E900-03-019	SS14-2	Floor	~76	31	13,124
SCS7072S	E900-03-019	SS14-6	Trench & Sumps	~62	4.7	13,124

A.L. = Administrative Limit

2.1.2 SRA's results indicate that none of these survey units are above the applicable DCGLw. SRA did note that some slightly elevated areas were identified on the eastern footprint floor (**Reference 3.2**). SRA also identified the maximum Cs-137 concentration in these survey units as ***~3,400 dpm/100 cm^2***.

2.1.3 Because of access difficulties, SRA could not survey all of the surface area in these survey units. Additional surveys were necessary to complete the FSS.

2.2 SSGS Area Trench & Sump Survey Design (E900-03-025)

2.2.1 The trench and sump areas (SS14-6) were surveyed using conventional survey instrumentation (i.e., hand-held portable (GFPC), and 2" by 2" NaI (w) gamma radiation detectors). The estimated surface area for all trenches in the SSGS basement area (including all sumps) is ~100 square meters. Approximately 62 m^2 of this area is located in the SS14-1 and SS14-2 survey units (see **Attachment 1-1** to **1-2**). Survey overlap with SRA areas was unavoidable.

Table 2, DCGLw Values Applicable to E900-03-025 (SR-95)

Survey Unit	Location	Area (m^2)	Area Surveyed (m^2)	GA DCGLw (dpm/100 cm^2)	DCGLw (Cs-137 pCi/g)
SS14-6	Trench Segments 1-5, SE & NE Sump Areas	~62*	~62*	13,000 (A.L.)**	4.93 (A.L.)

*This portion of the survey unit resides in the eastern SSGS footprint.

**This is the same DCGLw value as that in Table 1, rounded to 13,000 dpm/100 cm^2.

2.2.2 Results of GFPC scanning of these survey units yielded no net count rates above 500 ncpm (~6,700 dpm/100 cm^2 or 983 ncpm was equivalent to the DCGLw from Compass).

2.2.3 Results from fifty two (52) random start systematic GFPC static measurements ranged from 166 cpm to 338 cpm for the entire survey unit (SS14-6). Concrete background in this area is estimated at ~298 cpm ± 56.8 cpm. The calculated efficiency for the instrument is 0.06 c/d and the probe factor was 1.26. Thus the maximum dpm/100 cm^2 encountered during the measurement effort (subtracting the average background value minus 2 sigma), was about ***2,050 dpm/100 cm^2***. This is well below the surface activity DCGLw shown in Table 2 above and thus this area meets the release criteria.

$$(((338 - (298-(2 \times 56.8)))/0.06)/1.26) = \underline{2{,}049\ dpm/100\ cm^2}$$

2.2.4 Since no action levels were exceeded, no concrete samples were collected.

2.3 Balance of SSGS Footprint – Survey Plan (E900-03-027)

2.3.1 This SD addressed basement floor areas missed by SRA (other than the trench and sump areas) see **Attachment 3-1** and **3-2**. Some of this area overlapped previously surveyed surfaces. As a result, the calculated area as shown in Table 3 is nearly as large as the available floor space.

2.3.2 The areas missed by SRA (in SS14-1 & SS14-2) were surveyed or re-surveyed using conventional survey instrumentation (i.e., hand-held portable (GFPC), and 2" by 2" NaI (w) gamma radiation detectors).

Table 3, DCGLw Values Applicable to E900-03-027 (SR-97)

Survey Unit	Location	Area (m^2)	Area Surveyed (m^2)	GA DCGLw (dpm/100 cm^2)	DCGLw (Cs-137 pCi/g)
SS14-1	Floor	~75	~65*	13,000 (A.L.)**	4.93 (A.L.)
SS14-2	Floor	~76	~58*	13,000 (A.L.)**	4.93 (A.L.)

*This survey unit resides in the eastern portion of the SSGS footprint.

**This is the same DCGLw previously established in Table 1, rounded to 13,000 dpm/100 cm^2.

2.3.3 MDCscan values for GFPC measurements are listed in Table 4 below.

Table 4, GFPC MDCscan Value & Applicable DCGLw - E900-03-027 (SR-97)

Materials	Scanning Action Level	MDCscan (dpm/100 cm^2)	DCGLw (ncpm)
Concrete/Steel	500 ncpm	2,175 Concrete & 1,671 Steel	983

2.3.3.1 Since the action level was not reached, the site release criteria was not exceeded.

NOTE

A few areas could not be scanned with a GFPC type instrument and were marked for scanning with a NaI detector.

2.3.4 Static GFPC measurement results

Results from static measurements over all types of surfaces in SS14-1 to SS14-5 yielded a maximum count rate of 514 cpm at static point 8 in SS14-1. The action level was 983 cpm for a 1 minute count and the measurement location was a concrete surface. If a typical background value is 298 cpm the maximum concentration would be 514 cpm – 298 cpm = (216 ncpm/0.0595 c/d)/1.26 = ~***2,900 dpm/100 cm^2***. If the surface were a steel material the maximum surface concentration would have been ~ ((514 – 176)/0.0595)/1.26 = ~***4,500 dpm/100 cm^2***. Both of these values are well below the surface DCGLw listed in Table 3.

2.3.5 MDCscan values for NaI measurements are listed in Table 5 below.

Table 5, NaI MDCscan Values Applicable to E900-03-027 (SR-97)

Materials	Action Level	MDCscan (Cs-137 - pCi/g)	MDCscan (dpm/100 cm^2)
Concrete	300 gcpm	2 pCi/g up to 4.8 pCi/g	3,211 to 5,561

NOTE: The values listed in Table 5 are based on a background count rate of 100 to 300 cpm.

2.3.6 Results of a NaI scan of these survey units show less than the action levels for this instrument. An error in the SD indicated that the minimum conversion efficiency should not be less than 180k cpm/mR/h. The planning value was actually 221k cpm/mR/h. Field survey personnel however, used instruments of equal efficiency to the planning value for all GFPC survey work (221k cpm /mR/h), therefore there is no

impact on survey quality from this incorrect assignment. Surveys completed under SR-0097 indicated the 44-10 NaI instruments used for these surveys had the following serial numbers (see **Attachments 4-1 through 4-5**):

2350-1 = 126172; 44-10 NaI Probe = 196022, (cal due 3/4/04), and
2350-1 = 126182; 44-10 NaI Probe = 196021, (cal due 1/30/04)

2.3.7 Results of NaI scanning exceeded the alarm set-point in only one area (AP-1). The count rate from this area was 342 cpm. The area was sampled IAW the SR's instructions and yielded a concrete sample concentration of about 13.3 pCi/g ± 1.5 pCi/g $_{Cs\text{-}137}$. Since there was only one instrument alarm in the area where this sample was taken, the area was obviously small in diameter. Thus this concentration is not representative of the entire SS14-1 or SS14-2 survey units (eastern SSGS basement concrete floor).

All accessible areas in the SSGS were surveyed. Two (2) hard to reach areas in SS14-1 & SS14-2 were surveyed at the closest point (~4.5 inches), yielding count rates from 100 to 250 gross cpm. The total surface area for these two points was about 1.25 square meters. A surface area factor could have been applied if necessary but the gross count rate from these areas did not exceed the action level.

NOTE

A few areas/items were not surveyed with either survey instrument and an additional survey design was developed to cover these areas/items.

2.4 Balance of SSGS Footprint 2 – Survey Plan (E900-03-029)

This survey design was issued to augment/address remaining SSGS basement areas or items. The areas/items surveyed IAW this SD included the following:

Table 6, Areas Designated for Additional Survey Work (SR-100)

Survey Unit	Location/Item	Material
SS14-1	Downcomer flange & opening (2 ea.)	Steel
SS14-2	Downcomer flange (2 ea. – closed top)	Steel
SS14-1	Potential elevated floor area (AP-2 from FSS-360)	Concrete
SS14-1 & SS14-2	Static Measurement Points 1 – 13 in both Survey Units	Concrete

2.4.1 NaI scans of Table 6 items indicated only one additional area above the action level of 300 gcpm. The area was assigned the number AP2-1 and showed a count rate of ~360 cpm representing in an area of about 0.75 m^2. This sample (SXCF4281) yielded a concentration of 12.1 ± 1.3 pCi/g Cs-137.

2.4.2 Additional concrete samples were taken from these survey units under this survey request. The highest value was 25.3 pCi/g Cs-137 taken at fixed point location No. 8 in survey unit SS14-1. In all, eight (8) samples were collected yielding a range of Cs-137 concentrations between 0.2 to 25.3 pCi/g. These samples were from small areas of volumetric contamination that were identified during scanning evolutions.

Core bore data from this area indicated the contamination was no more than ½ inch deep.

2.4.3 A sample of concrete core bore samples collected during the execution of several survey requests are assembled in Table 7.

Table 7, Concrete Core Bore Results from the SSGS Footprint

	SURVEY UNIT SS14-1 SAMPLE RESULTS					
	Location	SR No.	Sample	Cs-137 (pCi/g)	NaI CPM	Area (m^2)
1	FP1	100	SXCF4280	3.2	193	4.65E-03
2	FP2	100	SXCF4282	5.3	242	4.65E-03
3	FP8	100	SXCF4283	25.3	356	4.65E-03
4	AP1	97	SXCF4273	13.3	342	6.97E-02
5	AP1	94	SXCF4228	9	523	1.16E-01
6	AP2	94	SXCF4281	12.1	360	2.32E-02
7	AP2-3	102	SXCF4322	13.5	412	3.02E-01
8	AP2-4	102	SXCF4336	27	582	4.65E-02
9	AP2-6	102	SXCF4323	66.7	606	2.32E-01
10	AP2-7	102	SXCF4325	22	437	2.32E-01
11	AP-3	94	SXCF4229	4.6	410	2.32E-02
12	AP-4	94	SXCF4244	2.3	256	2.32E-02
13	AP-5	94	SXCF4245	10.6	341	2.32E-02
14	FP-10	102	SXCF4331	2.4	183	4.65E-03
15	FP-11	102	SXCF4332	1.3	126	4.65E-03
16	FP-12	102	SXCF4333	2.2	152	4.65E-03
17	FP-13	102	SXCF4334	2.4	157	4.65E-03
			Mean=>	*13.1*	*Sum=>*	*1.12*

Table 7 samples are from areas of the basement floor which are much smaller than one (1) square meter individually. In sampling these areas, much of the peak volumetric contamination was removed (see **Attachment 5-1** to **5-2** for map of sample locations). Taking the mean concentration from Table 7 and using this value in the MicroShield computer code for an area the approximate size of SS14-1 (73 m^2) yields an exposure rate of:

2.117E-03 mR/h x 2000 hrs = ***4.2 mR*** per year (see **Attachment 6-1** to **6-2**)

Elevated concentrations like those in Table 7 are not representative of the entire floor area. However, when the mean concentration of the core bore sample results listed in Table 7 are used to estimate the dose/y, the resulting yearly dose is still less than the 25 mR/y.

2.4.4 Static NaI measurements using a fixed geometry and a 5 minute were made at the same randomly selected locations shown on **Attachment 1-1** and **1-2**, and provided a range of values from ~65 cpm to ~356 cpm. The only elevated measurement was at fixed point location number 8 - previously described. If background is nominally ~50 cpm and the 44-10 NaI instrument conversion efficiency is 221,206 cpm/mR/h (**Attachment 4-1** and **4-5**) the resulting concentrations based on a MicroShield

model (see **Attachment 7-1**) of a one (1) square meter area at each survey point would be IAW the following Table:

Table 8, NaI Fixed Point Count Rate Results (SR-100)

SS14-1	CPM	ncpm	mR/h	pCi/g	SS14-2	CPM	ncpm	mR/h	pCi/g
1	192.6	142.6	6.45E-04	2.76	1	178.6	128.6	5.81E-04	2.49
2	242	192	8.68E-04	3.72	2	143	93	4.20E-04	1.80
3	166.8	116.8	5.28E-04	2.26	3	144.2	94.2	4.26E-04	1.82
4	149.8	99.8	4.51E-04	1.93	4	169.4	119.4	5.40E-04	2.31
5	109.6	59.6	2.69E-04	1.15	5	133.6	83.6	3.78E-04	1.62
6	186	136	6.15E-04	2.63	6	92.4	42.4	1.92E-04	0.82
7	202	152	6.87E-04	2.94	7	116.4	66.4	3.00E-04	1.29
8	356	306	1.38E-03	5.92	8	117.4	67.4	3.05E-04	1.30
9	108.6	58.6	2.65E-04	1.13	9	120.6	70.6	3.19E-04	1.37
10	182.6	132.6	5.99E-04	2.57	10	131.8	81.8	3.70E-04	1.58
11	126.4	76.4	3.45E-04	1.48	11	94.4	44.4	2.01E-04	0.86
12	152	102	4.61E-04	1.97	12	64.6	14.6	6.60E-05	0.28
13	156.8	106.8	4.83E-04	2.07	13	93	43	1.94E-04	0.83
			Mean=>	**2.50**				*Mean=>*	**1.41**
			Sigma=>	**1.26**				*Sigma=>*	**0.62**

The mean Cs-137 concentrations derived for survey units SS14-1 and SS14-2 is shown in Table 8 above. These values are more consistent with what would be expected for the area and are not driven by elevated core bore results as in Section 2.4.3. Thus the dose from residual volumetric contamination in these survey units is well below the 25 mR/y dose limit (< 1 mR/y).

2.4.5 GFPC scanning of these areas and items using a 500 gcpm value as the action level, did not yield any instrument response exceeding this level.

2.5 Assessment of E900-03-025, Rev 0 – SSGS Trench & Sump Area (E900-04-003)

The purpose of this SD was to perform a new survey of the Trench and Sump area in the SSGS Basement because of a change in the assigned DCGLw values for the sump and trench areas. Previous survey results for this area are described in Section 2.2. The re-evaluated DCGLw values are shown in Table 9 below.

Table 9, Re-evaluated DCGLw values for SSGS Sump & Trench Areas

Surface DCGLw (dpm/100 cm^2)	Volumetric DCGLw (pCi/g)
GA = 6,475 (4,857 A.L.)	5.25 (3.93 A.L.) for Cs-137

A.L. = the administrative limit.

2.5.1 The revised action level for the GFPC instrument was lowered to 200 ncpm. This value was not exceeded during surface scanning activities.

2.6 Conclusions

2.6.1 Using GFPC instrumentation, no surface concentrations (in dpm/100 cm^2) above the applicable DCGLw have been identified in the SSGS footprint area. However, volumetric concentrations in concrete were identified in excess of the applicable volumetric limits. These areas were not generally identified by GFPC scanning techniques and were located using a gamma-ray detection systems moved over the surface at very slow scan speeds. Concrete core bores were then taken to confirm the actual depth of penetration and the magnitude of activity in individual samples. It was found that the maximum depth was no more than one (1) inch and in most cases, less than ½ inch. In addition, these elevated core bores were collected from areas that were much less than one square meter in area. Thus they over estimate the mean concentration for these two survey units.

2.6.2 A better average concentration is derived from fixed point NaI measurements. The mean derived from these measurements is significantly less than that derived solely from sample results. In both cases however, the yearly dose to someone standing on the floor of the SSGS basement for 2000 hours is much less than 25 mR/y.

2.6.3 All NaI detectors used were calibrated with a Cs-137 energy window eliminating significant background contributions. Background in the area is generally below 75 cpm and without Cs-137 present at low chronic level, may have been closer to 50 cpm for this type of structure. Using 50 cpm as a background mean yields a conservative estimate of dose for this facility.

2.6.4 Extremely corroded steel surfaces preclude the use of GFPC survey techniques. The survey approach used for these surfaces was scanning at a slow pace with a NaI detector. However, the MDCscan value for steel was less than the DCGLw and no instrument response above the action level was reported in any survey data.

3.0 REFERENCES

3.1 SNEC Facility Historical Site Assessment.

3.2 SCM Survey of Saxton Nuclear Experimental Corporation SSGS Footprint,

3.3 SNEC Calculation No. E900-03-019, Rev 0 – 1, Shonka SSGS Footprint & CV Steam Pipe Tunnel (SSGS Side) FSS Survey Design, 10/7/03.

3.4 Plan SNEC Facility License Termination Plan.

3.5 SNEC Procedure E900-IMP-4500.59, "Final Site Survey Planning and DQA".

3.6 MicroShield, Computer Radiation Shielding Code, Version 5.05-00121, Grove Engineering.

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

4.0 ASSUMPTIONS AND BASIC DATA

4.1 Minimal assumption as presented in Section 2.0.

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 SS14-1 and SS14-2 survey units.

6.2 **Attachment 2-1** to **2-4**, are photos from the SSGS Basement area in the SS14-1 & 2 areas.

6.3 **Attachment 3-1** to **3-2**, is the rough surface areas missed by SRA that are found in the SSGS Basement area.

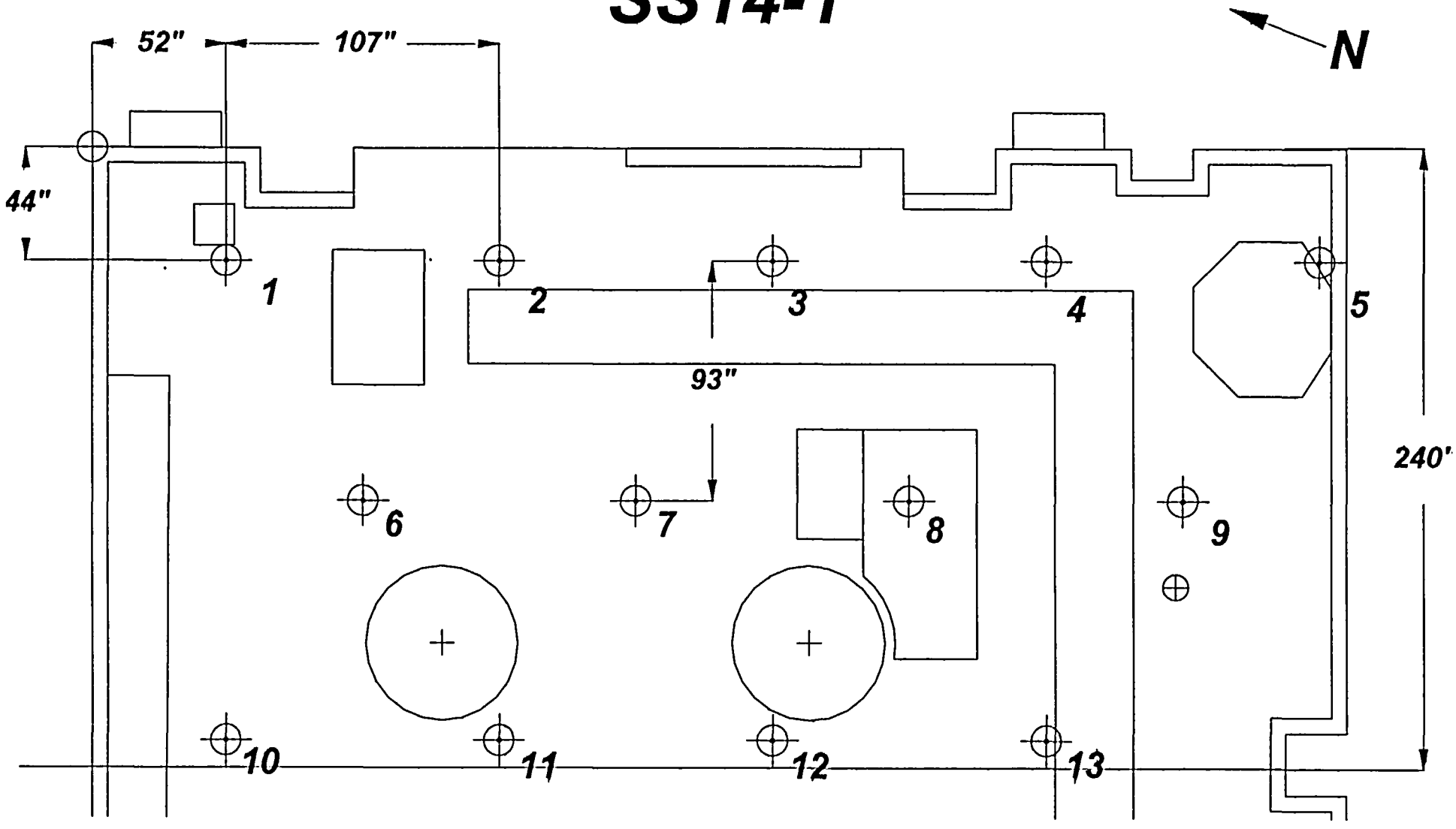
6.4 **Attachment 4-1** to **4-5**, are actual NaI instrument conversion efficiencies (in cpm per mR/h), for instruments used during these survey efforts.

