FirstEnergy

SNEC CALCULATION COVER SHEET

CALCULATION DESCRIPTION

Calculation Number	Revision Number	Effective Date	Page Number
E900-04-010	0	6/17/04	1 of 20

Subject

Assessment of E900-03-014, Rev 0, "Shonka Line Shack & Warehouse/Garage Pads FSS Survey Design"

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	P. Donnachie/	Date	6/17/04
Technical Reviewer	R. Holmes/	Date	6/17/04
Additional Review	A. Paynter/	Date	17 June 04
Additional Review		Date	
SNEC Management Approval		Date	

1.0 PURPOSE

1.1 The purpose of this calculation is to review the survey design guidance and subsequent FSS surveys performed by SRA in the Penelec Line Shack. The original survey design was documented as SNEC Calculation #E900-03-014, Reference 3.1. The Warehouse and Garage Pads have been excluded from this assessment since these areas may require re-survey work after trailers and materials are removed. The actual FSS survey results are documented in Reference 3.2 and summarized in Attachment 3.

1.2 Shonka Research Associates (SRA) conducted scan surveys using procedures reviewed and approved by SNEC. These procedures were part of Reference 3.1. The original surveys were covered under Survey Request 0081 (Attachment 2).

2.0 SUMMARY OF RESULTS

2.1 The following information was used to conduct the applicable FSS for this survey design:

2.1.1 The Line Shack area was divided into a total of six (6) survey units, i.e. five (5) Class 2 and one (1) Class 3. In the original design (Reference 3.1) only five survey units were considered. The reason for this was the ceiling was included in the same survey unit (LS2-1) with the upper walls above 2 meters. During the performance of the FSS survey the ceiling was split out as its own survey unit (i.e. LS2-2). However, the total surface area remained unchanged for both areas.

2.1.2 The Line Shack Survey Unit (SU) Numbers are as follows:

SU Number	Area Description	Classification	Total Area (m^2)
LS1-1	Floors	2	290
LS1-2	Interior walls up to 2 meters	2	177
LS2-1	Interior upper walls above 2 meters	2	191
LS2-2	Ceiling	2	412
LS3	Exterior walls	3	343
LS4	Roof	2	324

2.1.3 Based on the summary results in Attachment 3 all scan results for the Line Shack were less than 10% of the $DCGL_w$ with the exception of the roof which was 21% of the $DCGL_w$. Attachment 4 provides a written analysis as to why the roof background is elevated. **Based on these results static measurements do not need to be performed.**

2.1.4 Scan coverage for Class 2 & 3 areas was performed for 10-50% of the total area described in the above table. Attachment 3 provides acceptable information as to how much of each survey unit area was scanned.

2.1.5 Scan speed was set in accordance with SRA procedures and the SNEC MDC_{scan} value calculated for structure surfaces.

2.1.6 The **gross activity surface $DCGL_w$** for this assessment is determined to be **44,434 dpm/100 cm²** based on the new mix calculation logic provided in Attachment 1. The 75% administrative gross activity $DCGL_w$ limit is **33,325 dpm/100 cm²**. The Cs-137 DCGLw is calculated to be **19,834 dpm/100 cm²**.

2.1.7 The maximum $DCGL_{emc}$ will use the Co-60 surface area factor for a 1-m² area equal to 10.1.

2.1.8 Based on the SNEC LTP section 5.5.2.5 the **MDC_{scan}** value for this design that SRA must achieve is **14,875 dpm/100 cm²**, based on achieving 75% of the Cs-137 $DCGL_w$ (i.e. 19,834 dpm/100 cm²).

2.1.9 All surveys were performed with SRA's Surface Contamination Monitor (SCM). The SCM utilized large-area position-sensitive proportional counters (PSPCs) in the rolling (scanning) modes. The PSPCs used with the SCM were typically either 90 cm or 180 cm in active length.

2.1.10 In rolling mode, the SCM logs information in 25 cm² bins by logging data for each 5 cm width of the PSPC and for every 5 cm of forward travel. A precision wheel encoder measured the distance the SCM traveled. Corner mode data was recorded in a similar manner, except the wheel encoder was replaced with a computer-based timer and a "speed" parameter was set so that the desired count time corresponds to a "distance" of 5 cm. In either mode, data are recorded in 25 cm² pixels over the entire surface surveyed, meaning the SCM records 400 measurements for every square meter it covered. When SCM data is analyzed, the software algorithm considers each 25 cm² measurement as ¼th of four separate 100 cm² areas. This technique ensures that the highest-activity 100-cm² area is identified because it is not sensitive to registration of the detector as may occur using systems that employ multiple, non-overlapping detectors. The fact the SCM records 400 measurements for every square meter it covers allows data to be evaluated via statistical methods that consider the distribution of activity on a surface in addition to its average concentration.

The PSPCs were calibrated using a traceable, wide-area reference standard provided by GPU. This calibration source used was a Cs-137 source with serial number GO536. The efficiency applied to 100 cm² data is calculated as:

Total 100cm² Efficiency= $\varepsilon_{T100} = \varepsilon_i * \varepsilon_s$

Where	ε_{T100},	Total Efficiency
	ε_i,	Instrument Efficiency
	ε_s,	Source Efficiency

The Source Efficiency was chosen per ISO 7503 Part 1 Sec 4.2.3.2 to be 50%. The Instrument Efficiency is the net count rate the SCM reports for a 100 cm^2 area divided by the decay corrected emission rate per 100 cm^2 of the calibration source.

2.1.11 The following table provides the data between the original design (i.e. E900-03-014) and the new $DCGL_w$ derived using the new mix logic calculation.

Comparison Table

Parameter	E900-03-014 Value	E900-04-00 Value
Gross $DCGL_w$ (dpm/100cm^2)	28,000 (NRC default for Cs-137)	44,434
Gross $DCGL_w$ (75% AL) (dpm/100cm^2)	21,000	33,325
Cs-137 $DCGL_w$ (dpm/100cm^2)	21,000	19,834
MDC_{scan} (dpm/100cm^2)	10,500	14,875
Area Factor (1 m^2)	11 (Cs-137)	10.1 (Co-60)
$DCGL_{emc}$ (dpm/100cm^2)	231,000 (Cs-137)	200,323 (Co-60)
Nuclide mix	Cs-137 (100%)	Cs-137 (59.5%) H-3 (39.5%) Co-60/Sr-90 (<1%)
Number of Survey Units	5	6

3.0 REFERENCES

3.1 SNEC Calculation #E900-03-014, Revision 0, "Shonka Line Shack & Warehouse/Garage Pads FSS Survey Design".

3.2 Shonka Report – "Final Report for SCM Survey of Saxton Nuclear Experimental Corporation," October 17, 2003.

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

4.0 ASSUMPTIONS AND BASIC DATA

4.1 SRA procedures were used to perform scan surveys.

4.2 Remediation History

There was no remediation required inside or outside the Penelec Line Shack with the exception of the attic. However, this area is to be covered under a separate design. Demolition of the SNEC Warehouse and Garage was performed in 2002. Only the foundation pads for these buildings remained after demolition.