6.5 **Attachment 5-1** to **5-2**, are core bore locations and results.

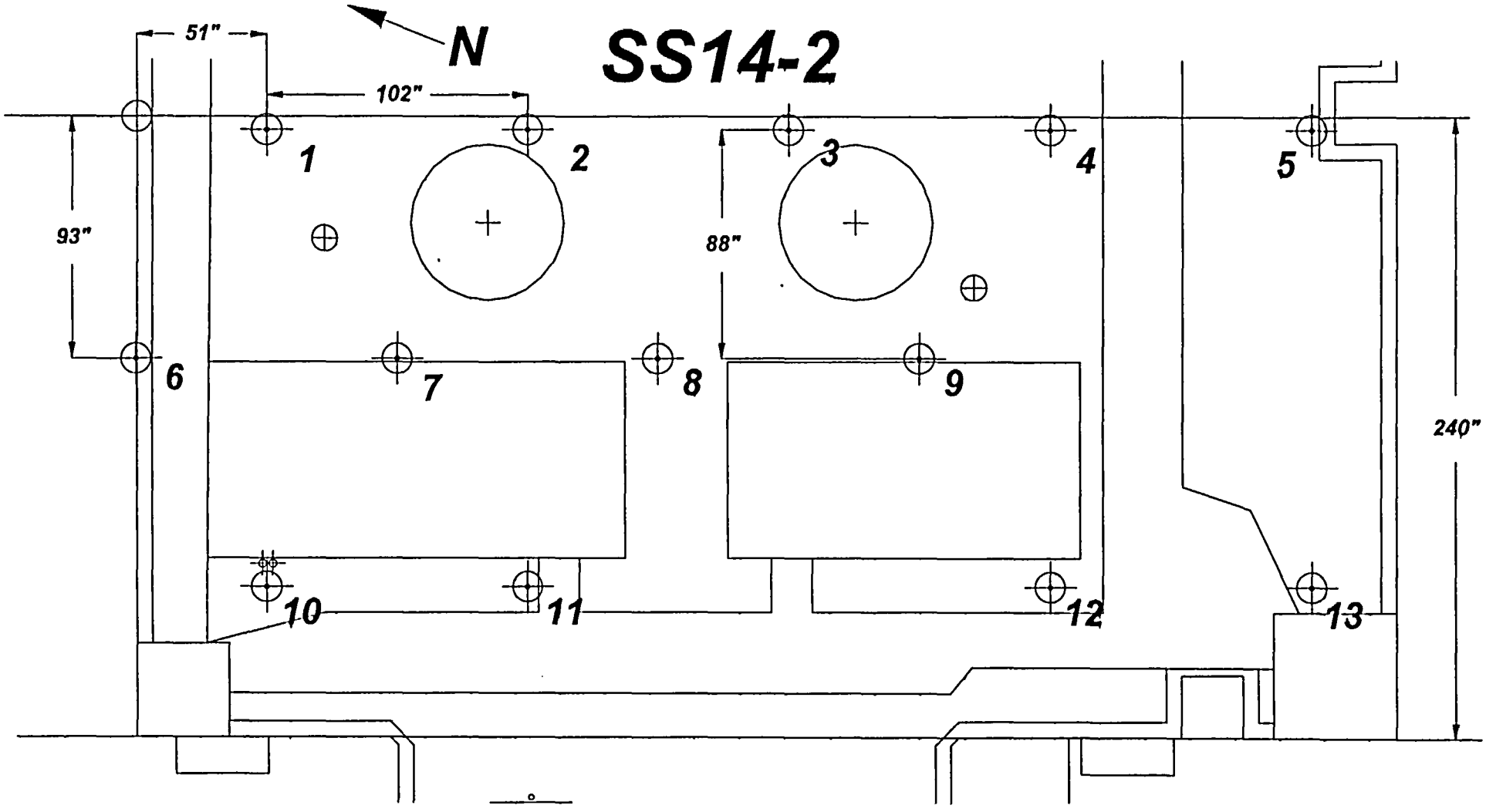
6.6 **Attachment 6-1** to **6-2**, is MicroShield model output sheets for the SS14-1 survey unit.

6.7 **Attachment 7-1**, is MicroShield model output sheet for a 1 square meter of volumetric concrete contamination.

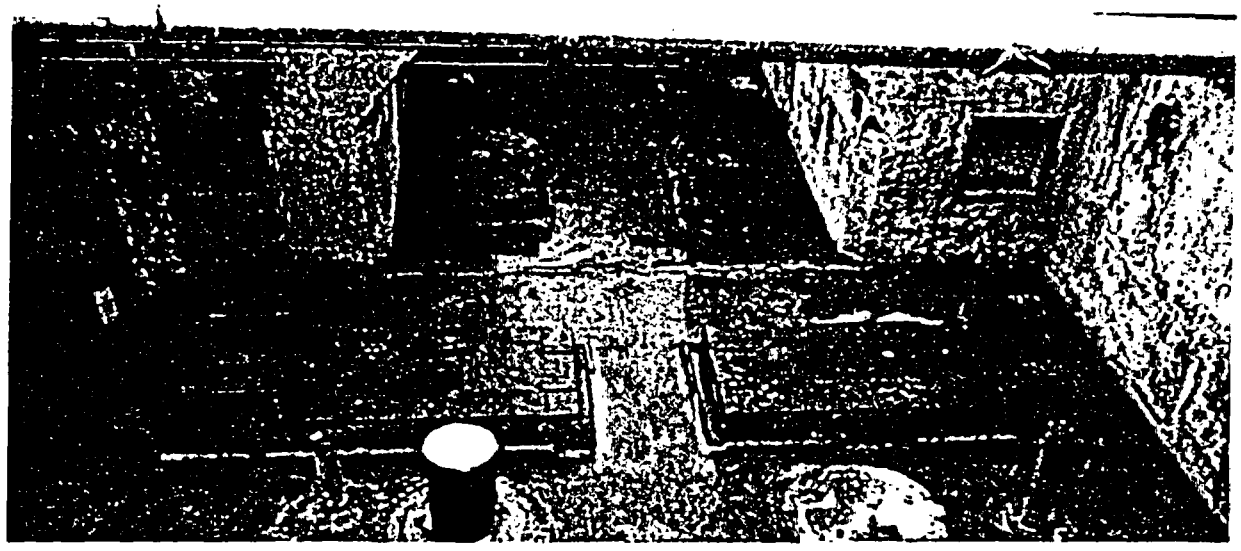
SS14-1



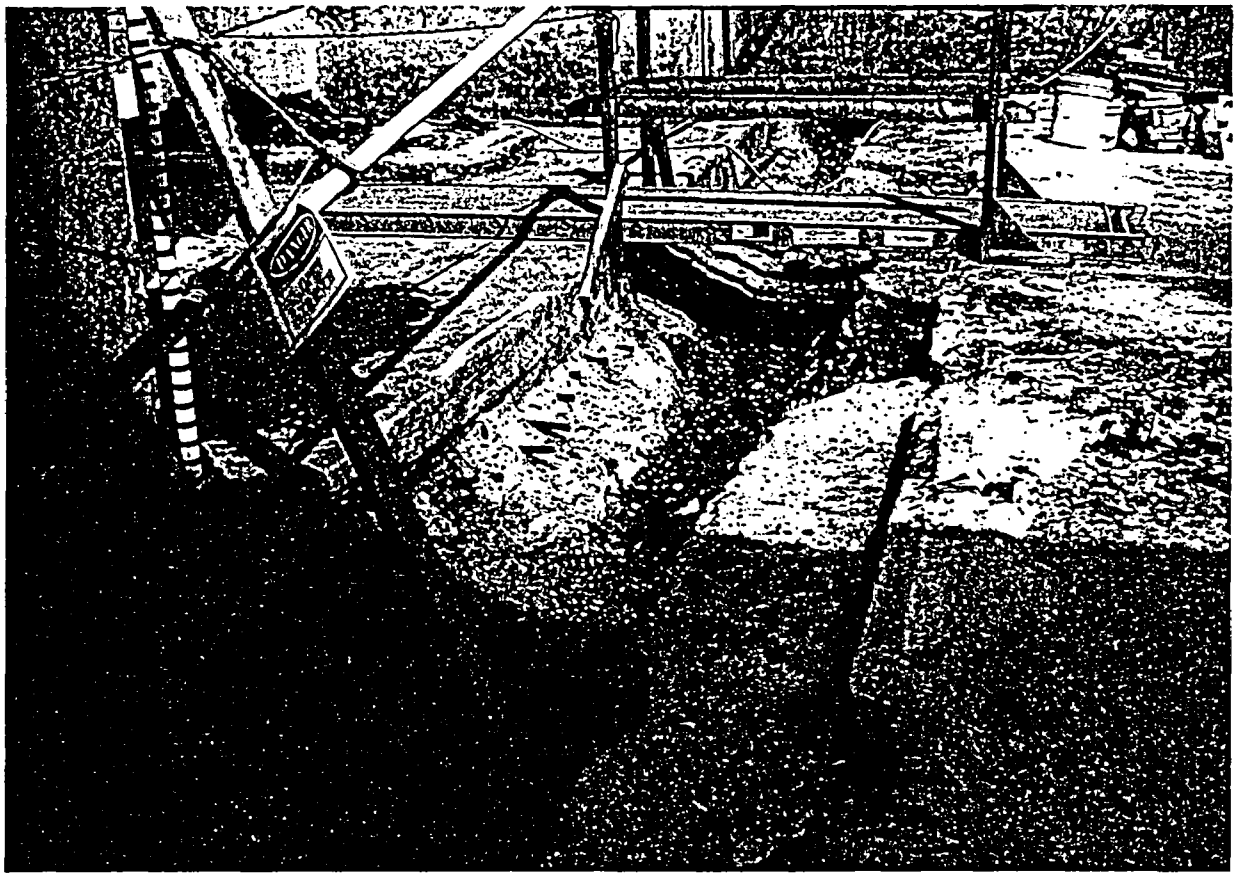
Attachment 1 - 1



Attachment 1 - 2

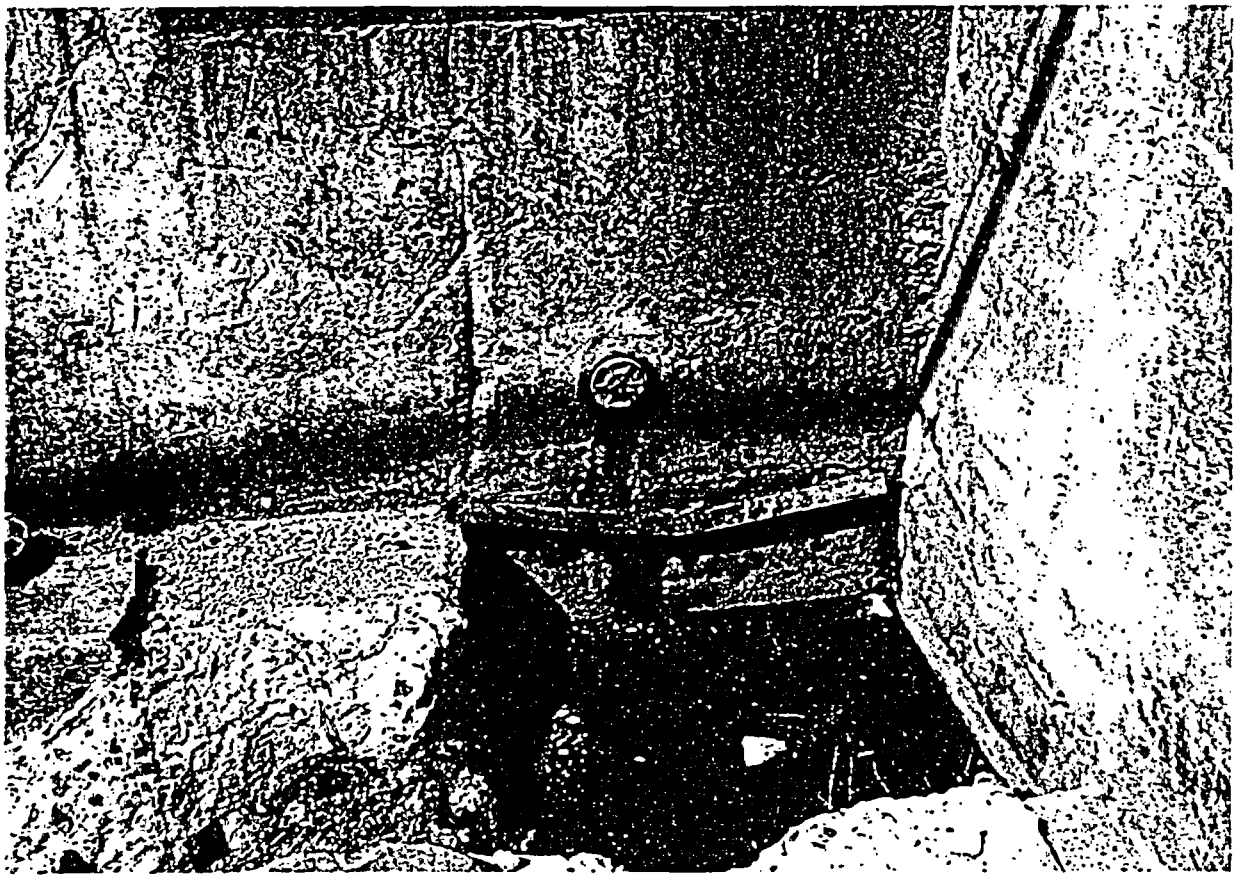


This photo shows what the SSGS basement area looked like just after excavation. The two survey units SS14-1 and SS14-2 are entirely within the eastern section of the basement area.



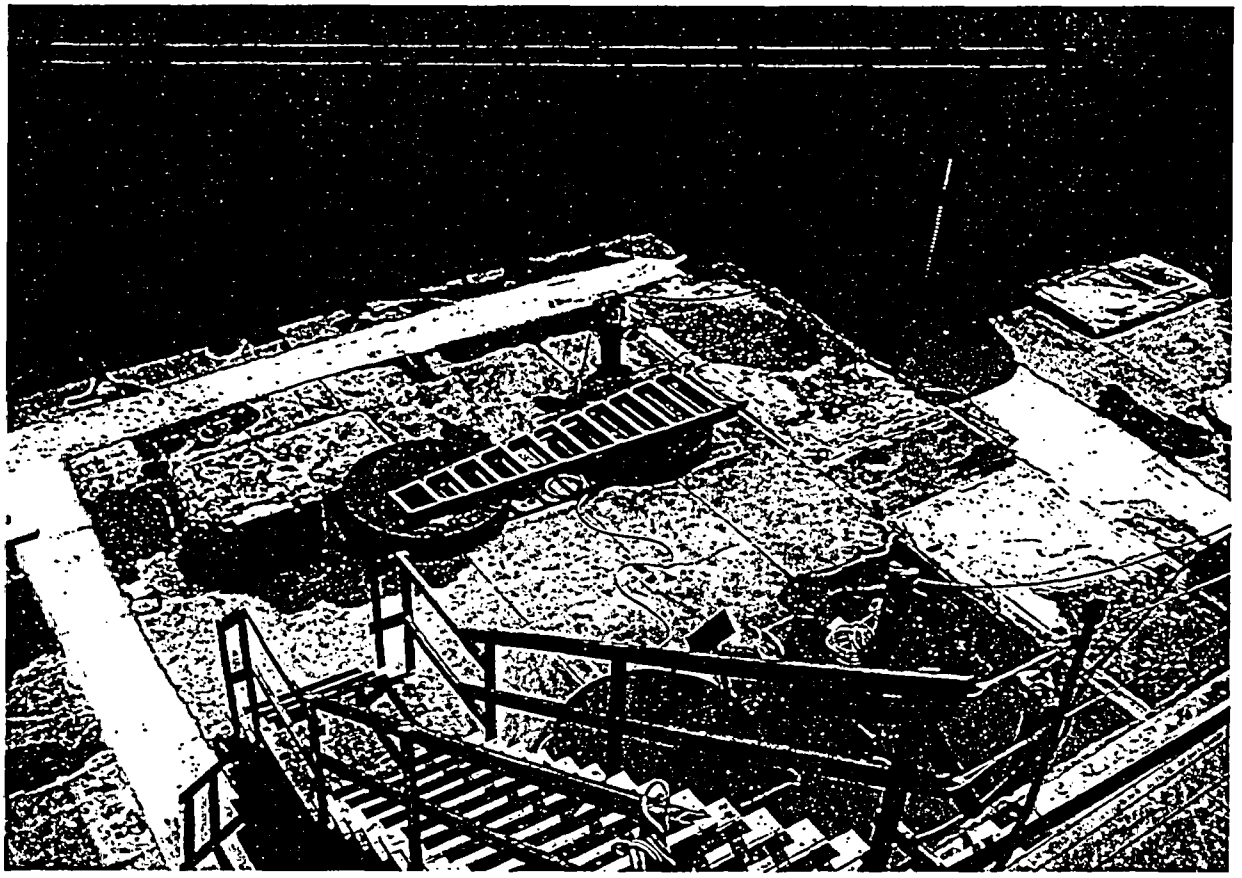
This photo shows what the SSGS basement area looked like after removal of contaminated piping that connected the sump areas. The floor was cut into in order to remove these pipe sections, leaving rough cut trench areas in the floor.

ATTACHMENT 2 . 2



This photo shows one (1) sump area in the SSGS basement.

ATTACHMENT 2 . 3



This photo shows the SSGS basement area after the sumps, floor and trench areas were surveyed and then the sumps and trench areas were filled with concrete to again restore some strength to the floor structure prior to re-fill.

SSGS Floor Class-1 Areas Missed by Shonka

Survey Unit-Evaluation area	Location	Approximate area (in^2)	Depth (mm)	Materials
SS14-1-001	Trough North	3345	3.4	Concrete
SS14-1-002	Large Pad, NE	2932	8.4	Concrete
SS14-1-003	Sm Pad N.E.	768	5.2	Concrete
SS14-1-004	Sm Gouge N.E.	88	17.4	Concrete
SS14-1-005	Bolt Heads	60	12.8	Concrete, Steel
SS14-1-006	Areas Under Stairs	8923	2.1	Concrete
SS14-1-007	Rough Areas Adjacent to Sec 1 Trench	852	10.2	Concrete
SS14-1-008	Deep Gouge East of Trench	180	81.7	Concrete, *
SS14-1-009	Trough Areas, South	8001	15.4	Concrete
SS14-1-010	Octagonal Pad	3580	0.4	Concrete
SS14-1-011	Pipe Imprint	727	42.2	Concrete
SS14-1-012	Rough Areas South of Trench	1644	24.4	Concrete
SS14-1-013	Pedastal, rough areas north of Section 2 of trough, around down comer	11385	32.4	Concrete, Steel
SS14-1-014	Area around Downcomer	3967.5	0.4	Concrete, Steel
SS14-1-015	Temp storage location of Down comer Cover	352.5	6.1	Concrete
SS14-1-016	Downcomer Covers and flanges	9035	>120	Steel *
SS14-2-001	Concrete adjacent to Down comer Cover	1152	17.4	Concrete *
SS14-2-002	Concrete adjacent to Down comer Cover	1152	17.4	Concrete *
SS14-2-003	½ of Down Cover storage location	705	6.1	Concrete
SS14-2-004	2 pipes to intake Tunnel	4476	14.2	Steel *
SS14-2-005	Gouge	81	15.6	Concrete
SS14-2-006	Rough Areas South of Trench	316	9.4	Concrete
SS14-2-007	Trough adjacent to Wall	523	0.2	Concrete
SS14-2-008	Pump Pedestals	24,965	22.1	Concrete
SS14-2-009	North sump edge	680	32	Concrete, Steel
SS14-2-010	South sump edge	1782	30.6	Concrete
SS14-2-011	Downcomer Covers and flanges	5669	>120	Steel *
SS14-3-001	Pad	7310	23.4	Concrete
SS14-3-002	Pad	7310	24.6	Concrete
SS14-3-003	Pipes	1413	49.6	Concrete, Steel *
SS14-3-004	Pad	4800	36	Concrete
SS14-3-005	Pad	480	36	Concrete
SS14-3-006	Rough Area	3690	38.2	Concrete, Steel
SS14-3-007	Rough Area	4160	63	Concrete *
SS14-3-008	Pipes/Drains	4700	>126	Concrete, Steel *
SS14-3-009	Cutout Pipe trenches	1227	87	Concrete *
SS14-3-010	Rough Patches North or Trench	714	24	Concrete
SS14-3-011	Trough	9216	15	Concrete

ATTACHMENT 3 . 1

SS14-4-001	Trough	6736	32.8	Concrete
SS14-4-002	Rough Area East of sump	2793	14.8	Concrete
SS14-4-003	Rough SE of Sump	3440	20.5	Concrete
SS14-4-004	Foundation	3960	42	Concrete
SS14-4-005	Foundation	8190	52.3	Concrete *
SS14-4-006	Pipe opening	10214	10.4	Concrete, Steel *
SS14-4-007	Rough Areas North and South of Trench	1030	17.5	Concrete
SS14-5-001	Trough	7348	30.5	Concrete *
SS14-5-002	Rough Areas West Trench	1980	61.8	Concrete *
SS14-5-003	Pedestal, Gouge	1977	43.2	Concrete, Steel
SS14-5-004	Floor Adjacent to Valve	7285	34.5	Concrete *
SS14-5-005	Valve, Pipe	4229	50.5	Steel *
SS15-001	Recesses in East Wall	2748	5.5	Concrete
SS15-002	Steel trim on Recesses in East Wall	936	0.4	Steel

* Area that may require evaluation via gamma analysis, due to inaccessible surfaces.

D-196022

Duratek

ORIGINAL

CALIBRATION CERTIFICATE

Duratek Instrument Services
628 Gallaher Road
Kingston, TN 37763
Phone: (865) 376-8337
Fax: (865) 376-8331

This Certificate will be accompanied by Calibration Charts or Readings where applicable

CUSTOMER INFORMATION		INSTRUMENT INFORMATION	
Customer Name: Duratek Inc. - Instrument Services Facility		Manufacturer: Ludlum	
Address: 628 Gallaher Road, Kingston, TN 37763		Model: 2350-1	Serial Number: 126172
Contact Name: Thomas Scott		Probe: N/A	Serial Number: N/A
Customer Purchase Order Number: N/A	Work Order Number: 2003-00909	Calibration Method: Electronic and Source	

INSTRUMENT CALIBRATION INFORMATION

Instrument Range (CPM)	Calibration Standard Value (CPM)	Instrument Response		Comments
		Before Calibration	After Calibration	Calibrated in accordance with RP-INS-I-245 Rev 0
400K	400,000	405,044	405,044	Pulser: 120935 Cal Due: 03/28/04
40K	40,000	40,178	40,178	D-814: 2551 Cal Due: 10/07/03
4K	4,000	4,017	4,017	Psychron: 5546 Cal Due: 02/11/04
400	400	401	401	EPPROM Version: 37122N21
HV Cal Values (M2350 HV Entry)	Desired HV (Voltmeter) (VDC)	As Found (VDC)	As Left (VDC)	
600	600	601	601	Temp: 22.1°C
1,200	1,200	1,202	1,202	Pressure: 739 mmHg
1,800	1,800	1,799	1,799	Humidity: 56%
Parameter	Tolerance (±10%)	As Found	As Left	
Threshold T = 100	10 ± (9 to 11) mVDC	N/A	10.0	Geotropism: SAT ACK/Scroll: SAT
Threshold T = 500	50 ± (45 to 55) mVDC	N/A	49.1	BAT>4.5: SAT Volume: SAT
Threshold T = 1000	100 ± (90 to 110) mVDC	N/A	97	Count: SAT Audio Divide: SAT
Window Width W = 100	10 ± (9 to 11) mVDC	N/A	10	Alarms: SAT Lamp: SAT
Display-to-mV ratio:	100 to 10 mV			Overload Test: SAT

STATEMENT OF CERTIFICATION

We Certify that the instrument listed above was calibrated and inspected prior to shipment and that it met all the Manufacturers published operating specifications. We further certify that our Calibration Measurements are traceable to the National Institute of Standards and Technology. (We are not responsible for damage incurred during shipment or use of this instrument).

Instrument Calibrated By:	Reviewed By:	Date: 9-5-03
Calibration Date: 09/04/03	Calibration Due: 03/04/04	

ATTACHMENT 4.1

uratek

Duratek Instrument Services
628 Gallaher Road
Kingston, TN 37763
Phone: (865) 376-8337
Fax: (865) 376-8331

ORIGINAL

CALIBRATION CERTIFICATE

126172

This Certificate will be accompanied by Calibration Charts or Readings where applicable

CUSTOMER INFORMATION		DETECTOR INFORMATION
Customer Name: Duratek Instrument Services		Manufacturer: Ludlum
Address: 628 Gallaher Rd Kingston, TN 37763		Detector Model: 44-10
Contact Name: Thomas Scott		Serial Number: 196022
Customer Purchase Order Number: N/A	Work Order Number: 2003-00722	Evaluation Method: Source

DETECTOR EFFICIENCY/RESPONSE/PRECISION INFORMATION			
1) Source Nuclide: Cs^{137}	Serial Number: 019454	Activity: 5μCi nominal	Certification Date: N/A (Used for Plateau Only)
2) Source Nuclide: Cs^{137}	Serial Number: 049711	Activity: Variable	Certification Date: 04/09/03

Scaler Information		Precision Test	mR/Hr (Source #2)
2350-1	#117566	Count 1	2.00
Due Date	01/22/04	Count 2	2.00
Threshold	T=100 (10mV)	Count 3	2.01
Cable Length	5ft.	Average	2.00
N/A	N/A	Tolerance ±10%	All counts within ±10% of Average
N/A	N/A	Pass/Fail	Pass
N/A	N/A		

Low Sample Activity (400uR/hr): Using Source #2 = 73,896	High Sample Activity (2mR/hr) Using Source #2 = 265,785	Dead Time (DT): 1.583900E-05	Calibration Constant (CC): 6.141193E+10

ATTACHMENTS			DETECTOR DATA: DOSE RATE PROBES (mR/Hr)			
Detector Setup Report	YES ✓	NO	Desired Exposure	Tolerance ±10%	As Found	As Left
Barcode Report	YES ✓	NO	0.400	0.360-0.440	.432	.396
Voltage Plateau:	YES ✓	NO	1	0.90-1.10	.958	.951
High Voltage: 1000V			2	1.8-2.2	2.12	2.00

COMMENTS

Detectors set up with a 2350-1 may be used with any 2350-1 provided that the setup parameters are scanned into the 2350-1 prior to use with that specific detector
Calibrated with 5ft. Cable

STATEMENT OF CERTIFICATION

We Certify that the detector listed above was evaluated for proper operation prior to shipment and that it met all the Manufacturers published operating specifications. We further certify that our Calibration Measurements are traceable to the National Institute of Standards and Technology. (We are not responsible for damage incurred during shipment or use of this detector).

Detector Certified By:	Reviewed By: Thomas F. Scott	Date: 11-4-03
Certification Date: 07/22/03		Certification Due: 07/22/04

ATTACHMENT 4.2

ORIGINAL

LUDLUM MODEL 44-10 HIGH VOLTAGE PLATEAU DATA SHEET

Serial Number: 196022

HIGH VOLTAGE	SOURCE (10 second count)
705	34,636
706	36,264
707	37,529
708	37,718
709	38,471
710	38,124
711	37,737
712	38,616
713	N/A
714	N/A
715	N/A
716	N/A
Detector plateau performed using Cs137 #019464 5uCi nominal value button source	

Detector Parameters for Peaking		
Parameter	Setting	Comments
Threshold (10mV/100)	612	Peaked for Cs^{137} at 662keV
Window (On)	100	
High Voltage	709	
CPM/mR/Hr	221,206	
CPM/mR/Hr conversion performed using Cs137 #049711 Certification Date: 04/09/03		

FWHM values performed with Threshold = 642 and Window = 40	
FWHM = $\frac{680 - 610}{662} \times 100\%$	10.6%

Detector peaked for Cs^{137} using Ludlum peaking procedure and threshold setting of 612 and window setting of 100 as requested by John Duskin. 2350-1 #117566 calibration due 01/22/04 used for peaking 44-10 detector.

Performed By: [signature] Date: 11/04/03

Reviewed By: [signature] Date: 11-4-03

ATTACHMENT 4.3

Duratek

CALIBRATION CERTIFICATE

Duratek Instrument Services
628 Gallaher Road
Kingston, TN 37763
Phone: (865) 376-8337
Fax: (865) 376-8331

ORIGINAL

This Certificate will be accompanied by Calibration Charts or Readings where applicable

CUSTOMER INFORMATION		INSTRUMENT INFORMATION	
Customer Name: Duratek Inc. - Instrument Services Facility		Manufacturer: Ludlum	
Address: 628 Gallaher Road, Kingston, TN 37763		Model: 2350-1	Serial Number: 126182
Contact Name: Thomas Scott		Probe: N/A	Serial Number: N/A
Customer Purchase Order Number: N/A	Work Order Number: 2003-00753	Calibration Method: Electronic and Source	

INSTRUMENT CALIBRATION INFORMATION

Instrument Range (CPM)	Calibration Standard Value (CPM)	Instrument Response		Comments	
		Before Calibration	After Calibration	Calibrated in accordance with RP-INS-I-245 Rev 0	
400K	400,000	402,437	403,468	Pulser: 120935	Cal Due: 03/28/04
40K	40,000	40,248	40,302	D-814: 2551	Cal Due: 10/07/03
4K	4,000	4,026	4,030	Psychron: 5546	Cal Due: 02/10/04
400	400	405	405	EPPROM Version: 37122N21	
HV Cal Values (MZ350 HV Entry)	Desired HV (Voltmeter) (VDC)	As Found (VDC)	As Left (VDC)		
600	600	602	602	Temp:	20.7°C
1,200	1,200	1202	1202	Pressure:	741mmHg
1,800	1,800	1798	1798	Humidity:	56%
Parameter	Tolerance (±10%)	As Found	As Left		
Low End Threshold	10 ± (9 to 11) mVDC	N/A	10.6	Geotropism: SAT	ACK/Scroll: SAT
Midpoint Threshold	50 ± (45 to 55) mVDC	N/A	48.8	BAT>4.5: SAT	Volume: SAT
High End Threshold	100 ± (90 to 110) mVDC	N/A	97	Count: SAT	Audio Divide: SAT
Window Width	10 ± (9 to 11) mVDC	N/A	10	Alarms: SAT	Lamp: SAT
Display-to-mV ratio:	100 to 10 mV			Overload Test: SAT	

STATEMENT OF CERTIFICATION

We Certify that the instrument listed above was calibrated and inspected prior to shipment and that it met all the Manufacturers published operating specifications. We further certify that our Calibration Measurements are traceable to the National Institute of Standards and Technology. (We are not responsible for damage incurred during shipment or use of this instrument).

Instrument Calibrated By:	Reviewed By:	Date: 7-30-03
Calibration Date: 07/30/03	Calibration Due: 01/30/04	

ATTACHMENT 4.4

Inst. # ~~126218~~ 126182 shales Rm

Duratek

ORIGINAL

CALIBRATION CERTIFICATE

Duratek Instrument Services
628 Gallaher Road
Kingston, TN 37763
Phone: (865) 376-8337
Fax: (865) 376-8331

Replaced @ New Cal. Info. 11/12/03

This Certificate will be accompanied by Calibration Charts or Readings where applicable

CUSTOMER INFORMATION		DETECTOR INFORMATION
Customer Name: Duratek Instrument Services		Manufacturer: Ludlum
Address: 628 Gallaher Rd Kingston, TN 37763		Detector Model: 44-10
Contact Name: Thomas Scott		Serial Number: 196021
Customer Purchase Order Number: N/A	Work Order Number: 2003-00722	Evaluation Method: Source

DETECTOR EFFICIENCY/RESPONSE/PRECISION INFORMATION			
1) Source Nuclide: Cs^{137}	Serial Number: 019454	Activity: 5μCi	Certification Date: N/A (Used for Plateau Only)
2) Source Nuclide: Cs^{137}	Serial Number: 049711	Activity: Variable	Certification Due Date: 04/09/03

Scaler Information		Precision Test	mR/Hr (Source #2)
2350-1	#117566	Count 1	1.99
Due Date	01/22/04	Count 2	2.00
Threshold	T=100 (10mV)	Count 3	2.01
Cable Length	5ft.	Average	2.00
N/A	N/A	Tolerance ±10%	All counts within ±10% of Average
N/A	N/A	Pass/Fail	Pass
N/A	N/A		

Low Sample Activity (400uR/hr): Using Source #2 = 74,731	High Sample Activity (2mR/hr) Using Source #2 = 268,512	Dead Time (DT): 1.57194E-05	Calibration Constant (CC): 6.213047E+10

ATTACHMENTS			DETECTOR DATA: DOSE RATE PROBES (mR/Hr)			
Detector Setup Report	YES ✓	NO	Desired Exposure	Tolerance ±10%	As Found	As Left
Barcode Report	YES ✓	NO	0.400	0.360-0.440	.417	.402
Voltage Plateau:	YES ✓	NO	1	0.90-1.10	.942	.937
High Voltage: 1050V			2	1.8-2.2	2.07	2.00

COMMENTS

Detectors set up with a 2350-1 may be used with any 2350-1 provided that the setup parameters are scanned into the 2350-1 prior to use with that specific detector
Calibrated with 5ft. Cable

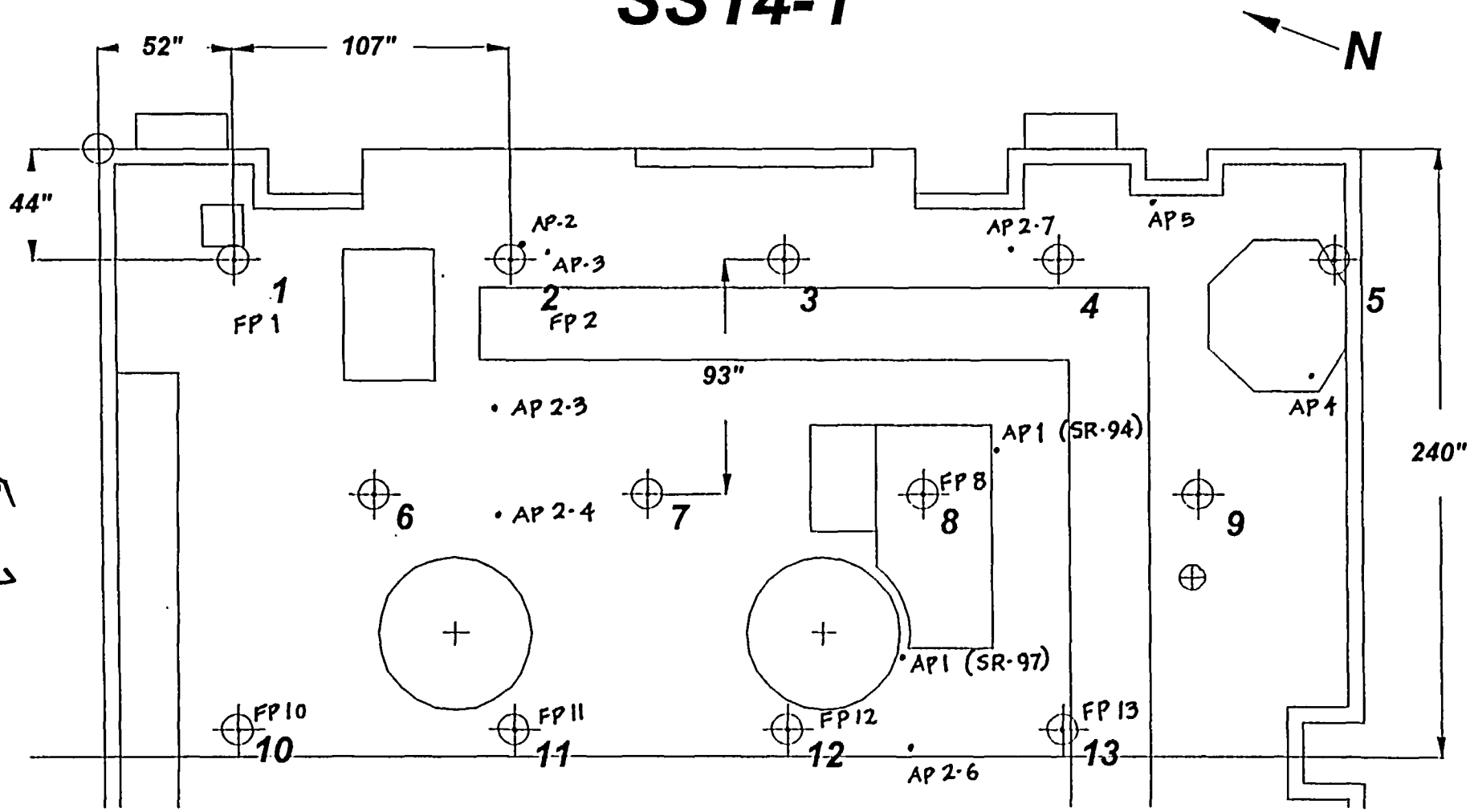
STATEMENT OF CERTIFICATION

We Certify that the detector listed above was evaluated for proper operation prior to shipment and that it met all the Manufacturers published operating specifications. We further certify that our Calibration Measurements are traceable to the National Institute of Standards and Technology. (We are not responsible for damage incurred during shipment or use of this detector).