4.3 The MDC_{scan} calculation is determined based on LTP section 5.5.2.5.

5.0 CALCULATIONS

- The required DCGLw = 44,434 x 0.75 = 33,325 dpm/100 cm^2.
- The MDC_{scan} = 19,834 x 0.75 = 14,875 dpm/100 cm^2.
- The required Cs-137 DCGLw = 33,325 x 0.0.5951 = 19,834 dpm/100 cm^2.
- $DCGL_{emc}$ for 1 m^2 = 19,834,000 X AF of 10.1 = 200,323 dpm/100 cm^2.

6.0 APPENDICES

6.1 **Attachment 1** - DCGL Calculation Logic-Line Shack, Warehouse & Garage Pads

6.2 **Attachment 2** - Survey Request (SR) #0081, "Penelec Line Shack," July 13 2003.

6.3 **Attachment 3** - Shonka Survey Results on Line Shack.

6.4 **Attachment 4** – Results of Investigation of Line Shack Roof Elevated Count Rate.

Attachment 1

DCGL Calculation Logic-Line Shack, Warehouse & Garage Pads

I. **Survey Unit:** Line Shack, Warehouse & Garage Pads

Description: The purpose of this calculation is to determine a representative isotopic mix for the Line Shack building and the Warehouse & Garage concrete pads from available sample analyses. The effective surface area $DCGL_w$s is then determined from the mean percent of applicable samples. The Line Shack consists of interior floors, walls and ceilings and exterior walls and rooftop. The Warehouse and Garage consist of concrete pads with various sump or pipe chase areas within the pad.

II. **Data Selection Logic Tables:** The radionuclide selection logic and subsequent DCGL calculations are provided in five (5) tables. These tables were developed using Microsoft Excel. The CV Soil and Boulder radionuclide mix tables were used to determine a representative $DCGL_w$ for the Line Shack, Warehouse and Garage areas. This is based on the assumption that soil/boulder radioactivity became airborne, as a result of site wind erosion, and therefore impacted these areas. 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 soil media that was 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 MDA values are noted in the gray shaded fields.

Table 2: Decayed Listing – This table decays the data from Table 1. Half-life values (days) are listed above each respective nuclide column. Samples are decayed from the respective analysis date to January 15, 2004. Positive results are denoted in a yellow background field while MDA values are noted in the gray shaded fields.

Table 3: Decayed Listing of Positive Nuclides & MDAs Removed – This table provides the best overall representation of the data. Non-positive nuclide columns have been removed as well as all the MDA values. Therefore, 11 nuclides have been reduced to four (4).

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 area $DCGL_w$ 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 (e.g. Sr-90) 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 Table 4 only the "mean % of total" values are used as input to the "Effective DCGL Calculation Spreadsheet" as illustrated in Table 5.

Table 5: Effective DCGL Calculator for Cs-137 (dpm/100 cm2) – This table provides the surface gross activity $DCGL_w$ calculation results from data derived from Table 4.

III. **Summary** – The Line Shack, Warehouse, and Garage surface materials consist of concrete, metal and/or wallboard. Therefore the release limit is based on the surface $DCGL_w$. Using the above data selection logic tables the calculated gross activity $DCGL_w$ is 44,434 dpm/100 cm^2. This value will 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)