Detector Certified By:	I certify that the above information is correct: Reviewed By:	Date: 7-22-03
Certification Date: 07/22/03		Certification Due: 01/22/04

ATTACHMENT 4.5

SS14-1



ATTACHMENT 5 . 1

~~Attachment 4 - 1~~ BIWB
2/24/05

SURVEY UNIT 14-1 RESULTS

LOCATION	SR NUMBER	SAMPLE	Cs-137 RESULTS (pCi/g)	Static Measurement Results NaI Detector (gross cpm)	SURFACE AREA (FT^2)
FP1	100	SX-CF-4280	3.2 ± 0.4	193	DETECTOR AREA
FP2	100	SX-CF-4282	5.3 ± 0.6	242	DETECTOR AREA
FP8	100	SX-CF-4283	25.3 ± 2.6	356	DETECTOR AREA
AP1	97	SX-CF-4273	13.3 ± 1.5	342	0.75
AP1	94	SX-CF-4228	9.0 ± 1.0	523	1.25
AP2	94	SX-CF-4281	12.1 ± 1.3	360	0.25
AP2-3	102	SX-CF-4322	13.5 ± 1.4	412	3.25
AP2-4	102	SX-CF4336	27 ± 2.7	582	0.5
AP2-6	102	SX-CF-4323	66.7 ± 6.5	606	2.5
AP2-7	102	SX-CF-4325	22 ± 2.2	437	2.5
AP-3	94	SX-CF-4229	4.6 ± 0.45	410	0.25
AP-4	94	SX-CF-4244	2.3 ± 0.3	256	0.25
AP-5	94	SX-CF-4245	10.6 ± 1.1	341	0.25
FP-10	102	SX-CF-4331	2.4 ± 0.3	183	DETECTOR AREA
FP-11	102	SX-CF-4332	1.3 ± 0.2	126	DETECTOR AREA
FP-12	102	SX-CF-4333	2.2 ± 0.3	152	DETECTOR AREA
FP-13	102	SX-CF-4334	2.4 ± 0.3	157	DETECTOR AREA

ATTACHMENT 5 . 2

MicroShield v5.05 (5.05-00121)
GPU Nuclear

Page : 1
DOS File : SSGS14A.MS5
Run Date: February 22, 2005
Run Time: 2:51:20 PM
Duration : 00:00:20

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

Case Title: SS14-1
Description: 1 Meter Above Survey Unit - SS14-1
Geometry: 13 - Rectangular Volume

Source Dimensions

Length	2.54 cm	1.0 in
Width	612.14 cm	20 ft 1.0 in
Height	1.2e+3 cm	41 ft 0.0 in

Dose Points

	X	Y	Z
# 1	102.54 cm	624.84 cm	306.07 cm
	3 ft 4.4 in	20 ft 6.0 in	10 ft 0.5 in

Shields

Shield Name	Dimension	Material	Density
Source	1.94e+06 cm³	Concrete	2.35
Air Gap		Air	0.00122

Source Input
Grouping Method : Actual Photon Energies

Nuclide	curies	becquerels	µCi/cm³	Bq/cm³
Ba-137m	5.6587e-005	2.0937e+006	2.9123e-005	1.0775e+000
Cs-137	5.9817e-005	2.2132e+006	3.0785e-005	1.1390e+000

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
0.0318	4.335e+04	1.111e-04	1.360e-04	9.253e-07	1.133e-06
0.0322	7.997e+04	2.139e-04	2.636e-04	1.721e-06	2.121e-06
0.0364	2.910e+04	1.197e-04	1.584e-04	6.801e-07	9.000e-07
0.6616	1.884e+06	7.525e-01	1.090e+00	1.459e-03	2.113e-03

ATTACHMENT 6.1

DOS File : SSGS14A.MS5
Run Date: February 22, 2005
Run Time: 2:51:20 PM
Duration : 00:00:20

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:	2.036e+06	7.529e-01	1.091e+00	1.462e-03	2.117e-03

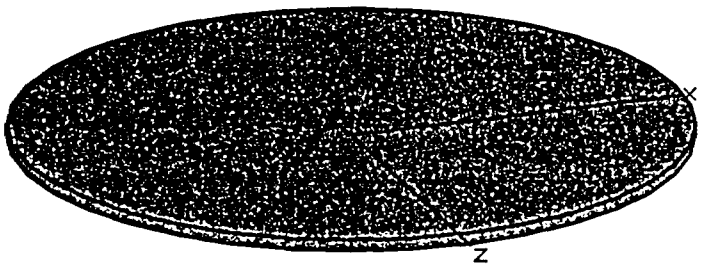
ATTACHMENT 6.2

MicroShield v5.05 (5.05-00121)
GPU Nuclear

Page : 1
DOS File : FLOOR.MS5
Run Date: February 22, 2005
Run Time: 3:52:19 PM
Duration : 00:00:01

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

Case Title: Concrete Model
Description: 1" Thick of Concrete Slab @ 2.35E-06 uCi/cc
Geometry: 8 - Cylinder Volume - End Shields



Source Dimensions

Height	2.54 cm	1.0 in
Radius	71.628 cm	2 ft 4.2 in

Dose Points

	X	Y	Z
# 1	0 cm	7.62 cm	0 cm
	0.0 in	3.0 in	0.0 in

Shields

Shield Name	Dimension	Material	Density
Source	2498.32 in³	Concrete	2.35
Air Gap		Air	0.00122

Source Input
Grouping Method : Actual Photon Energies

Nuclide	curies	becquerels	µCi/cm³	Bq/cm³
Ba-137m	9.1014e-008	3.3675e+003	2.2231e-006	8.2255e-002
Cs-137	9.6209e-008	3.5597e+003	2.3500e-006	8.6950e-002

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	6.972e+01	1.085e-05	1.315e-05	9.041e-08	1.095e-07
0.0322	1.286e+02	2.088e-05	2.544e-05	1.680e-07	2.048e-07
0.0364	4.681e+01	1.159e-05	1.514e-05	6.582e-08	8.602e-08
0.6616	3.030e+03	7.726e-02	1.203e-01	1.498e-04	2.331e-04
TOTALS:	3.275e+03	7.730e-02	1.203e-01	1.501e-04	2.335e-04

ATTACHMENT 7.1

Radionuclide	
Co-60	

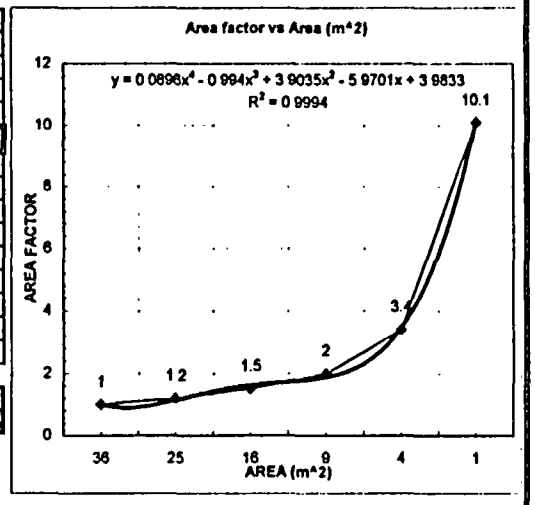
AF INTERPOLATOR - BUILDING SURFACE

Area Factors For Structural Surfaces

	Nuclide	Square Meters 36	25	16	9	4	1
1	Am-241	1	1.5	2.3	4.1	9.2	36.2
2	C-14	1	1.4	2.2	4	8.9	35.9
3	Co-60	1	1.2	1.5	2	3.4	10.1
4	Cs-137	1	1.2	1.5	2.2	3.7	11.2
5	Eu-152	1	1.2	1.5	2.1	3.5	10.7
6	H-3	1	1.4	2.2	4	8.9	35.8
7	Ni-63	1	1.4	2.2	4	9	35.3
8	Pu-238	1	1.4	2.3	4	9.1	36.9
9	Pu-239	1	1.4	2.2	4	9	35.4
10	Pu-241	1	1.4	2.2	4	9	34.8
11	Sr-90	1	1.4	2.2	3.9	8.8	34.7

NOTE: Used where DCGL is in dpm/100 cm^2

Area Factor	1	1.2	1.5	2	3.4	10.1
Area (m^2)	36	25	16	9	4	1



	Area 1	Area 2	Input Area	Projected Area Factor
Area (m^2)	0	1	1	10.10
	AF 1	AF 2	Input AF	Projected Area
Area Factor	FALSE	10.1	10.1	1.00

FirstEnergy

Site Report

Analysis Based on MARSSIM Equation 8-2

EMC CALCULATOR

Units ☐ dpm/100 cm^2 ☑ cpm/100 cm^2

Survey Unit Mean	278.7	cpm/100 cm^2
Reference Bkgnd Mean	243.5	cpm/100 cm^2
SU Mean	35.1	ncpm/100 cm^2
AP-1	961.5	ncpm/100 cm^2
AP-2	636.5	ncpm/100 cm^2
AP-3		ncpm/100 cm^2
Unity Fraction	0.4398	Equation 8-2, MARSSIM

	GA		
DCGLw	424	ncpm/100 cm^2	
	AF	m^2	EMC
Survey Unit AF	1	108	PASS
AF-1	10.1	0.2	PASS
AF-2	10.1	0.2	PASS
AF-3			PASS

PASS

NOTE: Required input values in RED.

LOCATION
Ceiling of Discharge Tunnel at ~ 120' near turn to river.
Survey Unit (SS4) = 108 m^2
SS4-011A is Subset of SS4 and is ~4.4 m^2
EMC 1 & 2 are < 1m^2 each, residing in SS4-011A.

ATTACHMENT 8.1

Williamsburg Concrete Background Measurements

37122N21	Instrument 95348	RLM6220	Time	Detector	Counts	Count Time (sec)	Mode	Designator		FSS-001	BHB
0	BKGND	1/4/2002	8:52	1	7.26E+03	1800	SCL	Inital Background	β		
1	Source Check	1/4/2002	9:07	1	1.79E+05	60	SCL	Source	β		
2	BKGND	1/4/2002	10:05	2	4.40E+01	1800	SCL	Inital Background	α	*Concrete CF(cpm) ⇒*	*5.56E+01*
14	Source Check	1/4/2002	10:39	2	1.51E+05	60	SCL	Source	α	**Shielded**	**Unshielded**
15	CON A1S	1/4/2002	13:00	1	2.78E+02	60	SCL	Shielded	β	2.78E+02	
16	CON A1U	1/4/2002	13:02	1	3.88E+02	60	SCL	Unshielded	β		3.32E+02
17	CON A2S	1/4/2002	13:20	1	2.39E+02	60	SCL	Shielded	β	2.39E+02	
18	CON A2U	1/4/2002	13:21	1	2.22E+02	60	SCL	Unshielded	β		1.66E+02
19	CON A3S	1/4/2002	13:28	1	2.39E+02	60	SCL	Shielded	β	2.39E+02	
20	CON A3U	1/4/2002	13:30	1	2.62E+02	60	SCL	Unshielded	β		2.06E+02
21	CON A4S	1/4/2002	13:36	1	2.45E+02	60	SCL	Shielded	β	2.45E+02	
22	CON A4U	1/4/2002	13:38	1	2.71E+02	60	SCL	Unshielded	β		2.15E+02
23	CON A5S	1/4/2002	13:58	1	2.00E+02	60	SCL	Shielded	β	2.00E+02	
24	CON A5U	1/4/2002	14:00	1	2.82E+02	60	SCL	Unshielded	β		2.26E+02
25	CON A6S	1/4/2002	14:03	1	1.84E+02	60	SCL	Shielded	β	1.84E+02	
26	CON A6U	1/4/2002	14:05	1	3.10E+02	60	SCL	Unshielded	β		2.54E+02
27	CON A7S	1/4/2002	14:09	1	1.98E+02	60	SCL	Shielded	β	1.98E+02	
28	CON A7U	1/4/2002	14:10	1	3.15E+02	60	SCL	Unshielded	β		2.59E+02
29	CON A8S	1/4/2002	14:19	1	2.34E+02	60	SCL	Shielded	β	2.34E+02	
30	CON A8S	1/4/2002	14:22	1	2.31E+02	60	SCL	Shielded	β	2.31E+02	
31	CON A8U	1/4/2002	14:24	1	2.88E+02	60	SCL	Unshielded	β		2.32E+02
32	CON A9S	1/4/2002	14:31	1	2.65E+02	60	SCL	Shielded	β	2.65E+02	
33	CON A9U	1/4/2002	14:33	1	2.89E+02	60	SCL	Unshielded	β		2.33E+02
34	CON A10S	1/4/2002	14:42	1	2.46E+02	60	SCL	Shielded	β	2.46E+02	
35	CON A10U	1/4/2002	14:43	1	3.16E+02	60	SCL	Unshielded	β		2.60E+02
36	CON A11S	1/4/2002	15:10	1	1.95E+02	60	SCL	Shielded	β	1.95E+02	
37	CON A11U	1/4/2002	15:12	1	2.94E+02	60	SCL	Unshielded	β		2.38E+02
38	CON A12S	1/4/2002	15:13	1	2.21E+02	60	SCL	Shielded	β	2.21E+02	
39	CON A12U	1/4/2002	15:14	1	2.84E+02	60	SCL	Unshielded	β		2.28E+02
40	CON A13S	1/4/2002	15:23	1	1.74E+02	60	SCL	Shielded	β	1.74E+02	
41	CON A13U	1/4/2002	15:24	1	2.94E+02	60	SCL	Unshielded	β		2.38E+02
42	CON A14S	1/4/2002	15:25	1	1.96E+02	60	SCL	Shielded	β	1.96E+02	
43	CON A14U	1/4/2002	15:26	1	3.33E+02	60	SCL	Unshielded	β		2.77E+02
44	CON A15S	1/4/2002	15:28	1	2.16E+02	60	SCL	Shielded	β	2.16E+02	
45	CON A15U	1/4/2002	15:29	1	3.45E+02	60	SCL	Unshielded	β		2.89E+02
46	CON A16S	1/4/2002	15:30	1	1.83E+02	60	SCL	Shielded	β	1.83E+02	
47	CON A16U	1/4/2002	15:31	1	3.13E+02	60	SCL	Unshielded	β		2.57E+02
48	CON A17S	1/4/2002	15:33	1	1.82E+02	60	SCL	Shielded	β	1.82E+02	
49	CON A17U	1/4/2002	15:34	1	3.22E+02	60	SCL	Unshielded	β		2.66E+02
50	CON A18S	1/4/2002	15:35	1	1.84E+02	60	SCL	Shielded	β	1.84E+02	
51	CON A18U	1/4/2002	15:36	1	3.24E+02	60	SCL	Unshielded	β		2.68E+02
52	CON A19S	1/4/2002	15:37	1	1.91E+02	60	SCL	Shielded	β	1.91E+02	
53	CON A19U	1/4/2002	15:39	1	3.07E+02	60	SCL	Unshielded	β		2.51E+02
54	CON A20S	1/4/2002	15:40	1	1.94E+02	60	SCL	Shielded	β	1.94E+02	
55	CON A20U	1/4/2002	15:41	1	3.33E+02	60	SCL	Unshielded	β		2.77E+02
56	CON A21S	1/4/2002	15:57	1	2.23E+02	60	SCL	Shielded	β	2.23E+02	
57	CON A21U	1/4/2002	15:58	1	2.92E+02	60	SCL	Unshielded	β		2.36E+02
58	CON A22S	1/4/2002	15:59	1	1.72E+02	60	SCL	Shielded	β	1.72E+02	
59	CON A22U	1/4/2002	16:00	1	2.80E+02	60	SCL	Unshielded	β		2.24E+02
60	CON A23S	1/4/2002	16:01	1	1.94E+02	60	SCL	Shielded	β	1.94E+02	
61	CON A23U	1/4/2002	16:02	1	3.29E+02	60	SCL	Unshielded	β		2.73E+02
62	CON A24S	1/4/2002	16:04	1	1.87E+02	60	SCL	Shielded	β	1.87E+02	
63	CON A24U	1/4/2002	16:05	1	3.48E+02	60	SCL	Unshielded	β		2.92E+02
64	CON A25S	1/4/2002	16:06	1	2.07E+02	60	SCL	Shielded	β	2.07E+02	
65	CON A25U	1/4/2002	16:07	1	3.72E+02	60	SCL	Unshielded	β		3.16E+02
66	CON A26S	1/4/2002	16:09	1	2.09E+02	60	SCL	Shielded	β	2.09E+02	
67	CON A26U	1/4/2002	16:10	1	3.26E+02	60	SCL	Unshielded	β		2.70E+02
68	CON A27S	1/4/2002	16:11	1	2.07E+02	60	SCL	Shielded	β	2.07E+02	
69	CON A27U	1/4/2002	16:12	1	3.30E+02	60	SCL	Unshielded	β		2.74E+02
70	CON A28S	1/4/2002	16:14	1	2.30E+02	60	SCL	Shielded	β	2.30E+02	
71	CON A28U	1/4/2002	16:15	1	3.06E+02	60	SCL	Unshielded	β		2.50E+02
72	CON A29S	1/4/2002	16:20	1	2.13E+02	60	SCL	Shielded	β	2.13E+02	
73	CON A29U	1/4/2002	16:21	1	2.58E+02	60	SCL	Unshielded	β		2.02E+02
74	CON A30S	1/4/2002	16:24	1	2.33E+02	60	SCL	Shielded	β	2.33E+02	
75	CON A30U	1/4/2002	16:25	1	2.89E+02	60	SCL	Unshielded	β		2.33E+02
76	CON A31S	1/4/2002	16:28	1	1.84E+02	60	SCL	Shielded	β	1.84E+02	
77	CON A31U	1/4/2002	16:29	1	2.63E+02	60	SCL	Unshielded	β		2.07E+02
—	Source Check	1/4/2002	17:27	1	1.70E+05	60	SCL	—	β		
									Minimum ⇒	**1.72E+02**	**1.66E+02**
									Maximum ⇒	**2.78E+02**	**3.32E+02**
									Mean ⇒	**2.11E+02**	**2.50E+02**
									Sigma ⇒	**2.69E+01**	**3.45E+01**

ATTACHMENT 9.1

Appendix F

DCGL Calculation Logic

DCGL Calculation Logic-SSGS Footprint

I. **Survey Unit:** Saxton Steam Generating Station (SSGS) Footprint

II. **Description:** The purpose of this calculation is to determine a representative isotopic mix for the SSGS Footprint from available sample analyses. The effective surface area and volumetric $DCGL_w$s are then determined from the mean percent of applicable samples.

III. **Data Selection Logic Tables:** The radionuclide selection logic and subsequent DCGL calculations are provided in seven (7) tables. These tables were developed using Microsoft Excel. Table explanation is as follows.

Table 1: Data Listing – This table, which has been extracted from a larger database, provides a list of the most representative SSGS Footprint sample analyses. Results are from scoping, characterization, and pre/post remediation surveys. The samples consist of various sediments and concrete cores that were taken in support of the aforementioned surveys. As applicable, a sample number, sample location/description, radionuclide concentration, analysis date are provided for each sample. Positive nuclide concentrations are noted with yellow/shaded background fields while MDAs are noted in the gray shaded fields.

Table 2: Decayed Listing – This table provides the best overall representation of data selected and decayed from Table 1. In Table 1 half-life values (days) are listed above each respective nuclide column. Samples are decayed to the date noted above Table 1 (e.g. January 15, 2004). Positive results are denoted in a yellow background field while MDA values are in a gray background.

Table 3: Decayed Listing of Positive Nuclides & MDAs Removed– This table provides the decayed values of positive nuclides selected in Table 2. In addition MDA values have been removed from this table.

Table 4: Mean Percent of Total for Positive Nuclides – This table provides the calculation methodology for determining the relative fractions of the total activity contributed by each radionuclide. From this information the mean, sigma, and mean % of total are calculated. The mean % of total values is used to calculate the surface gross activity $DCGL_w$ per MARSSIM equation 4-4. See Table 6. Note that the Am-241 mean percent values were averaged using only samples 1 & 9. In addition, the mean percent value calculated from sample 9 for Co-60 and Pu-239 were not averaged throughout the spreadsheet, since this sample was the only one where these respective nuclides were positive. This results in higher "mean percent of total" values in the mix, which are conservative.