	Unit / Sample No.	Location/Description	U-3	Sr-90	Co-60	Cs-137	Am-241	Pu-238	Pu-239	Pu-241	C-14	Ni-63	Eu-152
1	CV Tunnel	CV Tunnel Sediment Composite OL1	9.60E+00	9.87E+00	1.29E+00	1.25E+03	1.88E-01	5.58E-01	2.29E-01	4.47E+01	4.34E+00	4.92E+00	1.30E-01
2	SHSL-99219	Subsurface Sample 929.10 @ AY-129, OL1			7.80E-02	5.50E-01							
3	SHSL-1063	North CV Yard Soil BA-127, 0-12" El. Sample # 5, OL1	4.56E+00	5.21E-02	1.52E-02	8.86E-01	9.61E-02	4.68E-02	3.27E-02	3.77E+00	2.10E-01	1.99E+01	5.25E-02
4	SHSL-1080	North CV Yard Soil AY-127, 0-12" El. Sample # 3, OL1	3.83E+00	6.95E-02	3.32E-02	1.29E+00	9.93E-02	1.29E-01	5.80E-02	4.91E+00	2.10E-01	7.54E+00	6.28E-02
5	SHSL-1115	North CV Yard Soil AY-126, 0-12" El. Sample # 2, OL1	4.08E+00	5.36E-02	2.43E-02	1.83E+00	2.46E-01	1.38E-01	4.07E-02	4.21E+00	2.13E-01	7.60E+00	5.71E-02
6	SHSL-1122	North CV Yard Soil AY-125, 0-12" El. Sample # 2, OL1	3.44E+00	5.29E-02	2.79E-02	4.77E+00	1.83E-01	8.54E-02	4.80E-02	5.66E+00	2.06E-01	8.75E+00	6.62E-02
7	SHSL-1130	North CV Yard Soil AX-129, 0-12" El. Sample # 5, OL1	4.59E+00	6.48E-02	2.96E-02	2.26E+01	1.49E-01	8.56E-02	1.21E-02	3.56E+00	2.31E-01	1.34E+01	9.09E-02
8	SHSL-1172	North CV Yard Soil AZ-129, 0-12" El. Sample # 5, OL1	2.98E+00	7.15E-02	3.50E-02	2.55E+00	1.64E-01	7.46E-02	6.46E-02	5.27E+00	2.15E-01	1.26E+01	7.34E-02
9	SHSL-1278	AA-129, 3-5, Soil, CV Lt. Side, 8' From CV, 0.00' El., OL1	1.13E+01	2.00E-02	1.00E-02	2.31E+01	3.70E-02	7.08E-03	7.80E-03	2.10E+00	1.53E+00	6.58E+00	1.80E-02
10	SHSL-1281	AA-129, 3-5, Soil, CV Tunnel East 8' From CV, 0.00' El. OL1	1.15E+01	3.00E-02	1.00E-02	4.30E+00	3.19E-02	1.66E-02	7.80E-03	1.91E+00	4.00E+00	7.78E+00	4.00E-02
11	SHSL-2040	Anubis Work A-2, 0 to 10' Depth, OL1	2.00E+00	3.14E-02	1.00E-01	6.00E-01	9.70E-03	1.33E-02	1.10E-02	1.87E+00	1.03E-01	1.77E+00	
13	SHSL-2071	CV Area - East Yard Dirt Pile - Middle, 1-2 Way Up, OL1		3.00E-02	7.00E-02	5.60E-01							
14	SHSL-2072	CV Area - East Yard Dirt Pile - Bottom (pile top corner), OL1		3.00E-02	6.00E-02	1.00E-01							
15	SHSL-2140	East CV Yard, Soil Pile @ 8' on West Side (0" Depth), OL1	1.49E+00	1.29E-02	1.40E-02	8.25E-01	7.00E-03	5.00E-03	5.00E-03	3.69E-01	8.63E-02	3.41E+00	3.00E-02
16	SHSL-2142	Soil Pile, CV Yard, Three Feet on East Side, SP 17, OL1		2.59E-02	7.00E-02	6.00E-01							
17	SHSL-2145	East CV Yard, Soil Pile @ 7' on East Side (0" Depth), OL1	1.90E+00	1.78E-02	1.30E-02	1.26E+00	4.00E-03	5.00E-03	5.00E-03	3.76E-01	6.30E-02	3.59E+00	3.00E-02
18	SHSL-2148	Soil Pile CV Yard, Six Feet on East Side, SP-17, OL1		2.97E-02	8.00E-02	3.00E-01							
19	SHSL-2153	East CV Yard, Soil Pile @ Top (0" Depth), OL1	1.54E+00	4.30E-02	2.30E-02	3.00E-01	3.00E-03	5.00E-03	5.00E-03	3.43E-01	8.73E-02	4.18E+00	5.50E-02
21	SHSL-2162	CV Yard Soil - West Side AP1-7, OL1	2.22E+00	3.25E-02	5.00E-02	9.00E-01	1.76E-02	6.71E-02	2.02E-02				
22	SHSL-2163	CV Yard Soil - West Side AP1-7, OL1	2.23E+00	3.16E-02	5.00E-02	5.00E-01	2.21E-02	6.31E-02	3.68E-02				
23	SHSL-2169	CV Yard Soil - West Side AP1-7, OL1	2.24E+00	2.77E-02	7.00E-02	3.90E+00	2.77E-02	4.10E-02	3.04E-02				

TABLE 2 - Decayed Listing (pCi/g)

			T1/2	T1/2	T1/2	T1/2	T1/2	T1/2	T1/2	T1/2	T1/2	T1/2	T1/2	Decay Date	
			4468.27	10446.95	1925.27275	11019.5325	157861.05	32050.6875	8913847.75	5.2516	2032812.5	36561.125	4967.4	January 16, 2002	
	Unit / Sample No.	Location/Description	U-3	Sr-90	Co-60	Cs-137	Am-241	Pu-238	Pu-239	Pu-241	C-14	Ni-63	Eu-152	Analysis Date	DT (d)
1	CV Tunnel	CV Tunnel Sediment Composite OL1	7.97E+00	9.01E+00	8.55E-01	1.17E+03	1.75E-01	5.37E-01	2.28E-01	3.88E+01	1.34E+00	3.94E+00	1.12E-01	February 26, 2001	1065
2	SHSL-99219	Subsurface Sample 929.10 @ AY-129, OL1			4.85E-02	5.36E-01								November 17, 1999	1520
3	SHSL-1063	North CV Yard Soil BA-127, 0-12" El. Sample # 5, OL1	4.20E+00	5.19E-02	1.51E-02	8.55E-01	9.59E-02	4.62E-02	3.27E-02	3.50E+00	2.10E-01	1.88E+01	4.85E-02	June 27, 2002	567
4	SHSL-1080	North CV Yard Soil AY-127, 0-12" El. Sample # 3, OL1	2.78E+00	6.65E-02	2.71E-02	1.24E+00	9.91E-02	1.26E-01	5.08E-02	4.65E+00	2.10E-01	7.48E+00	7.65E-02	June 28, 2002	566
5	SHSL-1115	North CV Yard Soil AY-126, 0-12" El. Sample # 2, OL1	4.07E+00	5.15E-02	1.98E-02	1.74E+00	2.39E-01	1.36E-01	4.07E-02	3.91E+00	2.10E-01	7.52E+00	5.20E-02	June 29, 2002	565
6	SHSL-1122	North CV Yard Soil AY-125, 0-12" El. Sample # 2, OL1	3.15E+00	5.10E-02	2.28E-02	4.60E+00	1.83E-01	8.83E-02	4.08E-02	3.42E+00	2.06E-01	8.66E+00	7.37E-02	June 29, 2002	565
7	SHSL-1130	North CV Yard Soil AX-129, 0-12" El. Sample # 5, OL1	4.50E+00	6.24E-02	2.44E-02	2.18E+01	1.49E-01	8.46E-02	1.21E-02	3.30E+00	2.31E-01	1.32E+01	9.15E-02	July 3, 2002	561
8	SHSL-1172	North CV Yard Soil AZ-129, 0-12" El. Sample # 5, OL1	2.71E+00	6.89E-02	2.86E-02	2.50E+00	1.64E-01	7.17E-02	6.46E-02	4.89E+00	2.15E-01	1.25E+01	6.79E-02	July 3, 2002	561
9	SHSL-1278	AA-129, 3-5, Soil, CV Lt. Side, 8' From CV, 0.00' El., OL1	9.84E+00	1.88E-02	7.72E-03	2.18E+01	3.59E-02	6.86E-03	7.00E-03	1.87E+00	3.93E+00	6.53E+00	6.17E-02	July 26, 2001	903
10	SHSL-1281	AA-129, 3-5, Soil, CV Tunnel East 8' From CV, 0.00' El. OL1	1.00E+01	2.83E-02	7.22E-03	4.14E+00	3.09E-02	1.57E-02	7.00E-03	1.69E+00	4.00E+00	7.65E+00	3.53E-02	July 26, 2001	903
11	SHSL-2040	Anubis Work A-2, 0 to 10' Depth, OL1	1.79E+00	3.00E-02	7.77E-02	5.74E-01	9.75E-03	1.31E-02	1.10E-02	1.71E+00	1.03E-01	1.73E+00		February 13, 2002	701
13	SHSL-2071	CV Area - East Yard Dirt Pile - Middle, 1-2 Way Up, OL1		2.87E-02	5.68E-02	5.37E-01								March 6, 2002	680
14	SHSL-2072	CV Area - East Yard Dirt Pile - Bottom (pile top corner), OL1		2.87E-02	4.78E-02	9.58E-02								March 6, 2002	680
15	SHSL-2140	East CV Yard, Soil Pile @ 8' on West Side (0" Depth), OL1	1.75E+00	1.16E-02	1.17E-02	7.99E-01	6.50E-03	4.75E-03	5.00E-03	3.45E-01	8.60E-02	3.37E+00	2.80E-02	August 30, 2002	503
16	SHSL-2142	Soil Pile, CV Yard, Three Feet on East Side, SP 17, OL1		2.85E-02	5.81E-02	5.81E-01								August 13, 2002	520
17	SHSL-2145	East CV Yard, Soil Pile @ 7' on East Side (0" Depth), OL1	1.76E+00	1.64E-02	1.08E-02	1.22E+00	3.94E-03	4.95E-03	5.00E-03	3.52E-01	6.30E-02	3.65E+00	3.54E-02	August 30, 2002	503
18	SHSL-2148	Soil Pile CV Yard, Six Feet on East Side, SP-17, OL1		2.87E-02	6.63E-02	2.90E-01								August 13, 2002	520
19	SHSL-2153	East CV Yard, Soil Pile @ Top (0" Depth), OL1	1.79E+00	4.16E-02	1.92E-02	2.91E-01	2.95E-03	4.95E-03	5.00E-03	3.21E-01	8.70E-02	4.14E+00	4.75E-02	August 30, 2002	503
21	SHSL-2162	CV Yard Soil - West Side AP1-7, OL1	2.18E+00	3.22E-02	4.81E-02	8.94E-01	1.76E-02	6.69E-02	2.02E-02					October 2, 2002	305
22	SHSL-2163	CV Yard Soil - West Side AP1-7, OL1	2.19E+00	3.16E-02	4.81E-02	4.97E-01	2.21E-02	6.30E-02	3.68E-02					October 2, 2002	305
23	SHSL-2169	CV Yard Soil - West Side AP1-7, OL1	2.20E+00	2.75E-02	6.74E-02	3.87E+00	2.77E-02	4.29E-02	3.04E-02					October 2, 2002	305

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

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

	SNEC Sample No	Location/Description	H-3	Sr-90	Co-60	Cs-137	Total pCi/g
1	CV Tunnel	CV Tunnel Sediment Composite, OL1		9.01E+00	8.59E-01	1.17E+03	1178.89
2	SX9SL99219	Subsurface Sample 829 (0-6"), AY-128, OL1				5.36E-01	0.54
3	SXSL1063	North CV Yard Soil BA-127, 812' El, Sample # 5, OL2	4.20E+00			8.55E-01	5.05
4	SXSL1089	North CV Yard Soil AY-127, 810' El, Sample # 3, OL1	2.78E+00			1.24E+00	4.02
6	SXSL1115	North CV Yard Soil AY-126, 804' El, Sample # 2, OL1	4.47E+00			1.74E+00	6.21
6	SXSL1122	North CV Yard Soil AY-129, 798' El, Sample # 2, OL1	3.15E+00			4.60E+00	7.76
7	SXSL1130	North CV Yard Soil AX-129, 803' El, Sample # 4, OL1	4.58E+00		2.44E-02	2.18E+01	26.42
8	SXSL1132	North CV Yard Soil AZ-130, Sample # 5, OL1	2.73E+00			2.50E+00	5.23
9	SXSL1270	AX-129, 3-3, Soil, CV SE Side 6' From CV, 800' El., OL1				2.18E+01	21.82
10	SXSL1281	AX-128, 3-1, Soil, CV Tunnel East 5' From CV, 800' El, OL1				4.14E+00	4.14
11	SXSL2849	Anulus Well, A-2, 5 to 10' Depth, OL1				5.74E-01	0.57
13	SXSL2871	CV Area - East Yard Dirt Pile - Middle, 1/2 Way Up, OL1				5.37E-01	0.54
14	SXSL2872	CV Area - East Yard Dirt Pile - Bottom (also top center), OL1				9.58E-02	0.10
15	SXSL3140	East CV Yard, Soil Pile @ 6' on West Side (6" Depth), OL1				7.99E-01	0.80
16	SXSL3142	Soil Pile, CV Yard, Three Feet on East Side, SR-37, OL1				5.81E-01	0.58
17	SXSL3145	East CV Yard, Soil Pile @ 3' on East Side (6" Depth), OL1				1.22E+00	1.22
18	SXSL3149	Soil Pile, CV Yard, Six Feet on East Side, SR-37, OL1				2.90E-01	0.29
19	SXSL3163	East CV Yard, Soil Pile @ Top (6" Depth), OL1				2.91E-01	0.29
21	SXSL4142	CV Yard Soil - West Side, AP1-7, OL1				8.94E-01	0.89
22	SXSL4143	CV Yard Soil - West Side, AP1-7, OL1				4.97E-01	0.50
23	SXSL4149	CV Yard Soil - West Side, AP1-7, OL1			6.74E-02	3.87E+00	3.94