Table 5: Ratio to Cs-137 for Positive Nuclides – This table provides the calculation methodology for determining the surrogate ratio to Cs-137 for each radionuclide. From this information the mean, sigma, and mean % of total are calculated. The mean % of total values is used to calculate the volumetric $DCGL_w$ per MARSSIM equation I-14. See Table 7. Note that the Am-241 ratios were averaged using only samples 1 & 9. In addition, the ratio values calculated from sample 9 for Co-60 and Pu-239 were not averaged throughout the spreadsheet, since this sample was the only one where the respective nuclides were positive. This results in higher "mean percent of total" values in the mix, which are conservative.

Note: From Tables 4 and 5 only the "mean % of total" values are used as input to the "Effective DCGL Calculation Spreadsheet" as illustrated in Tables 6 and 7.

Table 6: Effective DCGL Calculator for Cs-137 (dpm/100 cm^2) – This table provides the surface gross activity $DCGL_w$ calculation results from data derived from Table 4.

Table 7: Effective DCGL Calculator for Cs-137 (in pCi/g) – This table provides the surrogate volumetric modified Cs-137 $DCGL_w$ calculation results from data derived from Table 5.

IV. **Summary** – Since the SSGS Footprint is a concrete structure the release limit is primarily based on the surface area $DCGL_w$. However, some SSGS Footprint concrete surfaces have volumetric contamination. Therefore, a volumetric $DCGL_w$ is also determined. Using the above data selection logic tables the calculated gross activity $DCGL_w$ for surface area is 13,615 dpm/100 cm^2. The Cs-137 volumetric $DCGL_w$ is 6.56 pCi/g. These values would be reduced by 25% as part of SNEC's requirement to apply an administrative limit as discussed in the License Termination Plan (LTP).

TABLE 1 - Data Listing (pCi/g)

Decay Date: January 15, 2004

	SNEC Sample No	Location/Description	H-3	Sr-90	Co-60	Cs-137	Am-241	Pu-238	Pu-239	Pu-241	C-14	Ni-63	Eu-152	Analysis Date	Elapsed Time (d)
1	SX10GW00321	Sediment Phase - SSGS East Sump @ 25', AV183, Well #1			3	85	8.80E-02	0.03	0.04					April 25, 2000	1360
2	SX10SD00368	SSGS Footprint Collection Tank Area AW-132 (Pumped)		0.02	0.2	5.5	0.04	0.015	0.016	1.8				June 6, 2000	1318
3	SXCF1210	SSGS Footprint, Center Section, Core Bore # 2, Disk # 1	11.8	0.06	0.04	0.27	0.048	0.049	0.049	6.79	3.72	7.33	0.21	July 20, 2001	909
4	SXCF3531	SSGS Footprint Sample # 5, Concrete Floor Core - SR-56	2	0.0169	0.0584	3.73	0.132	0.116	0.0386	2.44	0.191	2.39	0.132	May 5, 2003	255
5	SXCF4323	SSGS Footprint SS14-1, AP-2-6	0.81	0.0256	0.0382	40.2	0.0154	0.0323	0.0241	1.56	0.147	2.5	0.197	November 18, 2003	58
6	SXCF4325	SSGS Footprint, AP-2-7, Sect 1, Slice 1	0.784	0.0243	0.0229	14.4	0.0132	0.0241	0.0108	1.57	0.143	0.334	0.0894	November 18, 2003	58
7	SXCF4330	SSGS Footprint SS14-2, Sect 1, Slice 1	0.746	0.0295	0.0278	2.73	0.0256	0.0398	0.0115	3.02	0.136	0.552	0.0815	November 24, 2003	52
8	SXCF4336	SSGS Footprint SS14-1, AP-2-4	0.606	0.0293	0.0243	16.9	0.0092	0.0117	0.0039	1.14	0.11	2.94	0.118	November 25, 2003	51
9	SXCF828	SSGS, East, Disk # 1	11.7	0.05	2.01	660	0.29	0.046	0.145	6.819	3.68	7.73	0.31	May 4, 2001	986

TABLE 2 - Decayed Listing (pCi/g)

			T 1/2	T 1/2	T 1/2	T 1/2	T 1/2	T 1/2	T 1/2	T 1/2	T 1/2	T 1/2	T 1/2	
			4485.27	10446.15	1925.23275	11019.5925	157861.05	32050.6875	8813847.75	5259.6	2092882.5	36561.525	4967.4	
	SNEC Sample No	Location/Description	H-3	Sr-90	Co-60	Cs-137	Am-241	Pu-238	Pu-239	Pu-241	C-14	Ni-63	Eu-152	Total (pCi/g)
1	SX10GW00321	Sediment Phase - SSGS East Sump @ 25', AV183, Well #1			1.84E+00	7.80E+01	8.75E-02	2.91E-02	4.00E-02					80.03
2	SX10SD00368	SSGS Footprint Collection Tank Area AW-132 (Pumped)		1.83E-02	1.24E-01	5.06E+00	3.98E-02	1.46E-02	1.60E-02	1.51E+00				6.79
3	SXCF1210	SSGS Footprint, Center Section, Core Bore # 2, Disk # 1	1.03E+01	5.65E-02	2.88E-02	2.55E-01	4.78E-02	4.80E-02	4.90E-02	6.02E+00	3.72E+00	7.20E+00	1.85E-01	27.87
4	SXCF3531	SSGS Footprint Sample # 5, Concrete Floor Core - SR-56	1.92E+00	1.66E-02	5.33E-02	3.67E+00	1.32E-01	1.15E-01	3.86E-02	2.36E+00	1.91E-01	2.38E+00	1.27E-01	11.01
5	SXCF4323	SSGS Footprint SS14-1, AP-2-6	8.03E-01	2.55E-02	3.74E-02	4.01E+01	1.54E-02	3.23E-02	2.41E-02	1.55E+00	1.47E-01	2.50E+00	1.95E-01	45.38
6	SXCF4325	SSGS Footprint, AP-2-7, Sect 1, Slice 1	7.77E-01	2.42E-02	2.24E-02	1.43E+01	1.32E-02	2.41E-02	1.08E-02	1.56E+00	1.43E-01	3.34E-01	8.87E-02	17.34
7	SXCF4330	SSGS Footprint SS14-2, Sect 1, Slice 1	7.40E-01	2.94E-02	2.73E-02	2.72E+00	2.56E-02	3.98E-02	1.15E-02	3.00E+00	1.36E-01	5.51E-01	8.09E-02	7.36
8	SXCF4336	SSGS Footprint SS14-1, AP-2-4	6.01E-01	2.92E-02	2.39E-02	1.68E+01	9.20E-03	1.17E-02	3.90E-03	1.13E+00	1.10E-01	2.94E+00	1.17E-01	21.82
9	SXCF828	SSGS, East, Disk # 1	1.00E+01	4.68E-02	1.41E+00	6.20E+02	2.89E-01	4.50E-02	1.45E-01	5.99E+00	3.68E+00	7.59E+00	2.70E-01	649.82

KEY	
	Yellow Shaded Background = Positive Result
	Gray Shaded Background = MDA

C01

TABLE 3 - Decayed Listing of Positive Nuclides & MDAs Removed (pCi/g)

	SNEC Sample No	Location/Description	H-3	Sr-90	Co-60	Cs-137	Am-241	Pu-238	Pu-239	Pu-241	C-14	Ni-63	Eu-152	Total (pCi/g)
1	SX10GW00321	Sediment Phase - SSGS East Sump @ 25', AV183, Well #1				7.80E+01	8.75E-02							78.12
2	SX10SD00368	SSGS Footprint Collection Tank Area AW-132 (Pumped)				5.06E+00								5.06
3	SXCF1210	SSGS Footprint, Center Section, Core Bore # 2, Disk # 1				2.55E-01								0.25
4	SXCF3531	SSGS Footprint Sample # 5, Concrete Floor Core - SR-56				3.67E+00								3.67
5	SXCF4323	SSGS Footprint SS14-1, AP-2-6				4.01E+01								40.05
6	SXCF4325	SSGS Footprint, AP-2-7, Sect 1, Slice 1				1.43E+01								14.35
7	SXCF4330	SSGS Footprint SS14-2, Sect 1, Slice 1				2.72E+00								2.72
8	SXCF4336	SSGS Footprint SS14-1, AP-2-4				1.68E+01								16.85
9	SXCF828	SSGS, East, Disk # 1			1.41E+00	6.20E+02	2.89E-01		1.45E-01					622.16
		Mean⇒			1.41E+00	8.68E+01	1.88E-01		1.45E-01					88.55
		Sigma⇒				201.618	0.142							
		Mean % of Total⇒			1.59%	98.03%	0.21%		0.16%					100.00%

TABLE 4 - Mean Percent of Total for Positive Nuclides

	SNEC Sample No	Location/Description	Co-60	Cs-137	Am-241	Pu-239	Total
1	SX10GW00321	Sediment Phase - SSGS East Sump @ 25', AV183, Well #1		99.89%	0.11%		100.00%
2	SX10SD00368	SSGS Footprint Collection Tank Area AW-132 (Pumped)		100.00%			100.00%
3	SXCF1210	SSGS Footprint, Center Section, Core Bore # 2, Disk # 1		100.00%			100.00%
4	SXCF3531	SSGS Footprint Sample # 5, Concrete Floor Core - SR-56		100.00%			100.00%
5	SXCF4323	SSGS Footprint SS14-1, AP-2-6		100.00%			100.00%
6	SXCF4325	SSGS Footprint, AP-2-7, Sect 1, Slice 1		100.00%			100.00%
7	SXCF4330	SSGS Footprint SS14-2, Sect 1, Slice 1		100.00%			100.00%
8	SXCF4336	SSGS Footprint SS14-1, AP-2-4		100.00%			100.00%
9	SXCF828	SSGS, East, Disk # 1	0.23%	99.70%	0.05%	0.02%	100.00%
		Mean⇒	2.27E-03	1.00E+00	7.92E-04	2.33E-04	1.00
		Sigma⇒		0.001	0.0005		
		Mean % of Total⇒	0.23%	99.67%	0.08%	0.02%	100.00%

TABLE 5 - Ratio to Cs-137 for Positive Nuclides

	SNEC Sample No	Location/Description	Co-60	Cs-137	Am-241	Pu-239	Total
1	SX10GW00321	Sediment Phase - SSGS East Sump @ 25', AV183, Well #1		1.00E+00	1.12E-03		1.00
2	SX10SD00368	SSGS Footprint Collection Tank Area AW-132 (Pumped)		1.00E+00			1.00
3	SXCF1210	SSGS Footprint, Center Section, Core Bore # 2, Disk # 1		1.00E+00			1.00
4	SXCF3531	SSGS Footprint Sample # 5, Concrete Floor Core - SR-56		1.00E+00			1.00
5	SXCF4323	SSGS Footprint SS14-1, AP-2-6		1.00E+00			1.00
6	SXCF4325	SSGS Footprint, AP-2-7, Sect 1, Slice 1		1.00E+00			1.00
7	SXCF4330	SSGS Footprint SS14-2, Sect 1, Slice 1		1.00E+00			1.00
8	SXCF4336	SSGS Footprint SS14-1, AP-2-4		1.00E+00			1.00
9	SXCF828	SSGS, East, Disk # 1	2.27E-03	1.00E+00	4.65E-04	2.34E-04	1.00
		Mean⇒	2.27E-03	1.00E+00	7.93E-04	2.34E-04	1.00
		Sigma⇒		0.0000	0.0005		
		Mean % of Total⇒	0.23%	99.67%	0.08%	0.02%	100.00%

C02

Table 6

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

Gross Activity DCGLW		Gross Activity Administrative Limit	
13615	dpm/100 cm^2	10211	dpm/100 cm^2

25.0 mrem/y TEDE Limit

SAMPLE NO(s)⇒ SSGS AREA

Cs-137 Limit		Cs-137 Administrative Limit	
13571	dpm/100 cm^2	10178	dpm/100 cm^2

SNEC AL	
	75%

	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	7.92E-04	0.079%	27	10.75	9.95	N/A	10.75	Am-241
2	C-14		0.000%	3,700,000	0.00	0.00	0.00	N/A	C-14
3	Co-60	2.27E-03	0.226%	7,100	30.81	0.11	30.81	N/A	Co-60
4	Cs-137	1.00E+00	99.672%	28,000	13570.59	12.12	13570.6	N/A	Cs-137
5	Eu-152		0.000%	13,000	0.00	0.00	0.00	N/A	Eu-152
6	H-3		0.000%	120,000,000	0.00	0.00	Not Detectable	N/A	H-3
7	Ni-63		0.000%	1,800,000	0.00	0.00	Not Detectable	N/A	Ni-63
8	Pu-238		0.000%	30	0.00	0.00	N/A	0.00	Pu-238
9	Pu-239	2.33E-04	0.023%	28	3.16	2.82	N/A	3.16	Pu-239
10	Pu-241		0.000%	880	0.00	0.00	Not Detectable	N/A	Pu-241
11	Sr-90		0.000%	8,700	0.00	0.00	0.00	N/A	Sr-90
			100.000%		13615	25.0	13601	14	
					Maximum Permissible dpm/100 cm^2				

Table 7

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

						SNEC/AL	75%	Total Activity Limit DCGLw		Administrative Limit		
								6.58	pCi/g	4.94	pCi/g	
	SAMPLE NUMBER(s)⇒	SSGS AREA										
								Cs-137 Limit		Cs-137 Administrative Limit		
	15.24%	25.0	mrem/y TEDE Limit					6.56	pCi/g	4.92	pCi/g	
	0.35%	4.0	mrem/y Drinking Water (DW) Limit			☑ Check for 25 mrem/y						
	Isotope	Sample Input (pCi/g, uCi, % of Total, 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	0.001	0 079%	9.9	2.3	0 01	0.22	0 01		0 00	0.00	Am-241
2	C-14		0 000%	2.0	5.4	0 00	0.00	0 00		0 00	0.00	C-14
3	Co-60	0.0023	0 226%	3.5	67.0	0 01	0.64	0 01		0 02	0.00	Co-60
4	Cs-137	1.0000	99 671%	6.6	397	6.56	283.29	6.56		3 79	0.01	Cs-137
5	Eu-152		0 000%	10.1	1440	0 00	0.00	0 00		0 00	0.00	Eu-152
6	H-3		0 000%	132	311	0 00	0.00	0 00		0 00	0.00	H-3
7	Ni-63		0 000%	747	19000	0 00	0.00	0 00		0 00	0.00	Ni-63
8	Pu-238		0 000%	1.8	0.41	0.00	0.00	0.00		0 00	0.00	Pu-238
9	Pu-239	0.0002	0 023%	1.6	0.37	0 00	0.07	0 00		0 00	0.00	Pu-239
10	Pu-241		0 000%	86	19.8	0 00	0.00	0 00		0 00	0.00	Pu-241
11	Sr-90		0 000%	1.2	0.61	0 00	0.00	0 00		0 00	0.00	Sr-90
		1.00E+00	100.000%			6.58	284.22	6.58		3.810	0.014	
						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 *not % of Total.*		

Appendix G

Assessment of Trench and Sumps

ORIGINAL

FirstEnergy

SNEC CALCULATION COVER SHEET

CALCULATION DESCRIPTION

Calculation Number	Revision Number	Effective Date	Page Number
E900-04-003	0	4/15/04	1 of 10

Subject

Assessment of E900-03-025, Rev 0 - SSGS Trench & Sump Area

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/ B. Brosey	Date	4/15/04
Technical Reviewer	P. Donnachie/ P. Donnachie	Date	4/15/04
Additional Review	A. Paynter/ [illegible]	Date	4/15/04
Additional Review		Date	
SNEC Management Approval		Date	

1.0 PURPOSE

1.1 The purpose of this calculation is to review and update a previous survey design developed for segments of the SSGS 790' El floor area called the "Trench" area. This area includes four (4) connecting sumps (the NE, SE, NW & SW sumps) (see Reference 3.1). The reason for this update is that new surface and volumetric DCGLw values have now been reviewed and are concurred for use by US NRC. The reviewed DCGLw values are lower than previous values used, which necessitates this assessment.

DCGLw Comparison Values

FSS Calculation No.	Original Surface DCGLw (dpm/100 cm^2)	Original Volumetric DCGLw (pCi/g)
E900-03-025, Rev 0	GA = 17,498 (13,124 A.L.)	6.57 (4.94 A.L.) for Cs-137
FSS Calculation No.	**Updated Surface DCGLw (dpm/100 cm^2)**	**Updated Volumetric DCGLw (pCi/g)**
E900-04-003, Rev 0	GA = 6,475 (4,857 A.L.)	5.25 (3.93 A.L.) for Cs-137

1.2 As a result of this assessment an additional survey design activity is assigned to augment the previous survey design developed in Reference 3.1.

2.0 SUMMARY OF RESULTS

2.1 A review of the data collected during the original FSS survey of the SSGS Trench and Sump areas under SR-095 (Reference 3.2 – Attachment 1-1 to 1-3), indicates that all 52 randomly placed static survey points showed no net surface activity concentrations above the previously defined surface DCGLw limit. In addition, the net values reported per 100 cm^2 are below the revised surface DCGLw value. See data below.

Data from SR-095

Static Points	Mean of Unshielded Values (cpm)	Sigma (cpm)	Maximum (cpm)
1 to 52	260.2	34.5	338

The initial estimated general area background for this area was 298 cpm (see Reference 3.1).

The original mix was thought to be 99.8 % Cs-137 and therefore only a Cs-137 counting efficiency was considered applicable. The current and final mix assessment indicates that the radionuclide concentration is ~91.8% Cs-137. Carbon-14 is 6 % and Ni-63 is 1 % of the current mix. Both of these radionuclides have very low energy beta radiations and therefore are not considered contributors to the total counting efficiency. The remaining beta emitting radionuclides contribute about 1% of detectable beta radiations. For purposes of this assessment this small additional contribution will be ignored.

2.2 The detection efficiency for this area was originally corrected by a efficiency loss factor based on a surface roughness assessment of the concrete material in this area. For comparison, detection efficiency correction factors for the previous survey design and the current assessment are provided below.

Detection Efficiency Data

FSS Calculation No.	ε_i	ε_s	% Cs-137	Efficiency Loss Factor	counts/disintegration
E900-03-025, Rev 0	0.478	0.5	0.996	0.25	0.0595
FSS Calculation No.	**ε_i**	**ε_s**	**% Cs-137**	**Efficiency Loss Factor**	**counts/disintegration**
E900-04-003, Rev 0	0.478	0.5	0.917	0.25	0.0548

2.3 The overall counting efficiency for this assessment has been reduced by the use of the latest mix as shown below.

1-(0.0548/0.0595) = 0.079 x 100% resulting in an ***~8% loss in detection efficiency*** from the previous survey design

2.4 These new parameters were incorporated into the Compass computer program to assess the consequences of this overall efficiency loss (Reference 3.3). A re-assessment of the MDCscan and action levels are also performed. The results are summarized below (see Attachment 2-1 to 2-5):

Previous MDCstatic (dpm/100 cm²)**	Previous MDCscan (dpm/100 cm²)**	Previous Minimum No. of Static Points	Action Level Assigned During Phase 1 Scanning (ncpm)
1,101	2,175	8*	500
Revised MDCstatic (dpm/100 cm²)**	**Revised MDCscan (dpm/100 cm²)****	**Revised Minimum No. of Static Points**	**New Action Level Needed During Phase 1 Scanning (ncpm)**
1,322	2,610	13	200

*Actual number assigned was 52.

**As calculated by the Compass computer program assuming a corrected background value of 298 cpm as reported in Reference 3.1.

2.5 Gas Flow Proportional Counter (GFPC) Measurements

As a result of this assessment, ***GFPC scanning must be re-done*** using a reduced action level (alarm set-point). The following information should be used to develop a survey request in order to complete the necessary survey work for this area:

2.5.1 These areas are ***Class 1*** survey areas that collectively represent one (1) survey unit (***SS14-6***). All of these areas are shown on Attachment 3-1 and 3 -2.