TABLE 4 - Mean Percent of Total for Positive Nuclides

	SNEC Sample No	Location/Description	H-3	Sr-90	Co-60	Cs-137	Total
1	CV Tunnel	CV Tunnel Sediment Composite, OL1		0.76%	0.07%	99.16%	100.0%
2	SX9SL99219	Subsurface Sample 829 (0-6"), AY-128, OL1				100.00%	100.0%
3	SXSL1063	North CV Yard Soil BA-127, 812' El, Sample # 5, OL2	83.07%			16.93%	100.0%
4	SXSL1089	North CV Yard Soil AY-127, 810' El, Sample # 3, OL1	69.04%			30.96%	100.0%
6	SXSL1115	North CV Yard Soil AY-126, 804' El, Sample # 2, OL1	72.02%			27.98%	100.0%
6	SXSL1122	North CV Yard Soil AY-129, 798' El, Sample # 2, OL1	40.65%			59.35%	100.0%
7	SXSL1130	North CV Yard Soil AX-129, 803' El, Sample # 4, OL1	17.32%		0.09%	82.59%	100.0%
8	SXSL1132	North CV Yard Soil AZ-130, Sample # 5, OL1	52.22%			47.78%	100.0%
9	SXSL1270	AX-129, 3-3, Soil, CV SE Side 6' From CV, 800' El., OL1				100.00%	100.0%
10	SXSL1281	AX-128, 3-1, Soil, CV Tunnel East 5' From CV, 800' El, OL1				100.00%	100.0%
11	SXSL2849	Anulus Well, A-2, 5 to 10' Depth, OL1				100.00%	100.0%
13	SXSL2871	CV Area - East Yard Dirt Pile - Middle, 1/2 Way Up, OL1				100.00%	100.0%
14	SXSL2872	CV Area - East Yard Dirt Pile - Bottom (also top center), OL1				100.00%	100.0%
15	SXSL3140	East CV Yard, Soil Pile @ 6' on West Side (6" Depth), OL1				100.00%	100.0%
16	SXSL3142	Soil Pile, CV Yard, Three Feet on East Side, SR-37, OL1				100.00%	100.0%
17	SXSL3145	East CV Yard, Soil Pile @ 3' on East Side (6" Depth), OL1				100.00%	100.0%
18	SXSL3149	Soil Pile, CV Yard, Six Feet on East Side, SR-37, OL1				100.00%	100.0%
19	SXSL3163	East CV Yard, Soil Pile @ Top (6" Depth), OL1				100.00%	100.0%
21	SXSL4142	CV Yard Soil - West Side, AP1-7, OL1				100.00%	100.0%
22	SXSL4143	CV Yard Soil - West Side, AP1-7, OL1				100.00%	100.0%
23	SXSL4149	CV Yard Soil - West Side, AP1-7, OL1			1.71%	98.29%	100.0%
		Mean=>	5.57E-01	7.64E-03	6.25E-03	8.40E-01	1.41
		Sigma=>	0.241		0.009	0.284	
		Mean % of Total=>	39.50%	0.54%	0.44%	59.51%	100.00%

Table 5

	Effective DCGL Calculator for Cs-137 (dpm/100 cm^2)					Gross Activity DCGLw		Gross Activity Administrative Limit	
						44434	dpm/100 cm^2	33325	dpm/100 cm^2
	25.0	mrem/y TEDE Limit							
						Cs-137 Limit		Cs-137 Administrative Limit	
	SAMPLE NO(s)=>	Line Shack and Warehouse/Garage Pads				26445	dpm/100 cm^2	19834	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		0.000%	27	0.00	0.00	N/A	0.00	Am-241
2	C-14		0.000%	3,700,000	0.00	0.00	0.00	N/A	C-14
3	Co-60	6.25E-03	0.443%	7,100	196.87	0.69	196.87	N/A	Co-60
4	Cs-137	8.40E-01	59.515%	28,000	26444.68	23.61	26444.7	N/A	Cs-137
5	Eu-152		0.000%	13,000	0.00	0.00	0.00	N/A	Eu-152
6	H-3	5.57E-01	39.500%	120,000,000	17551.45	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		0.000%	28	0.00	0.00	N/A	0.00	Pu-239
10	Pu-241		0.000%	880	0.00	0.00	Not Detectable	N/A	Pu-241
11	Sr-90	7.64E-03	0.542%	8,700	240.75	0.69	240.75	N/A	Sr-90
			100.000%		44434	25.0	26882	0	
					Maximum Permissible dpm/100 cm^2				

Attachment 2

ORIGINAL

SURVEY REQUEST FORM

SR NUMBER	SR-0081	REQUEST DATE	7/16/03	DATE ISSUED	7/21/03
TYPE OF SR	☒ FSS ☐ CHARACTERIZATION ☐ OTHER:				
AREA/LOCATION	Penelec Line Shack				
PURPOSE	The purpose of the SR is to perform the Final Status Survey (FSS) of the Penelec Line Shack. This SR only includes the surface scan surveys that will be performed by Shonka Research Associates (SRA), Inc using a Surface Contamination Monitor (SCM) and Position Sensitive Proportional Counter (PSPC). SNEC personnel will obtain the other required measurements (i.e., static measurements) under a separate SR.				
CALCULATION #	E900-03-014				
SURVEY UNIT #	LS1-1 (Floors)		GRID #	N/A	
SURVEY UNIT #	LS1-2 (Interior Walls up to 2 Meters)		GRID #	N/A	
SURVEY UNIT #	LS2-1 (Interior Upper Walls & Ceiling)		GRID #	N/A	
SURVEY UNIT #	LS3 (Exterior Walls)		GRID #	N/A	
SURVEY UNIT #	LS4 (Roof)		GRID #	N/A	

SAMPLE TYPE

☐ SURFACE SOIL SAMPLE:
☐ SUB-SURFACE SOIL SAMPLE:
☐ SEDIMENT SAMPLE:
☐ CORE SAMPLE:
☐ WATER SAMPLE:
☐ OTHER:

SURVEY TYPE

SURFACE SCAN	☒ BETA ☒ GAMMA ☐ ALPHA	INST. TYPE PROBE TYPE	SCM PSPC	SCAN RATE & DETECTOR DISTANCE FROM SURFACE	Detector scan rate and distance from surface shall be set in accordance with SRA procedures and the MDC_{scan} value required by this SR, which is 10,500 dpm/100cm^2.
SURFACE SCAN	☐ BETA ☐ GAMMA ☐ ALPHA	INST. TYPE PROBE TYPE		SCAN RATE & DETECTOR DISTANCE FROM SURFACE	
STATIC MEASUREMENT	☐ BETA ☐ GAMMA ☐ ALPHA	INST. TYPE PROBE TYPE		COUNT TIME & DETECTOR DISTANCE FROM SURFACE	
STATIC MEASUREMENT	☐ BETA ☐ GAMMA ☐ ALPHA	INST. TYPE PROBE TYPE		COUNT TIME & DETECTOR DISTANCE FROM SURFACE	
OTHER					

Page 1 of 3

ORIGINAL

SR NUMBER	SR-0081	AREA/LOCATION	Penelec Line Shack

SPECIFIC SAMPLING & SURVEYING INSTRUCTIONS / COMMENTS

PREREQUISITES & GENERAL REQUIREMENTS

1. Shonka Research Associates (SRA), Inc personnel must receive Site Access Training, Survey Request Familiarization Training, and Post Remediation Isolation Training before surveying begins.
2. All personnel involved in surveying under this SR must attend a formal and documented initial pre-job briefing. The SR Coordinator and GRCS shall be in attendance. Subsequent briefings will be at the discretion of the GRCS.
3. The survey unit inspection, which was performed to provide input to the FSS Design, showed that all surfaces within this survey unit are relatively clean and dry. Survey Teams shall verify conditions have not changed before performing any surveys. Questions concerning surface preparation should be directed to the responsible Survey Unit Inspector.
4. If survey support work is needed (i.e., moving of equipment, ladders, etc.), contact the D&D Supervisor.
5. **DANGER:** The primary electrical power for the Line Shack enters the building near the east end of the roof. No surveying or personnel access will be permitted near these wires.
6. No remediation may be performed under this SR unless the responsible Survey Designer and SR Coordinator give specific authorization.

   NOTE: The original Survey Design will be void if remediation is performed.
7. The MDC_{scan} value for this SR that must be achieved is 10,500 dpm/100cm^2.
8. All surveying will be performed in accordance with the approved SRA procedures that are attached to the original Survey Design (Calculation Number E900-03-014), which include:
   - SCM Procedure 001 (Revision 6) - Confirmation & Calibration of the Incremental Encoder
   - SCM Procedure 005 (Revision 6) - Requirements for Completion of a Survey Using the SCM
   - SCM Procedure 006 (Revision 4) - Performance of a Position Calibration on a PCPC
   - SCM Procedure 007 (Revision 7) - Source Response Check and Performance Based Check of any PSPC Detector Configuration Installed on the SCM
   - SCM Procedure 008 (Revision 3) - Conduct of Operations for Surveys Using the SCM/SIMS
   - SCM Procedure 011 (Revision 1) - Survey Naming Convention when Using the SCM

   NOTE: These procedures have been incorporated into the Survey Design Package and therefore, may not be modified without specific authorization by SNEC Management.

APPROVAL SIGNATURES

SR COORDINATOR	William Stoner /	DATE	7/17/03
RTR	Robert Holmes /	DATE	7/21/03
SR	N/A	DATE	
CONCURRENCE	N/A	DATE	
RSO APPROVAL	Art Paynter /	DATE	7/21/03

SR CLOSE-OUT

GRCS		DATE	
QAO		DATE	
SR COORDINATOR		DATE	

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ORIGINAL

SURVEY REQUEST CONTINUATION SHEET

SR NUMBER	SR-0081	AREA/LOCATION	Penelec Line Shack

SPECIFIC SAMPLING & SURVEYING INSTRUCTIONS / COMMENTS

SURFACE SCAN MEASUREMENTS FOR BETA/GAMMA

1. Observe and comply with "Prerequisites & General Requirements" section of this SR.
2. Verify that the applicable instrument performance checks (i.e., instrument calibration, source response check (SRC), performance based response (PBR), etc.) have been completed in accordance with SRA procedures.
3. Locate the survey point or area.
4. Obtain surface scan measurements in accordance with SRA procedures. The entire building is a Class 2 area except for the exterior walls (Class 3). The scan coverage for a Class 2 area is at least 50% and 10-50% for a Class 3 area.
5. The surface $DCGL_w$ for this SR is 21,000 dpm/100cm^2 based on the NRC default value for Cs-137 and application of SNEC's practice of applying a 75% administrative limit. Areas greater than the $DCGL_w$ must be identified, documented, marked, and bounded to include an area estimate.

QUALITY CONTROL (QC) MEASUREMENTS

As a minimum, 5% of all scan measurement areas will be re-surveyed using identical methodology contained in this SR. Refer to Section 4.6.2 of SNEC procedure E900-IMP-4520.04.

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Attachment 3

Shonka Survey Results on Line Shack

Survey Unit:	LS1-1 (floors) Class 2				
File SCS#	Survey Average (dpm/100 cm²)	Scan MDC (dpm/100 cm²)	Instrument Efficiency	Survey Coverage (m²)	% of Total Area
7016Z	-189	4550	0.2336	125.28	43%
7039Z	32	1600	0.3695	21.24	7%
			Total	146.52	51%

Survey Unit:	LS1-2 (interior walls < 2 meters) Class 2				
File SCS#	Survey Average (dpm/100 cm²)	Scan MDC (dpm/100 cm²)	Instrument Efficiency	Coverage (m²)	% of Total Area
7010Z	67	1388	0.3664	2.73	2%
7011Z	36	1213	0.3664	7.63	4%
7014Z	98	1424	0.3664	6.02	3%
7040L	-32	1319	0.3695	5.76	3%
7040M	322	2032	0.3695	2.88	2%
7040N	-21	1425	0.3695	1.44	1%
7040O	244	1927	0.3695	2.88	2%
7040P	-113	1230	0.3695	3.42	2%
7040Z	-35	1319	0.3695	5.4	3%
7042L	-117	1244	0.3695	5.22	3%
7042M	-112	1289	0.3695	1.98	1%
7042Z	-72	1271	0.3695	1.62	1%
7044Z	-47	1476	0.3695	3.96	2%
7007Z	-243	2811	0.2521	5.53	3%
7008Z	164	3974	0.2521	7.32	4%
			Total	63.79	36%

Survey Unit:	LS2-1 (interior walls > 2 meters) Class 2				
File SCS#	Survey Average (dpm/100 cm²)	Scan MDC (dpm/100 cm²)	Instrument Efficiency	Coverage (m²)	% of Total Area
7012Z	3	1316	0.3664	7.63	4%
7013Z	9	1359	0.3664	9.45	5%
7043Z	-102	1720	0.3695	13.1	7%
7045Z	27	1643	0.3695	1.65	1%
7009Z	-422	3465	0.2521	9.49	5%
			Total	41.32	22%

Survey Unit	LS2-2 (ceiling) Class 2				
File SCS#	Survey Average (dpm/100 cm²)	Scan MDC (dpm/100 cm²)	Instrument Efficiency	Coverage (m²)	% of Total Area
7017X	36	1590	0.3695	48.87	12%
7017Z	-12	1507	0.3695	66.78	16%
7041Z	201	1880	0.3695	19.44	5%
			Total	135.09	33%

Survey Unit:	LS3 (exterior walls) Class 3				
File SCS#	Survey Average (dpm/100 cm²)	Scan MDC (dpm/100 cm²)	Instrument Efficiency	Coverage (m²)	% of Total Area
7015R	126	3794	0.2336	19.89	6%
7015S	-7	3579	0.2336	22.68	7%
7015Z	-50	3507	0.2336	32.13	9%
			Total	74.7	22%