2.5.2 The total physical area for this survey unit is ***~100 square meters***. The exact amount of area represented by these locations is approximated since the Trench area is an irregular surface cut into the existing SSGS 790' El. floor area to allow removal of facility piping. This survey unit is divided into 9 Trench sections and 4 Sumps as depicted in Attachment 3-1 and 3-2.

2.5.3 A gas flow proportional counter (GFPC) shall be used in the beta detection mode for this survey work (Ludlum 2350-1 with a 43-68B probe).

2.5.4 No static measurements are necessary for this survey design.

2.5.5 A scan speed of ***2.2 cm/sec*** is required. ***Scan coverage is set at 100% of the available surface area***. Areas that cannot be accessed with the GFPC were previously scanned using a NaI detector IAW Reference 3.1.

2.5.6 This survey design requires the detector be in ***contact with the surface*** during all measurement phases except in areas where this is not physically possible (gouges, cavities, etc.).

2.5.7 The revised administrative limit surface DCGLw is ***4,857 dpm/100 cm²*** or ***306 cpm above background*** for a static measurement (from Compass output – see Attachment 2-1 to 2-5).

2.5.8 The action level during first phase scanning is ***200 cpm above background***. If this level is reached, the surveyor should stop and perform ***a count of at least 1/2 minute*** duration to identify the actual count rate from the elevated location.

2.5.9 Areas greater than the DCGLw (306 ncpm) must be identified, documented, marked, and bounded to include an area estimate.

> **NOTE**
> If remediation actions are taken as a result of this survey, this survey design must be revised or re-written entirely.

2.5.10 Other instruments of the type specified in 2.5.3 above may be used during the FSS but they must demonstrate an efficiency at or above the value listed in Attachment 4-1 (23.9%).

2.6 NaI Scanning Measurements

2.2.1 From Reference 3.2, the results of all NaI scanning of SS14-6 indicated less than the action level (≥ 300 gross cpm). Therefore, ***no additional NaI scan work is necessary***.

2.7 Sampling

2.3.1 Sample any location that is above the action level cited is Section 2.5.8. The action level for GFPC work is ***200 ncpm***. A 4" long core bore sample is preferred so that the depth of penetration can be identified. However, when a core bore cannot be taken because of the quality of the concrete, or because of limited access in an area, sampling should remove the first 1" of concrete and yield a volume of at least 200 cc to ensure an adequate counting MDA for Cs-137.

2.3.2 The updated volumetric DCGLw for concrete is calculated to be ***5.25 pCi/g*** and the ***administrative limit*** is ***3.93 pCi/g*** for Cs-137 as a surrogate (see Attachment 5-6).

3.0 REFERENCES

3.1 SNEC Calculation No. E900-03-025, "SSGS Area Trench & Sump Survey Design", Rev 0, 10-8-03.

3.2 SNEC Survey Request No. SR-0095, "SSGS Footprint 790' – Concrete Sumps and Trenches".

3.3 Compass Computer Program, Version 1.0.0, Oak Ridge Institute for Science and Education.

3.4 GPU Nuclear, SNEC Facility, SSGS Footprint, Drawing, SNECRM-041_S1_RO.

3.5 ISO 7503-1, Evaluation of Surface Contamination, Part 1: Beta-emitters (maximum beta energy greater than 0.15 MeV) and alpha-emitters, 1988.

3.6 SNEC Procedure E900-IMP-4500.59, "Final Site Survey Planning and DQA".

3.7 Plan SNEC Facility License Termination Plan.

3.8 SNEC Calculation No. E900-03-012, Effective DCGL Worksheet Verification.

3.9 SNEC procedure E900-IMP-4520.06, "Survey Unit Inspection in Support of FSS Design".

3.10 MicroShield, Computer Radiation Shielding Code, Version 5.05-00121, Grove Engineering.

3.11 SNEC procedure E900-IMP-4520.04, "Survey Methodology to Support SNEC License Termination".

3.12 NUREG-1575, "Multi-Agency Radiation Survey and Site Investigation Manual", August, 2000.

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

4.0 ASSUMPTIONS AND BASIC DATA

4.1 The drawing used to determine the physical extent of these areas is listed as Reference 3.4 and can be seen in Attachment 3-1 to 3-2.

4.2 This assessment and resulting survey design adjustment uses an effective surface gross activity DCGLw and volumetric Cs-137 surrogate DCGLw values developed for and reported in Attachment 5-1 to 5-6.

4.2.1 Cs-137 accounts for the majority of the total activity in the current sample mix.

- The current SNEC modified sample is 91.7% Cs-137.

Cs-137 provides the only reasonably detectable radionuclide in this mix. Cs-137's detection efficiency has been checked by SNEC personnel using ISO standard 7503-1 methodology (Reference 3.5). The SNEC facility uses only the lowest reported efficiency for any of the instruments available for the survey work as input to the survey design process. Attachment 5-1 indicates an ***instrument efficiency of 0.478***. The ***ISO value of 0.5*** is used as the source efficiency. The instrument S/N used to determine this value is 126218 and the probe S/N is 95080 (as an example of an efficiency only).

Other instruments may be used during the FSS but they must demonstrate an efficiency at or above 0.478 for the instrument efficiency.

4.3 The current version of Compass (version 1.0) does not perform correctly when using the gross activity option for multiple radionuclides. Therefore, an alternative was implemented for this survey design. This alternative involves several small changes that will not negatively impact the survey design process. These changes are:

4.3.1 For this survey design, the effective efficiency will be calculated using the following:

- ε_i = 0.478 x [any surface condition correction factor that impacts efficiency e.g., the impact from an increase in the average distance between the detector and source caused by a rough surface (uneven source area)].

- ε_s = [0.5 (ISO for Cs-137 energy betas)] x [the fraction of Cs-137 in the source area, which would be 1 for the Cs-137 calibration source or 0.917 for Cs-137 in the SSGS footprint]

4.3.2 A radionuclide was created in the library of Compass called "Gross Activity". This radionuclide has the same nuclear parameters as Cs-137 (half-life, decay time, etc.). The effect will be (when called up) that "Gross Activity" will replace Cs-137 on the print-out from the Compass program (administrative impact only).

4.3.3 Only "Gross Activity" will be used in the Compass program for this survey design. However, the Area Factors (AF) input to Compass will be for Co-60, which is the more conservative of all SNEC AF values for radionuclides present in the mix. Note that Co-60 AF values are very close to Cs-137 AF values. There is no significant impact from using Co-60 area factors.

4.3.4 A detector stand-off distance of 2 ½" was assumed to compensate for rough surfaces in the Trench area. This factor corrects the overall efficiency by a factor of 0.25 (see Reference 3.1)

4.4 The GFPC detectors physical probe area is 126 cm^2, and the instrument is calibrated to the same source area for Cs-137. The gross activity DCGLw is taken to be 4,857 dpm/100 cm^2 x (126 cm^2 physical probe area/100 cm^2) = 6,120 x (0.917 disintegration of Cs-137/ disintegration in mix) x ε_i (0.478) x ε_s (0.5) x 0.25 (distance factor) which yields ~335 net cpm above background (Compass calculates 306 ncpm as the gross beta DCGLw). The 0.055 count per disintegration counting efficiency considers only the Cs-137 contaminant present in the sample material matrix, and is calculated by: ε_i (0.478) x ε_s (0.5) x 0.917 disintegration of Cs-137/disintegration in mix x 0.25 (efficiency loss factor due to distance from surface) = 0.055 cts/gamma.

4.5 Surface defects (gouges, cracks, etc.), are present in this survey unit, but a portion of the surface area in this survey unit is relatively smooth. Thus the mean concentration of the source term for the entire survey unit will be somewhat overestimated by using a constant of 0.25 as a distance correction factor.

4.6 Inaccessible areas, i.e., areas where a 43-68 beta probe could not be used, were originally gamma scanned using a 2" x 2" NaI detector. The detector was set-up and calibrated using a Cs-137 window setting equivalent to that described in Reference 3.1.

4.7 MicroShield models of concrete slabs containing Cs-137 were developed for this survey design (see Reference 3.1). Two models were used; 1) a 3" thick slab of concrete 18" long by 12", wide with a density of 2/3 that of concrete to simulate an extremely rough surface (many pits and valleys), and 2) a 1" thick slab of concrete 18" long and 6" wide to simulate a narrow but relatively smooth surface such as the bottom of the Trench channel. The concentration used was 1 pCi/g Cs-137 and the full density of concrete is assumed to be 2.35 g/cc. Then the concentration of Cs-137 in the first model is 2.35g/cc x 2/3 x 1 pCi/g or 1.567E-06 uCi/cc of Cs-137 for the rough model, and 2.35E-06 uCi/cc for the smaller slab model. A 1" thickness was modeled for the smaller slab since volumetric contamination in concrete in the SSGS Footprint area has not been seen much below 1" in concrete core bore samples taken from this structure. From Attachment 10-1 to 10-3 of Reference 3.1, the calculated MDCscan for these two modeled volumes is 2 and 4.8 pCi/g Cs-137 respectively.

4.8 The results of the MicroShield modeling indicate that an exposure rate of approximately 6.611E-05 mR/h is obtained at a distance of 3" (2" inches from the face of the detector), from the surface of the smaller slab model, and 1.601E-04 mR/h is seen 3 inches from the surface of the larger or rough surface model. Exposure rate is measured to the center of the detector and therefore the air gap between the surface of both models is taken to be 2".

4.9 The newest volumetric DCGLw for concrete is calculated to be 5.25 pCi/g and the administrative limit is 3.93 pCi/g (see Attachment 5-6). The volumetric limits can be compared directly to the NaI scanning results. Therefore, scanning using the prescribe criteria will detect values slightly below or above the DCGLw of 5.25 pCi/g Cs-137. When an elevated scan result was observed while scanning with the NaI, sampling was indicated. As a result of this assessment, no additional NaI scanning is necessary.

4.10 The survey units described in this survey design were inspected after remediation efforts were completed. A copy of portions of the SNEC facility post-remediation inspection report (Reference 3.9), is included as Attachment 13-1 to 13-4 of Reference 3.1.

4.11 No special area characteristics including any additional residual radioactivity (not previously noted during characterization) have been identified in this survey unit.

4.12 The decision error for this survey design is 0.05 for the α value and 0.1 for the β value.

4.13 Special measurements including gamma-ray spectroscopy are not included in this survey design. Gross beta scans are conducted.

4.14 Sampling is performed on an as needed basis IAW Section 2.7.

4.15 The applicable SNEC site radionuclides and their individual DCGLw values are listed on Exhibit 1 of this calculation.

4.16 The survey design checklist is listed in Exhibit 2.

4.17 The Area Factors for this survey unit is shown below (Co-60). These values as applicable, were input to the Compass computer program (see Attachment 2-1). The lower limit area factor for areas less than 1 square meter is the value 10.1. Area factors for values between the values listed in the following table, are interpolated from the data by Compass.

AREA (m^2)	AREA FACTOR
1	10.1
4	3.4
9	2
16	1.5
25	1.2
36	1

5.0 CALCULATIONS

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

6.0 APPENDICES

6.1 Attachment 1-1 and 1-3, is an "information only" copy of the SR-0095 FSS results (Reference 3.2).

6.2 Attachment 2-1 to 2-6, is the Compass output as a result of the additional survey design requirements as a result of this assessment of Reference 3.1. Input parameters for this survey unit are identical to those used in this reference except for the use of the latest radionuclide mix and resulting detection efficiency loss.

6.3 Attachment 3-1 to 3-2, are SS14-6 survey unit diagrams of the area broken into sections. Additionally, photos are included in Reference 3.1 to aid the reader in identifying each survey unit section.

6.4 Attachment 4-1, is the SNEC site calibration sheet for the GFPC radiation measurement instrument with the lowest Cs-137 detection efficiency used for planning the survey work.

6.5 Attachment 5-1 to 5-6, is the latest SNEC sample results for seventeen (17) samples used to develop a representative mix for this survey unit. These sample results were reviewed and concurred with by the US NRC and its contractor ORISE.

Exhibit 1

SNEC Facility Individual Radionuclide DCGL Values [a]

Radionuclide	25 mrem/y Limit Surface Area (dpm/100cm^2)	25 mrem/y Limit (All Pathways) Open Land Areas (Surface & Subsurface) (pCi/g)	4 mrem/y Goal (Drinking Water) Open Land Areas [b] (Surface & Subsurface) (pCi/g)
Am-241	2.7E+01	9.9	2.3
C-14	3.7E+06	2	5.4
Co-60	7.1E+03	3.5	67
Cs-137	2.8E+04	6.6	397
Eu-152	1.3E+04	10.1	1440
H-3	1.2E+08	132	31.1
Ni-63	1.8E+06	747	1.9E+04
Pu-238	3.0E+01	1.8	0.41
Pu-239	2.8E+01	1.6	0.37
Pu-241	8.8E+02	86	19.8
Sr-90	8.7E+03	1.2	0.61

NOTES:

(a) While drinking water DCGLs will be used by SNEC to meet the drinking water 4 mrem/y goal, only the DCGL values that constitute the 25 mrem/y regulatory limit will be controlled under this LTP and the NRC's approving license amendment.

(b) Listed values are from the subsurface model. These values are the most conservative values between the two models (i.e., surface & subsurface).

Exhibit 2
Survey Design Checklist

Calculation No.	Location Codes
E900-04-003	SS14-6

ITEM	REVIEW FOCUS	Status (Circle One)	Reviewer Initials & Date
1	Has a survey design calculation number been assigned and is a survey design summary description provided?	Yes, N/A	4/15/04
2	Are drawings/diagrams adequate for the subject area (drawings should have compass headings)?	Yes, N/A	4/15/04
3	Are boundaries properly identified and is the survey area classification clearly indicated?	Yes, N/A	4/15/04
4	Has the survey area(s) been properly divided into survey units IAW EXHIBIT 10	Yes, N/A	4/15/04
5	Are physical characteristics of the area/location or system documented?	Yes, N/A	4/15/04
6	Is a remediation effectiveness discussion included?	Yes, N/A	4/15/04
7	Have characterization survey and/or sampling results been converted to units that are comparable to applicable DCGL values?	Yes, N/A	4/15/04
8	Is survey and/or sampling data that was used for determining survey unit variance included?	Yes, N/A	4/15/04
9	Is a description of the background reference areas (or materials) and their survey and/or sampling results included along with a justification for their selection?	Yes, N/A	4/15/04
10	Are applicable survey and/or sampling data that was used to determine variability included?	Yes, N/A	4/15/04
11	Will the condition of the survey area have an impact on the survey design, and has the probable impact been considered in the design?	Yes, N/A	4/15/04
12	Has any special area characteristic including any additional residual radioactivity (not previously noted during characterization) been identified along with its impact on survey design?	Yes N/A	4/15/04
13	Are all necessary supporting calculations and/or site procedures referenced or included?	Yes, N/A	4/15/04
14	Has an effective DCGLw been identified for the survey unit(s)?	Yes, N/A	4/15/04
15	Was the appropriate $DCGL_{EMC}$ included in the survey design calculation?	Yes, N/A	4/15/04
16	Has the statistical tests that will be used to evaluate the data been identified?	Yes, N/A	4/15/04
17	Has an elevated measurement comparison been performed (Class 1 Area)?	Yes, N/A	4/15/04
18	Has the decision error levels been identified and are the necessary justifications provided?	Yes, N/A	4/15/04
19	Has scan instrumentation been identified along with the assigned scanning methodology?	Yes N/A	4/15/04
20	Has the scan rate been identified, and is the MDCscan adequate for the survey design?	Yes, N/A	4/15/04
21	Are special measurements e.g., in-situ gamma-ray spectroscopy required under this design, and is the survey methodology, and evaluation methods described?	Yes, N/A	4/15/04
22	Is survey instrumentation calibration data included and are detection sensitivities adequate?	Yes, N/A	4/15/04
23	Have the assigned sample and/or measurement locations been clearly identified on a diagram or CAD drawing of the survey area(s) along with their coordinates?	Yes, N/A	4/15/04
24	Are investigation levels and administrative limits adequate, and are any associated actions clearly indicated?	Yes, N/A	4/15/04
25	For sample analysis, have the required MDA values been determined.?	Yes, N/A	4/15/04
26	Has any special sampling methodology been identified other than provided in Reference 6.3?	Yes, N/A	4/15/04

NOTE: a copy of this completed form or equivalent, shall be included within the survey design calculation.

SURVEY REQUEST CONTINUATION SHEET			
SR NUMBER	SR-0095	AREA/LOCATION	SSGS Footprint 790' – Concrete Sumps and Trenches
SPECIFIC SAMPLING / SURVEY INSTRUCTIONS OR COMMENTS			

RESULTS SUMMARY FOR SR-0095 INFORMATION ONLY

SR-0095 was issued to perform the final status survey (FSS) of the SSGS footprint sumps and trenches. This survey unit (SS14-6) is a Class 1 area consisting of approx. 100 square meters of surface area. The survey unit is divided into 13 sections (9 trench sections and 4 sumps). The survey design calculation No. is E900-03-025. The SR required the following radiological measurements:

- Surface Scan Measurements Using a 2" x 2" Sodium Iodide Detector – 100% surface scan is required for all areas not able to be surveyed by GFPC detector (see below) at a rate not exceeding 10 cm/second. The action level ≥ 300 gross cpm.
- Surface Scan Using the L-2350 with 43-68 GFPC Detector – 100% surface scan for beta/gamma at a rate not exceeding 2.2 cm/second on contact with the surface. The action level is ≥ 500 ncpm.
- Static Measurements for Beta/Gamma Activity Using a Ludlum 2350-1 / 43-68B GFPC Detector – obtain measurements at each location listed in the SR and in locations indicating activity in excess of action level (500 ncpm). The DCGL for this survey unit is ≥ 983 ncpm.
- Concrete Samples – approx. 4" in depth. Obtain samples of areas indicating activity above action levels (either 500 ncpm for the GFPC or 300 gross cpm for the NaI).
- Loose Surface Contamination (Smear Survey) – obtain at least one smear sample from each location listed in the SR after the static measurement is obtained.
- QC Repeat Measurements – A minimum of 5% of all surface scan measurements and sampling will be re-performed and re-analyzed using identical methodology.

1. Summary of Results

A. Surface Scan Measurements (2"x 2" Sodium Iodide Detector)

Surface scan was performed on surfaces not able to be scanned with 43-68B. Action level was 300 gross cpm.

Results: All areas indicated levels below action level.

B. Surface Scan Measurements (L-2350 with a 43-68 Detector)

Surface scan was performed on all surfaces able to be scanned within 2.5 inches. Action level was 500 ncpm.

Results: All areas indicated levels below action level.