Survey Unit:	LS4 (roof) Class 2				
File SCS#	Survey Average (dpm/100 cm²)	Scan MDC (dpm/100 cm²)	Instrument Efficiency	Coverage (m²)	% of Total Area
7006Z	4154	10346	0.2336	169.38	52%

Total Survey Coverage (m²)	630.8	36%

Attachment 4

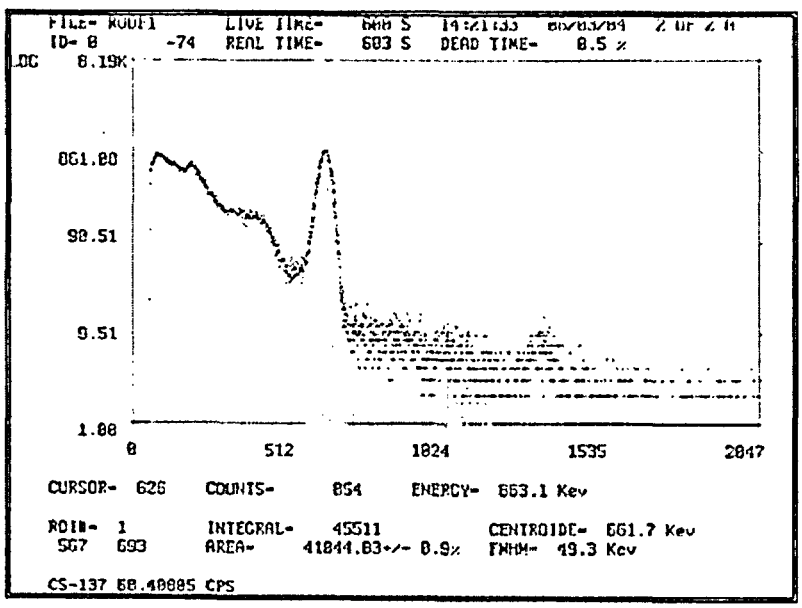
RESULTS OF INVESTIGATION OF LINE SHACK ROOF ELEVATED COUNT RATE

Introduction

On June 3, 2004 the PENELEC Line Shack roof was spot checked with a 2" by 2" sodium iodide connected to a multi-channel analyzer. Two counts were performed One count was taken in a region of the roof that had been replaced with new roofing materials. The other count was taken in an older roof section where Shonka Research Associates (SRA) reported elevated counting rates using a gas flow proportional counter (GFPC). In addition, several areas of the roof were sanded with a medium grade emery cloth to remove a representative sample of the contaminant. The collected materials were then counted on an HPGe laboratory counting system at the SNEC Facility count lab. The results of this work are reported herein.

NaI In-Situ Measurements

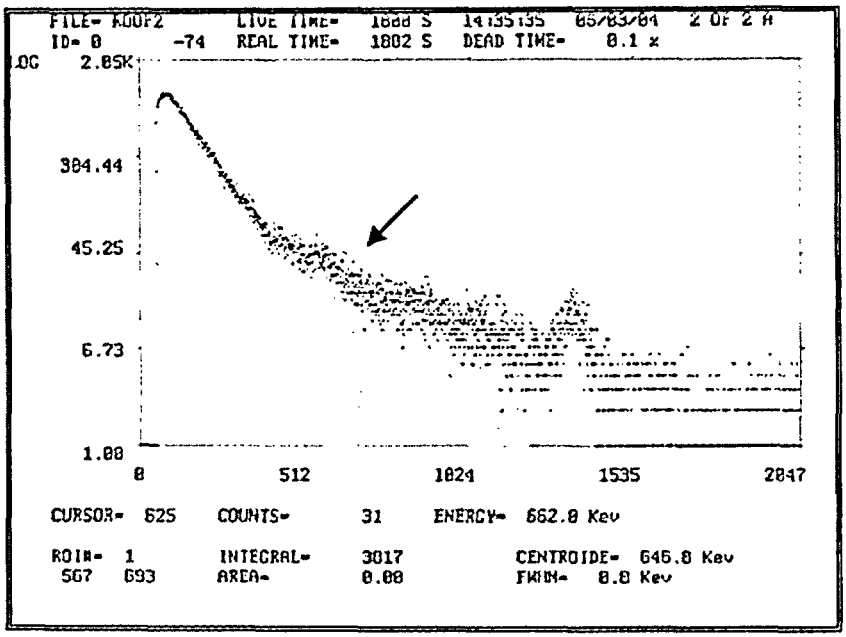
An initial energy check was performed on the NaI counting system using a Cs-137 check source. The source was counted for 600 seconds after adjusting the Cs-137's energy line to the desired region of interest (ROI) and channel width. The results are shown below.



1-6

RESULTS OF INVESTIGATION OF LINE SHACK ROOF ELEVATED COUNT RATE

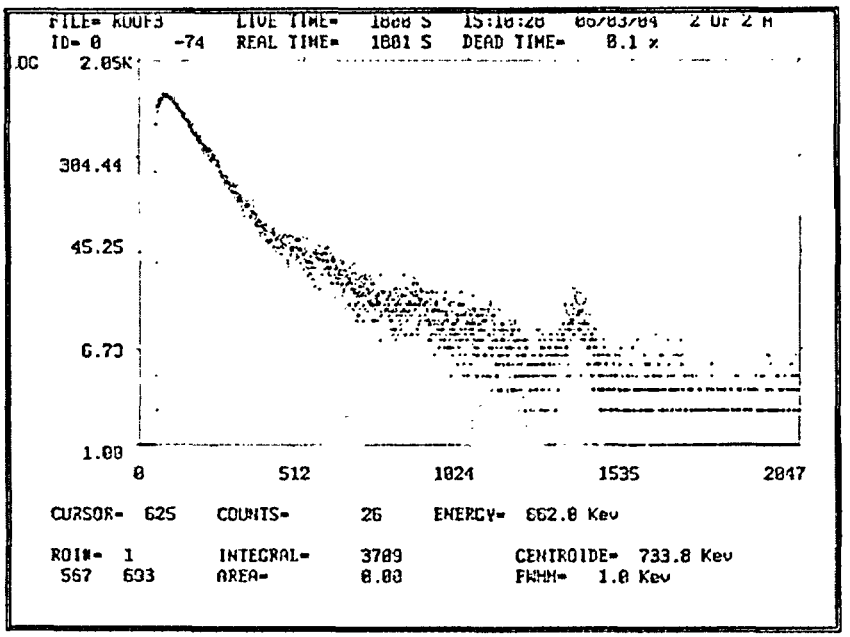
The Cs-137 ROI was set between channels 567 and 693. The next count was in the region of the Line Shack roof that had been replaced and originally showed a low count rate with the SRA GFPC radiation measurement system. This spectrum is shown below:



The integral count in the ROI was 3817 counts for an 1800 second count time. No Cs-137 peak is visible in this spectrum.