ATTACHMENT 1 - 1

SURVEY REQUEST CONTINUATION SHEET			
SR NUMBER	SR-0095	AREA/LOCATION	SSGS Footprint 790' – Concrete Sumps and Trenches
SPECIFIC SAMPLING / SURVEY INSTRUCTIONS OR COMMENTS			

C. Static Measurements (L-2350 with a 43-68 Detector)

Fifty-two measurement pairs were obtained as required by the SR. No additional static measurements were required. Two locations were relocated due to obstructions. All pairs were below the established DCGL (983 ncpm). The highest net difference was 122 ncpm. The following table lists the measurement results:

SS14-6 STATIC POINTS	UNSHIELDED READING (cpm)	SMEAR RESULTS (ncpm/100cm^2)		SS14-6 STATIC POINTS	UNSHIELDED READING (cpm)	SMEAR RESULTS (ncpm/100cm^2)	
		Beta-gamma	Alpha			Beta-gamma	Alpha
1	267	4	1	27	279	-11	0
2	239	0	0	28	285	-11	0
3	238	-3	0	29	269	2	0
4	254	0	0	30	299	4	1
5	242	0	0	31	306	-5	0
6	231	-6	0	32	321	-5	0
7	280	-1	0	33	277	-8	0
8	268	-10	0	34	264	-3	0
9	264	-8	0	35	301	-4	0
10	266	4	0	36	234	-5	0
11	200	3	0	37	221	-2	0
12	221	-1	0	38	262	-4	0
13	316	1	0	39	242	-7	0
14	228	0	0	40	222	2	1
15	251	-5	0	41	243	-2	-2
16	264	2	1	42	217	-3	0
17	229	-3	0	43	261	3	0
18	338	-7	0	44	202	5	0
19	272	1	0	45	261	-5	0
20	276	-3	0	46	253	-1	0
21	262	3	0	47	166	-11	0
22	317	0	0	48	195	-3	0
23	294	1	0	49	247	1	0
24	273	-2	0	50	271	0	0
25	304	-5	0	51	273	-2	0
26	274	1	0	52	291	0	0
STATIC MEASUREMENT RESULTS				MEAN	260.2		
				STANDARD DEVIATION	34.5		
				MIN	166		
				MAX	338		
				MEDIAN	264		

D. Concrete Core samples

ATTACHMENT 1 . 2

SURVEY REQUEST CONTINUATION SHEET			
SR NUMBER	SR-0095	AREA/LOCATION	SSGS Footprint 790' – Concrete Sumps and Trenches
SPECIFIC SAMPLING / SURVEY INSTRUCTIONS OR COMMENTS			

INFORMATION ONLY

No core samples were required.

E. Loose Surface Contamination Survey

52 were taken. Results indicated <MDC for beta-gamma (166 dpm/100 cm^2) and alpha (11.6 dpm/100 cm^2). Isotopic analysis of smears indicated <1.2 E –5 uCi/group Cs-137, <1.2 E –5 uCi/group Co-60.

F. Quality Control (QC) Measurements and Comparisons

- **Repeat Scan/Static Measurements and Smears** were performed and met the applicable acceptance criteria established in Section 4.6 of E900-IMP-4520.04 except for two static measurements. This was due to surface abnormalities causing different probe orientations.

2. General Note:

- Standing water found in trenches and sumps were removed prior to obtaining measurements and smears.

3. Exceptions & Discrepancies:

A. Static measurement points #38 & 45 were relocated due to obstructions encountered during survey.

B. Two QC static measurement comparisons failed the acceptance criteria established in E900-IMP-4520.04. Initial measurement probe orientation was not marked on surface due to surface abnormalities. Therefore the technician performing QC static measurements was not able to orient probe to match the initial measurements' probe position. These non-replicated QC measurements caused unacceptable results.

Conclusion: Since these measurement pairs' net differences are less than 25% of the established DCGL for this survey unit, these failed comparisons do not adversely affect the validity of the static measurement results. The results are accepted.

David Sarge (GRCS) _____ **Date** _____

ATTACHMENT 1 . 3

Site Report

Site Summary

Site Name: SSGS TRENCH RE-ASSESSMENT

Planner(s): BHB

Contaminant Summary

NOTE: Surface soil DCGLw units are pCi/g.
Building surface DCGLw units are dpm/100 cm².

Contaminant	Type	DCGLw	Screening Value Used?	Area (m²)	Area Factor
Gross Activity	Building Surface	4,857	No	36	1
				25	1.2
				16	1.5
				9	2
				4	3.4
				1	10.1

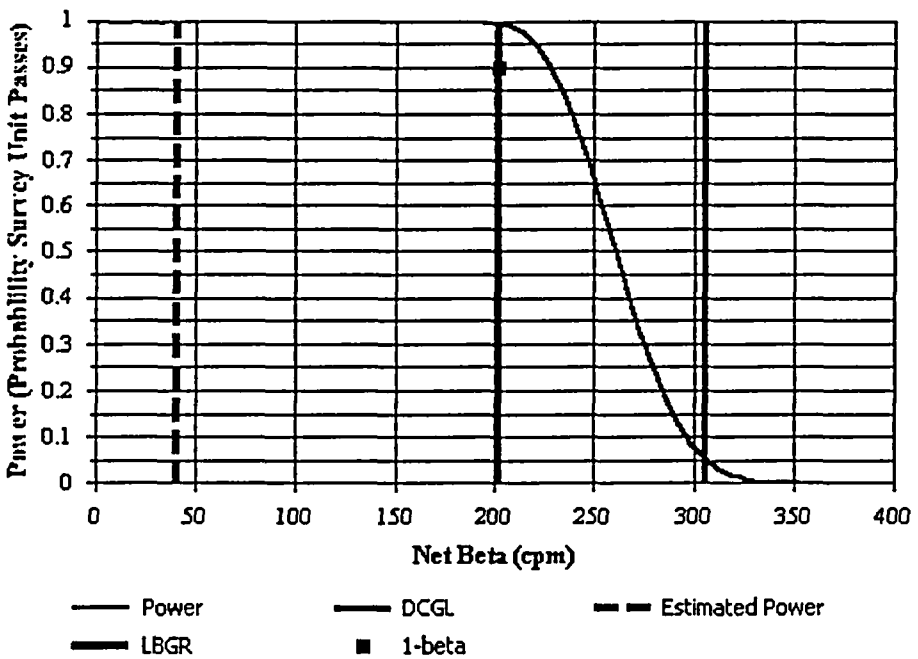
ATTACHMENT 2.1

Building Surface Survey Plan

Survey Plan Summary

Site:	SSGS TRENCH RE-ASSESSMENT		
Planner(s):	BHB		
Survey Unit Name:	RE-ASSESSMENT OF SSGS TRENCH AREA		
Comments:			
Area (m²):	100	Classification:	1
Selected Test:	WRS	Estimated Sigma (cpm):	65.2
DCGL (cpm):	306	Sample Size (N/2):	13
LBGR (cpm):	202	Estimated Conc. (cpm):	41
Alpha:	0.050	Estimated Power:	1.00
Beta:	0.100	EMC Sample Size (N):	13

Prospective Power Curve



ATTACHMENT 2 . 2

Building Surface Survey Plan

Contaminant Summary

Contaminant	DCGLw (dpm/100 cm²)
Gross Activity	4,857

Beta Instrumentation Summary

Gross Beta DCGLw (dpm/100 cm²): 4,857
Total Efficiency: 0.05
Gross Beta DCGLw (cpm): 306

ID	Type	Mode	Area (cm²)
15	GFPC	Beta	126

Contaminant	Energy[1]	Fraction[2]	Inst. Eff.	Surf. Eff.	Total Eff.
Gross Activity	187.87	1.0000	0.48	0.11	0.0548

[1] Average beta energy (keV) [N/A indicates alpha emission]
[2] Activity fraction

Gross Survey Unit Mean (cpm): 339 ± 65 (1-sigma)
Count Time (min): 1

Material	Number of BKG Counts	Average (cpm)	Standard Deviation (cpm)	MDC (dpm/100 cm²)
Concrete	7	298	56.8	1,322

ATTACHMENT 2.3

COMPASS - DQO Wizard for Building Surface Assessment

Beta Backgrounds and Survey Unit Mean Count Rate

The background materials entered earlier are shown below, including the material specific backgrounds to date that have been entered for the selected instrumentation. To view or to add more background measurements, click the material in the Background Material Summary list. Finally, enter the gross survey unit mean in cpm.

Instrumentation: ID:15 - GFPC

Count Time (min): 1

Background Material Summary

Material	Average (cpm)	Std. Dev. (cpm)	MDC (dpm/100 cm²)
Concrete	298	56.8	1,322

Background Material Details

Count (cpm)
295
235
388
344
253

DELETE

After selecting a material from the Background Material Summary list, additional background counts can be added to the Background Material Details list.

Enter a new background count (cpm) then press ENTER to save:

Gross Survey Unit Mean (cpm): 339 ± 65.2 (1σ)

Sign Test Sigma (cpm): ---

WRS Test Sigma (cpm): 65.2

Enable Training Card Help

v1.0.0

BACK NEXT

ATTACHMENT 2.4

COMPASS - DQO Wizard for Building Surface Assessment

Elevated Measurement Comparison (EMC) for Beta

Follow the order of each tab below to perform the EMC.

1) Enter Scanning Instrument Efficiencies | 2) Enter Scan MDC Parameters | **3) View EMC Results**

Scan MDC Required per Contaminant

Contaminant	DCGLw*	Area Factor	Scan MDC Required*
Gross Activity	4,857	2.36	11,463

Statistical Design

N/2:	13
Bounded Area (m²):	7.7
Area Factor:	2.36
DCGLw*:	4,857
Scan MDC Required*:	11,463

Hot Spot Design

Actual Scan MDC*:	2,610
Area Factor:	N/A
Bounded Area (m²):	N/A
Post-EMC N/2:	13

COMPASS

No additional samples are required because the actual scan MDC is less than the DCGLw for each contaminant.

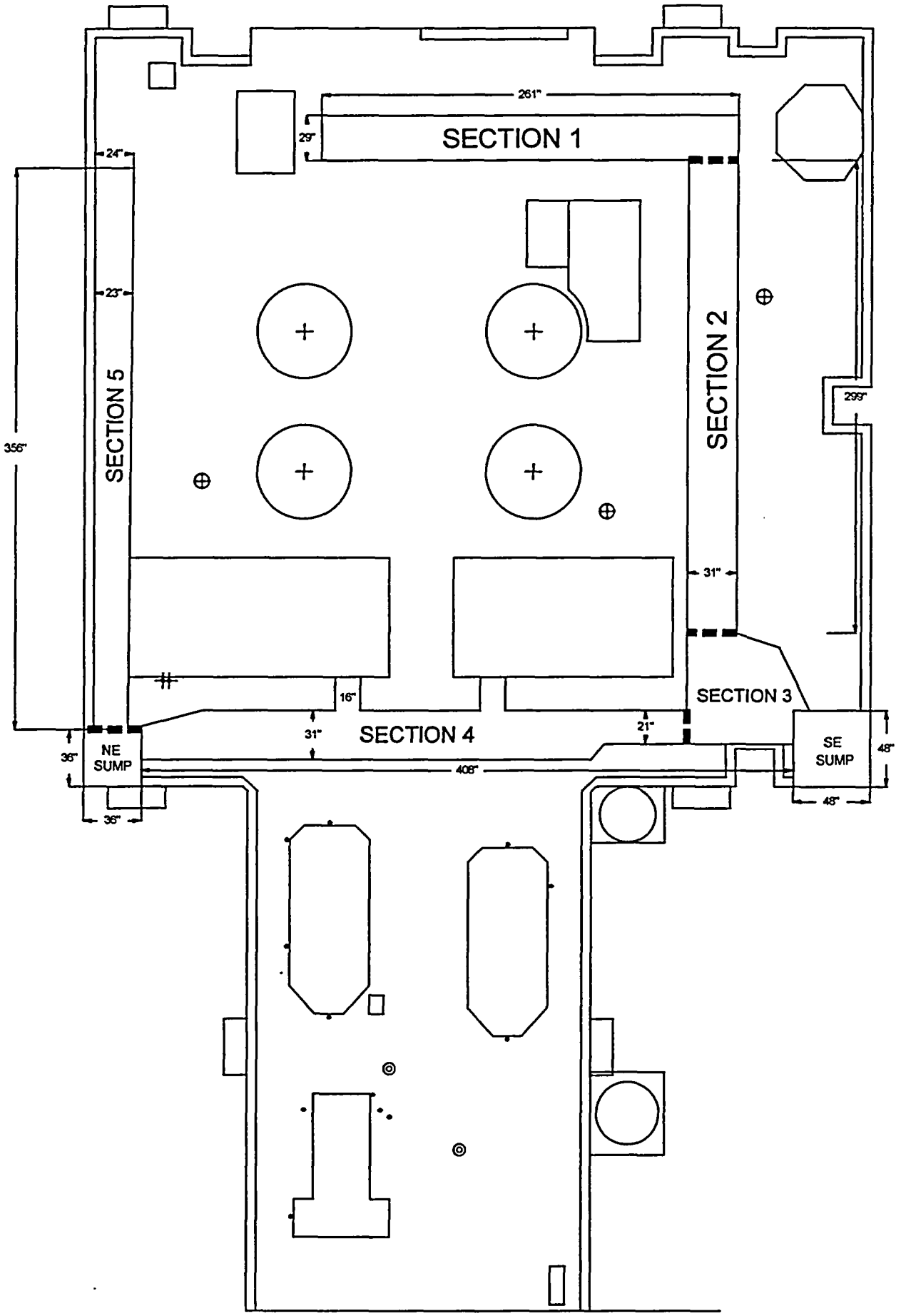
* dpm/100 cm²

Enable Training

v1.0.0

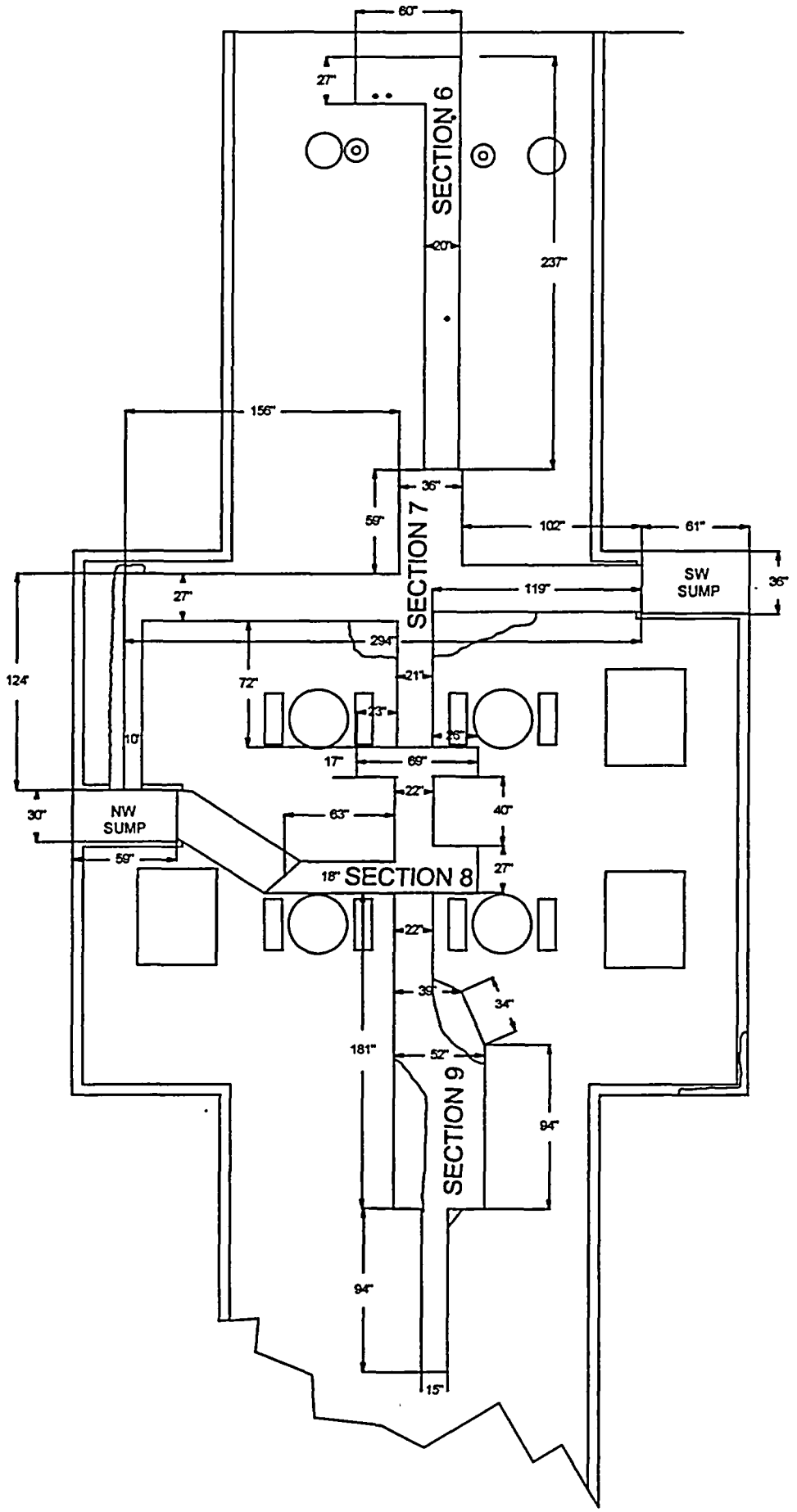
OK

ATTACHMENT 2.5



PLAN EL. 790'

ATTACHMENT 3-1



PLAN EL. 790'

ATTACHMENT 3-2

EXAMPLE

ORIGINAL

GFPC Radiation Measurement Instrument Calibration Worksheet

R J Reheard

Performed By:	R. J. Reheard	Date:	6/24/03
Instrument S/N:	126218	Probe S/N:	95080
Instrument Vendor Cal. Date:	12/20/03	Cal. Due Date:	12/20/03

Source No.	ISO 7503-1 Values "Ca"	Reference Date	As in µCi (± 6%)	2π β or α Emission Rate (sec-1) (± 3%)	
Am-241 (GO 535) S-023	0.25	4/8/99 12:00 GMT	4.24E-01	7.43E+03	☐ Am-241
Cs-137 (GO 536) S-024	0.50	4/8/99 12:00 GMT	3.11E-01	6.89E+03	☑ Cs-137

	Source Radionuclide	Decay Date
	Cs-137	6/24/03
Decay Factor⇒	9.075E-01	Elapsed Time (days)⇒

Elapsed Time (days)⇒	1538
Activity (µCi)⇒	2.821E-01
Source dpm⇒	6.262E+05
Source dpm/in Probe Area (cm^2)⇒	5.260E+05
2π Emission Rate (sec-1)⇒	6.253E+03
2π Emission Rate (min-1)⇒	3.752E+05
2π Emission Rate in Probe Area (min-1)⇒	3.151E+05

Probe Area (cm^2)
126

Record of 1 Minute Source & Background Counting Results

☑ Check if using ISO 7503-1 Value

No.	OW Source Gross CPM	OW Background CPM	OW Source Net CPM
1	1.48E+05	181	1.483E+05
2	1.49E+05	203	1.490E+05
3	1.50E+05	186	1.499E+05
4	1.50E+05	193	1.502E+05
5	1.51E+05	182	1.507E+05
6	1.51E+05	164	1.508E+05
7	1.52E+05	170	1.515E+05
8	1.51E+05	177	1.513E+05
9	1.52E+05	161	1.520E+05
10	1.52E+05	162	1.515E+05
Mean⇒		177.9	1.505E+05

RESULTS
Counts/Emission (εi)
47.8%
2π Emission/Disintigration (εs)
50.0%
Counts/Disintigration (εt)
23.9%

Approved: J Duskin / J Dac

Date: 6/25/03

Calibration Calculation Sheet Verification Date⇒	December-02
B. Brosey/P. Donnachie⇒	December-02

ATTACHMENT 4.1

DCGL Calculation Logic-SSGS Sumps & Piping

I. **Survey Unit:** Saxton Steam Generating Station (SSGS) Sumps & Piping

II. **Description:** The purpose of this calculation is to determine a representative isotopic mix for the SSGS Sumps & Piping from available sample analyses. The effective surface area and volumetric $DCGL_w$s are then determined from the mean percent of applicable samples.

III. **Data Selection Logic Tables**: The radionuclide selection logic and subsequent DCGL calculations are provided in six (6) tables. These tables were developed using Microsoft Excel. Table explanation is as follows.