The next count was taken in a region of the roof where SRA results indicated an elevated count rate existed using a beta counting GFPC. This spectrum is shown below:

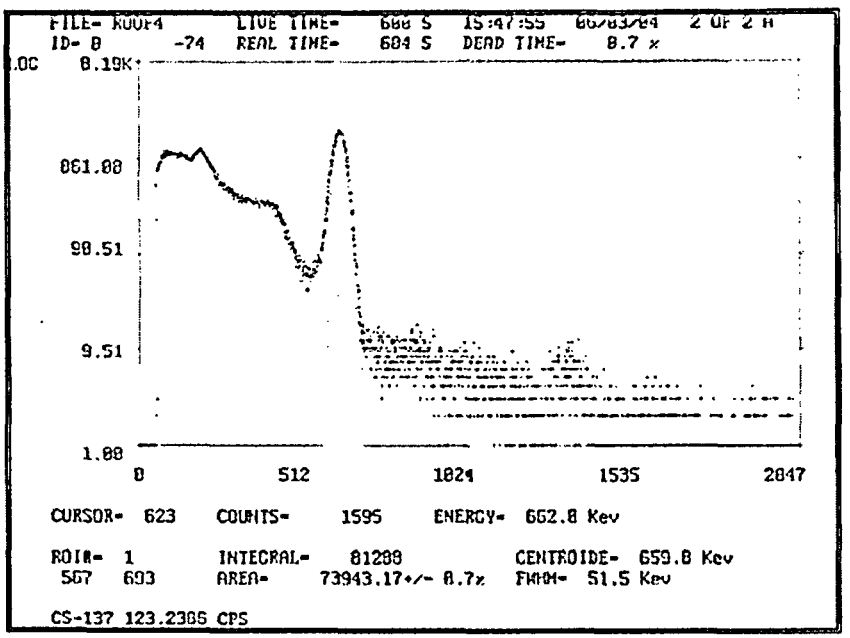
RESULTS OF INVESTIGATION OF LINE SHACK ROOF ELEVATED COUNT RATE



The total number of counts in the Cs-137 ROI was 3709 counts in the suspect area. The uncertainty of these two counts at ± 1 sigma indicates there is no significant difference in the ROI of these two areas. Thus the amount of Cs-137 present in the suspect area of the roof is not discernable without additional data manipulation (spectrum stripping or longer count times, etc).

A final source check shows Cs-137 again present in the appropriate ROI.

RESULTS OF INVESTIGATION OF LINE SHACK ROOF ELEVATED COUNT RATE



Contaminant Sampling

Materials removed from the roof were scanned using an HPGe detector. Several grams of sanding debris were collected and scanned for 20,000 seconds. In addition, a sample of emery cloth was also scanned for 20,000 seconds to pick-up any contribution to the previous spectrum from the emery cloth grit. The results of these scans are shown in the following two inserts.

RESULTS OF INVESTIGATION OF LINE SHACK ROOF ELEVATED COUNT RATE

```
ference Corrected Activity Report    6/3/2004    10:39:08 PM    Page  3

*****  N U C L I D E   I D E N T I F I C A T I O N   R E P O R T  *****

Sample Title:          Smear
Nuclide Library Used: C:\GENIE2K\CAMFILES\150.NLB

                       IDENTIFIED NUCLIDES

Nuclide    Id        Energy    Yield     Activity     Activity
Name    Confidence   (keV)     (%)     (uCi/UNIT)   Uncertainty

CS-137    1.000     661.65*    85.12   1.24618E-005  2.66287E-006

    * = Energy line found in the spectrum.
    @ = Energy line not used for Weighted Mean Activity
    Energy Tolerance :    2.000 keV
    Nuclide confidence index threshold =   0.30
    Errors quoted at  2.000 sigma
```

Sample Debris

Sample results for the sanding debris identified only Cs-137 at an extremely low concentration. Considering the sanded area was about 1.94 square feet, then: 1.24618E-05 uCi/1.94 ft^2 = 0.0069 pCi/cm^2 = ~1.5 dpm/100 cm^2 Cs-137. Even if the removal efficiency is 1/100 the result would not approach the Cs-137 DCGLw for this area. In addition, the emery cloth sample (next page), also shows Cs-137 as a contaminant. Therefore, the origin of the Cs-137 in the line shack roof sanding debris is not entirely certain.

In summary, since the contaminant concentration identified by SRA is obviously a beta or alpha emitting radionuclide, the origin of the count rate is most likely natural occurring background materials that have plated out over time on the older tin roof section, or are part of the make-up of the roofing material.

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RESULTS OF INVESTIGATION OF LINE SHACK ROOF ELEVATED COUNT RATE

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rence Corrected Activity Report    6/3/2004   10:40:06 PM   Page  3

*****************************************************************
**  N U C L I D E   I D E N T I F I C A T I O N   R E P O R T  *****
*****************************************************************

  Sample Title:          Smear
  Nuclide Library Used: C:\GENIE2K\CAMFILES\150.NLB

                        IDENTIFIED NUCLIDES

Nuclide    Id        Energy    Yield     Activity     Activity
Name     Confidence  (keV)      (%)     (uCi/Unit)   Uncertainty

CS-137    1.000     661.65*    85.12   3.31612E-006  1.81996E-006
RA-226    0.994     186.21*     3.28   5.89680E-005  4.32251E-005
TH-232    0.724     338.32*    11.40   4.69978E-005  1.33170E-005
                    463.00      4.40
                    794.70      4.60
                    835.50      1.75
                    911.07*    27.70   4.62304E-005  1.12112E-005
                    969.11*    15.60   2.90825E-005  1.67025E-005

    * = Energy line found in the spectrum.
    @ = Energy line not used for Weighted Mean Activity
    Energy Tolerance :     2.000 keV
    Nuclide confidence index threshold =    0.30
    Errors quoted at  2.000 sigma
```

Emory Cloth

6-6