Table 1: Data Listing – This table, which has been extracted from a larger database, provides a list of the most representative sample analyses. Results are from scoping, characterization, and pre/post remediation surveys. The samples consist of sediment media that were taken in support of the aforementioned surveys. As applicable, a sample number, sample location/description, radionuclide concentration, analysis date are provided for each sample. Positive nuclide concentrations are noted with yellow/shaded background fields while MDAs are noted in the gray shaded fields.

Table 2: Decayed Listing of Positive Nuclides & MDAs Removed – This table provides the best overall representation of data selected from Table 1. Half-life values (days) are listed above each respective nuclide column. Samples are decayed to the date noted above Table 1 (e.g. January 15, 2004). Positive results are denoted in a yellow background field while MDA values have been removed.

Table 3: Mean Percent of Total for Positive Nuclides – This table provides the calculation methodology for determining the relative fractions of the total activity contributed by each radionuclide. From this information the mean, sigma, and mean % of total are calculated. The mean % of total values is used to calculate the surface gross activity $DCGL_w$ per MARSSIM equation 4-4. See Table 5. Note that the mean percent values were averaged using only the positive sample results in each column. In some cases only a single nuclide value had a positive result. This value is listed as the value in the mean result field. This results in higher "mean percent of total" values in the mix, which are conservative.

Table 4: Ratio to Cs-137 for Positive Nuclides – This table provides the calculation methodology for determining the surrogate ratio to Cs-137 for each radionuclide. From this information the mean, sigma, and mean % of total are calculated. The mean % of total values is used to calculate the volumetric $DCGL_w$ per MARSSIM equation I-14. See Table 6. Note that the mean percent values were averaged using only the positive sample results in each column. In some cases only a single nuclide value had a positive result. This value is listed as the value in the mean result field. This results in higher "mean percent of total" values in the mix, which are conservative.

Note: From Tables 3 and 4 only the "mean % of total" values are used as input to the "Effective DCGL Calculation Spreadsheet" as illustrated in Tables 5 and 6.

Table 5: Effective DCGL Calculator for Cs-137 (dpm/100 cm^2) – This table provides the surface gross activity $DCGL_w$ calculation results from data derived from Table 3.

Table 6: Effective DCGL Calculator for Cs-137 (in pCi/g) – This table provides the surrogate volumetric modified Cs-137 $DCGL_w$ calculation results from data derived from Table 4.

ATTACHMENT 5 - 1

IV. **Summary** – Since the SSGS Sumps & Piping are part of a concrete structure the release limit is primarily based on the surface area $DCGL_w$. However, some SSGS Sumps & Piping have volumetric contamination. Therefore, a volumetric $DCGL_w$ is also determined. Using the above data selection logic tables the calculated gross activity $DCGL_w$ for surface area is 6,475 dpm/100 cm^2. The Cs-137 volumetric $DCGL_w$ is 5.25 pCi/g. These values would be reduced by 25% as part of SNEC's requirement to apply an administrative limit as discussed in the License Termination Plan (LTP).

ATTACHMENT 5 . 2

TABLE 1 - Data Listing (pCi/g)

	SNEC Sample No	Location/Description	H-3	Sr-90	Co-60	Cs-137	Am-241	Pu-238	Pu-239	Pu-241	C-14	Ni-63	Eu-152	Decay Date January 15, 2004 Analysis Date	Elapsed Time (d)
1	SX10GW00321	Sediment Phase - SSGS East Sump @ 25', AV183, Well #1			3.00E+00	8.50E+01	8.80E-02	3.00E-02	4.00E-02					April 25, 2000	1360
2	SX10SD00366	SSGS Footprint East Turbine Sump Area AV-133 (Pumped)	9.00E+01	6.00E-02	3.70E-01	9.78E+01	2.00E-01	2.00E-01	2.00E-01	1.00E+02	2.00E+00	2.00E+01	1.80E-01	June 5, 2000	1319
3	SX10SD00367	SSGS Footprint West Turbine Sump Area AV-134 (Pumped)		2.00E-02	2.00E-01	6.70E+00	1.30E-01	7.00E-03	1.20E-02	1.50E+00				June 5, 2000	1319
4	SX10SD01521	SSGS 4" Cross Over Line - Sump to Sump - 790' El.	2.16E+00	1.41E-01	4.08E-01	1.13E+02	6.71E-02	1.45E-01	8.75E-02	1.13E+01	1.88E-01	8.30E+00	5.98E-01	October 31, 2002	441
5	SX10SD01727	SSGS South East Sump Sediment AV-133, Building Structure	2.13E+00	1.56E-01	5.26E-01	8.88E+01	8.92E-02	6.59E-02	3.81E-02	5.35E+00	2.04E-01	7.95E+00	7.62E-01	February 26, 2001	1053
6	SX10SD990033	Discharge Tunnel 6" Drain Line Scraping	1.00E+02	8.00E+00	3.00E+01	4.80E+03	5.40E+00	1.60E+00	2.50E+00	6.00E+01	6.00E+00	5.50E+01	2.00E+01	July 22, 1999	1638
7	SX10SD990034	1st Seal Chamber Crud Pile Below 3" Vertical Drain Line			9.00E-02	6.20E+01	5.00E-02	4.00E-02	4.00E-02					July 22, 1999	1638
8	SX13SD00365D	SSGS DT 18" Line		2.00E-02	7.00E-02	3.10E+00	3.00E-02	7.00E-03	7.00E-03	6.00E-01				May 24, 2000	1331
9	SX5SD255 & 256	SSGSDT 8" & 15" Pipe Internal Composite (160 &163')			1.75E-01	2.20E+00	1.80E-02	2.00E-03	8.10E-03					November 17, 1999	1520
10	SX5SD99252	16" Pipe Internal ~138' SSGS Discharge Tunnel			5.00E-01	3.80E+00	4.00E-02	1.60E-03	2.00E-02					November 17, 1999	1520
11	SXSD1377	SSGS 790' El., East - Debris From Pump Stand Small Pipe	1.10E+01	4.00E-02	3.98E+00	3.13E+03	1.10E-01	7.00E-02	8.00E-02	4.74E+00	4.15E+00	8.61E+00	2.40E-01	September 4, 2001	863
12	SXSD344	SSGS Tunnel 18" Pipe, Sample From Robotic Entry			1.50E-02	1.40E+00	6.00E-01	1.00E-02	4.00E-02					May 10, 2000	1345
13	SXSD721	SSGS North Sump	1.27E+01	1.00E-02	7.00E-02	2.55E+00	4.00E-03	4.00E-03	3.00E-03	4.78E-01	4.13E+00	7.26E+00	7.00E-02	February 15, 2001	1064
14	SXSD723	SSGS SE Sump, AU-133, SR-0003	1.21E+01	2.00E-02	5.40E-01	1.59E+02	1.40E-02	3.00E-03	4.00E-03	5.62E-01	4.07E+00	7.20E+00	4.00E-02	February 20, 2001	1059
15	SXSD756	SSGS North Sump Penetration - 4" Pipe	3.66E+00	5.00E-02	2.80E-01	4.39E+00	5.30E-02	1.00E-02	4.00E-03	4.91E-01	5.61E-01	7.68E+00	7.00E-02	April 25, 2001	995
16	SX13CP00644	SSGS Tunnel, 3" Drain Line West, #1 Seal Chamber			3.00E-02	3.49E+00							1.80E-01	March 29, 2001	1022
17	SXSD1192	SSGS Footprint, East, SR-0004, NW Sump	3.38E+00	9.00E-02	1.40E-01	1.16E+01	1.36E-01	3.00E-03	3.00E-03	5.59E-01	7.29E-01	9.08E+00	6.00E-02	July 17, 2001	912

TABLE 2 - Decayed Listing of Positive Nuclides & MDAs Removed (pCi/g)

			T 1/2	T 1/2	T 1/2	T 1/2	T 1/2	T 1/2	T 1/2	T 1/2	
			10446.15	1925.23275	11019.5925	157861.05	32050.688	8813847.75	2092882.5	36561.525	
	SNEC Sample No	Location/Description	Sr-90	Co-60	Cs-137	Am-241	Pu-238	Pu-239	C-14	Ni-63	Total (pCi/g)
1	SX10GW00321	Sediment Phase - SSGS East Sump @ 25', AV183, Well #1			7.80E+01	8.75E-02					78.12
2	SX10SD00366	SSGS Footprint East Turbine Sump Area AV-133 (Pumped)		2.30E-01	9.00E+01						90.25
3	SX10SD00367	SSGS Footprint West Turbine Sump Area AV-134 (Pumped)			6.17E+00						6.17
4	SX10SD01521	SSGS 4" Cross Over Line - Sump to Sump - 790' El.	1.37E-01	3.48E-01	1.10E+02			8.75E-02			110.48
5	SX10SD01727	SSGS South East Sump Sediment AV-133, Building Structure	1.45E-01	3.60E-01	8.31E+01						83.62
6	SX10SD990033	Discharge Tunnel 6" Drain Line Scraping		1.66E+01	4.33E+03	5.36E+00	1.54E+00	2.50E+00		5.33E+01	4409.52
7	SX10SD990034	1st Seal Chamber Crud Pile Below 3" Vertical Drain Line			5.59E+01						55.93
8	SX13SD00365D	SSGS DT 18" Line			2.85E+00						2.85
9	SX5SD255 & 256	SSGSDT 8" & 15" Pipe Internal Composite (160 &163')			2.00E+00			8.10E-03			2.01
10	SX5SD99252	16" Pipe Internal ~138' SSGS Discharge Tunnel			3.45E+00			2.00E-02			3.47
11	SXSD1377	SSGS 790' El., East - Debris From Pump Stand Small Pipe		2.92E+00	2.96E+03		6.87E-02	8.00E-02			2967.72
12	SXSD344	SSGS Tunnel 18" Pipe, Sample From Robotic Entry			1.29E+00						1.29
13	SXSD721	SSGS North Sump		4.77E-02	2.38E+00						2.43
14	SXSD723	SSGS SE Sump, AU-133, SR-0003		3.69E-01	1.49E+02						149.12
15	SXSD756	SSGS North Sump Penetration - 4" Pipe		1.96E-01	4.12E+00						4.32
16	SX13CP00644	SSGS Tunnel, 3" Drain Line West, #1 Seal Chamber			3.27E+00						3.27
17	SXSD1192	SSGS Footprint, East, SR-0004, NW Sump		1.01E-01	1.10E+01				7.29E-01		11.78

KEY	
	Yellow Shaded Background = Positive Result
	Gray Shaded Background = MDA

C03

TABLE 3 - Mean Percent of Total for Positive Nuclides

	SNEC Sample No	Location/Description	Sr-90	Co-60	Cs-137	Am-241	Pu-238	Pu-239	C-14	Ni-63	Total
1	SX10GW00321	Sediment Phase - SSGS East Sump @ 25', AV183, Well #1			99.89%	0.11%					100.00%
2	SX10SD00366	SSGS Footprint East Turbine Sump Area AV-133 (Pumped)		0.26%	99.74%						100.00%
3	SX10SD00367	SSGS Footprint West Turbine Sump Area AV-134 (Pumped)			100.00%						100.00%
4	SX10SD01521	SSGS 4" Cross Over Line - Sump to Sump - 790' El.	0.12%	0.32%	99.48%			0.08%			100.00%
5	SX10SD01727	SSGS South East Sump Sediment AV-133, Building Structure	0.17%	0.43%	99.40%						100.00%
6	SX10SD990033	Discharge Tunnel 6" Drain Line Scraping		0.38%	98.20%	0.12%	0.04%	0.06%		1.21%	100.00%
7	SX10SD990034	1st Seal Chamber Crud Pile Below 3" Vertical Drain Line			100.00%						100.00%
8	SX13SD00365D	SSGS DT 18" Line			100.00%						100.00%
9	SX5SD255 & 256	SSGSDT 8" & 15" Pipe Internal Composite (160 &163')			99.60%			0.40%			100.00%
10	SX5SD99252	16" Pipe Internal ~138' SSGS Discharge Tunnel			99.42%			0.58%			100.00%
11	SXSD1377	SSGS 790' El., East - Debris From Pump Stand Small Pipe		0.10%	99.90%		0.00%	0.00%			100.00%
12	SXSD344	SSGS Tunnel 18" Pipe, Sample From Robotic Entry			100.00%						100.00%
13	SXSD721	SSGS North Sump		1.96%	98.04%						100.00%
14	SXSD723	SSGS SE Sump, AU-133, SR-0003		0.25%	99.75%						100.00%
15	SXSD756	SSGS North Sump Penetration - 4" Pipe		4.53%	95.47%						100.00%
16	SX13CP00644	SSGS Tunnel, 3" Drain Line West, #1 Seal Chamber			100.00%						100.00%
17	SXSD1192	SSGS Footprint, East, SR-0004, NW Sump		0.86%	92.96%				6.19%		100.00%
		Mean⇒	1.49E-03	1.01E-02	9.89E-01	1.17E-03	1.87E-04	2.24E-03	6.19E-02	1.21E-02	1.08
		Sigma⇒	0.0004	0.014	0.0192	0.0001	0.0002	0.003			
		Mean % of Total⇒	0.14%	0.93%	91.74%	0.11%	0.02%	0.21%	5.74%	1.12%	100.00%

TABLE 4 - Ratio to Cs-137 for Positive Nuclides

	SNEC Sample No	Location/Description	Sr-90	Co-60	Cs-137	Am-241	Pu-238	Pu-239	C-14	Ni-63	Total
1	SX10GW00321	Sediment Phase - SSGS East Sump @ 25', AV183, Well #1			1.00E+00	1.12E-03					1.00
2	SX10SD00366	SSGS Footprint East Turbine Sump Area AV-133 (Pumped)		2.56E-03	1.00E+00						1.00
3	SX10SD00367	SSGS Footprint West Turbine Sump Area AV-134 (Pumped)			1.00E+00						1.00
4	SX10SD01521	SSGS 4" Cross Over Line - Sump to Sump - 790' El.	1.25E-03	3.17E-03	1.00E+00			7.96E-04			1.01
5	SX10SD01727	SSGS South East Sump Sediment AV-133, Building Structure	1.75E-03	4.33E-03	1.00E+00						1.01
6	SX10SD990033	Discharge Tunnel 6" Drain Line Scraping		3.84E-03	1.00E+00	1.24E-03	3.57E-04	5.77E-04		1.23E-02	1.02
7	SX10SD990034	1st Seal Chamber Crud Pile Below 3" Vertical Drain Line			1.00E+00						1.00
8	SX13SD00365D	SSGS DT 18" Line			1.00E+00						1.00
9	SX5SD255 & 256	SSGSDT 8" & 15" Pipe Internal Composite (160 &163')			1.00E+00			4.05E-03			1.00
10	SX5SD99252	16" Pipe Internal ~138' SSGS Discharge Tunnel			1.00E+00			5.79E-03			1.01
11	SXSD1377	SSGS 790' El., East - Debris From Pump Stand Small Pipe		9.84E-04	1.00E+00		2.32E-05	2.70E-05			1.00
12	SXSD344	SSGS Tunnel 18" Pipe, Sample From Robotic Entry			1.00E+00						1.00
13	SXSD721	SSGS North Sump		2.00E-02	1.00E+00						1.02
14	SXSD723	SSGS SE Sump, AU-133, SR-0003		2.48E-03	1.00E+00						1.00
15	SXSD756	SSGS North Sump Penetration - 4" Pipe		4.75E-02	1.00E+00						1.05
16	SX13CP00644	SSGS Tunnel, 3" Drain Line West, #1 Seal Chamber			1.00E+00						1.00
17	SXSD1192	SSGS Footprint, East, SR-0004, NW Sump		9.20E-03	1.00E+00				6.65E-02		1.08
		Mean⇒	1.50E-03	1.04E-02	1.00E+00	1.18E-03	1.90E-04	2.25E-03	6.65E-02	1.23E-02	1.09
		Sigma⇒	0.0004	0.015	0.0000	0.0001	0.0002	0.003			
		Mean % of Total⇒	0.14%	0.95%	91.37%	0.11%	0.02%	0.21%	6.08%	1.13%	100.00%

COX

Table 5

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

Gross Activity DCGLw		Gross Activity Administrative Limit	
6475	dpm/100 cm^2	4857	dpm/100 cm^2

25.0 mrem/y TEDE Limit

SAMPLE NO(s)⇒ SSGS SUMPS AND PIPING

Cs-137 Limit		Cs-137 Administrative Limit	
5940	dpm/100 cm^2	4455	dpm/100 cm^2

SNEC AL	75%

	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	1.17E-03	0.109%	27	7.03	6.51	N/A	7.03	Am-241
2	C-14	6.19E-02	5.741%	3,700,000	371.76	0.00	371.76	N/A	C-14
3	Co-60	1.01E-02	0.937%	7,100	60.66	0.21	60.66	N/A	Co-60
4	Cs-137	9.89E-01	91.728%	28,000	5939.75	5.30	5939.7	N/A	Cs-137
5	Eu-152		0.000%	13,000	0.00	0.00	0.00	N/A	Eu-152
6	H-3		0.000%	120,000,000	0.00	0.00	Not Detectable	N/A	H-3
7	Ni-63	1.21E-02	1.122%	1,800,000	72.67	0.00	Not Detectable	N/A	Ni-63
8	Pu-238	1.87E-04	0.017%	30	1.12	0.94	N/A	1.12	Pu-238
9	Pu-239	2.24E-03	0.208%	28	13.45	12.01	N/A	13.45	Pu-239
10	Pu-241		0.000%	880	0.00	0.00	Not Detectable	N/A	Pu-241
11	Sr-90	1.49E-03	0.138%	8,700	8.95	0.03	8.95	N/A	Sr-90
			100.000%		6475	25.0	6381	22	
					Maximum Permissible dpm/100 cm^2				

ATTACHMENT 5.5

Table 6

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

SNEC AL	75%	Total Activity Limit DCGLw		Administrative Limit	
		5.74	pCi/g	4.31	pCi/g

SAMPLE NUMBER(s)⇒ SSGS SUMPS AND PIPING

Cs-137 Limit		Cs-137 Administrative Limit	
5.25	pCi/g	3.93	pCi/g

19.06%	25.0	mrem/y TEDE Limit
2.45%	4.0	mrem/y Drinking Water (DW) Limit

☑ Check for 25 mrem/y

	Isotope	Sample Input (pCi/g, uCi, % of Total, 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	0.001	0.108%	9.9	2.3	0.01	0.05	0.01	0.00	0.00	Am-241
2	C-14	0.0665	6.077%	2.0	5.4	0.35	2.71	0.35	0.83	0.05	C-14
3	Co-60	0.0104	0.950%	3.5	67.0	0.05	0.42	0.05	0.07	0.00	Co-60
4	Cs-137	1.0000	91.381%	6.6	397	5.25	40.81	5.25	3.79	0.01	Cs-137
5	Eu-152		0.000%	10.1	1440	0.00	0.00	0.00	0.00	0.00	Eu-152
6	H-3		0.000%	132	31.1	0.00	0.00	0.00	0.00	0.00	H-3
7	Ni-63	0.0123	1.124%	747	19000	0.06	0.50	0.06	0.00	0.00	Ni-63
8	Pu-238	0.0002	0.017%	1.8	0.41	0.00	0.01	0.00	0.00	0.00	Pu-238
9	Pu-239	0.0023	0.206%	1.6	0.37	0.01	0.09	0.01	0.04	0.02	Pu-239
10	Pu-241		0.000%	86	19.8	0.00	0.00	0.00	0.00	0.00	Pu-241
11	Sr-90	0.0015	0.137%	1.2	0.61	0.01	0.06	0.01	0.03	0.01	Sr-90
		1.09E+00	100.000%			5.74	44.65	5.74	4.766	0.098	
						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 *not % of Total.*		

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