Final Status Survey Report

Saxton Nuclear Experimental Corporation

Penelec Line Shack

Prepared by GPU Nuclear, Inc.

June 2004

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Executive Summary

This report presents the results and conclusions of the Final Status Survey (FSS) conducted by GPU Nuclear, Inc. and Shonka Research Associates on the Penelec Line Shack, located next to the Saxton Nuclear Experimental Corporation (SNEC) property. This FSS report provides the summary results of surface measurements taken on the aforementioned building. The FSS for this area was completed in July 2003.

This FSS was performed in accordance with the SNEC License Termination Plan (LTP). The Line Shack was divided into six (6) survey units. Each survey unit was comprised of either building wall, floor, ceiling and/or roof surfaces. Five (5) of the six Line Shack survey units were classified as Class 2, with the exception of the exterior walls, which were classified as Class 3. Survey data was collected from each survey unit according to data collection requirements specified in the FSS design criteria. The following areas represent 1,737 m^2 of total building surface areas. Since these are Class 2 and 3 areas, approximately 10-50% of the total surface area was surveyed. The measured surface areas are listed below with the percentage of total surface area denoted in parenthesis.

1. Scan measurements were performed by SRA on approximately 146.5 m^2 (51% of 290 m^2) of interior floor areas.
2. Scan measurements were performed by SRA on approximately 53.8 m^2 (30% of 177 m^2) of interior walls from the floor up to 2 meters.
3. Scan measurements were performed by SRA on approximately 41.3 m^2 (22% of 191 m^2) of interior upper walls above 2 meters.
4. Scan measurements were performed by SRA on approximately 135.1 m^2 (33% of 412 m^2) of the ceiling.
5. Scan measurements were performed by SRA on approximately 74.7 m^2 (22% of 343 m^2) of exterior walls.
6. Scan measurements were performed by SRA on approximately 169.4 m^2 (52% of 324 m^2) of the roof.

Results of the above measurements were less than the applicable action level or $DCGL_w$ value for each of the respective survey units. The collected FSS data demonstrate that each survey unit meets the radiological criteria for unrestricted use specified in 10 CFR 20.1402. Based on the results of the Penelec Line Shack final status survey, GPU Nuclear, Inc. concludes that this area, as described in this report, meet the NRC requirements for release to unrestricted use.

1.0 Purpose and Scope

This report presents the results and conclusions of the final status survey performed by Shonka Research Associates, Inc. on the following areas:

1. Line Shack floor.
2. Line Shack interior walls from floor up to 2 meters.
3. Line Shack interior upper walls above 2 meters.
4. Line Shack ceiling.
5. Line Shack exterior walls.
6. Line Shack roof.

These surveys provide the information required by 10 CFR 50.82(a)(11) and SNEC's License Termination Plan (LTP) to demonstrate that these areas meet the radiological criteria for unrestricted use specified in 10 CFR 20.1402.

Note:

The FSS survey for the Line Shack attic had not been completed at the time of this report. The FSS measurement results for this Class 2 area will be submitted in a subsequent FSS report.

The Line Shack has sheet metal walls, steel roofing material and a poured concrete interior floor. Other materials including masonite, cinderblocks, tile and miscellaneous painted surfaces which were encountered in the radiological surveys. All surveys were performed with SRA's Surface Contamination Monitor (SCM). The roof and interior ceiling were accessed from a mechanical lift (Genie). For exterior walls, the SCM was rolled on plywood to assure a constant speed and height.

2.0 Final Status Survey Designs

2.1 Description of Survey Units

2.1.1 Line Shack Interior Walls and Floor

There are four (4) Class 2 survey units specified inside the Line Shack. The four survey units (LS1-1, LS1-2, LS2-1, and LS2-2) cover the floors, interior walls up to 2 meters and interior walls above 2 meters and the ceiling.

The total area for the three survey units is approximately **1070 m^2**. A short description of each survey unit is included below.

1. Survey unit **LS1-1** is composed of portions of the Line Shack floor. This survey unit is approximately **290 m^2** in total area.
2. Survey unit **LS1-2** is composed of portions of the Line Shack's interior walls from the floor up to 2 meters. This survey unit is approximately **177 m^2** in total area.
3. Survey unit **LS2-1** is composed of portions of the Line Shack's upper interior walls above 2 meters. This survey unit is approximately **191 m^2** in total area.
4. Survey unit **LS2-2** is composed of portions of the Line Shack's ceiling. This survey unit is approximately **412 m^2** in total area.

2.1.2 Line Shack Exterior Walls and Roof

There are two (2) survey units specified for outside the Line Shack. The exterior walls survey unit (LS3) is a Class 3 area and the roof survey unit (LS4) is classified as a Class 2 area.

The total area for the two survey units is approximately **667 m^2**. A short description of each survey unit is included below.

1. Survey unit **LS3** is composed of portions of the Line Shack exterior walls. This survey unit is approximately **343 m^2** in total area.
2. Survey unit **LS4** is composed of portions of the Line Shack's roof. This survey unit is approximately **324 m^2** in total area.

2.2 Site Release Criteria

The site release criteria applied to the Line Shack correspond to the radiological dose criteria for unrestricted use per 10 CFR 20.1402. The dose criteria is met "if the residual radioactivity that is distinguishable from background radiation results in a Total Effective Dose Equivalent (TEDE) to an average member of the critical group that does not exceed 25 mrem/yr, including that from groundwater sources of drinking water, and that the residual radioactivity has been reduced to levels that are as low as reasonably achievable (ALARA)."

Levels of residual radioactivity that correspond to the allowable dose to meet the site or survey unit release criteria were derived by analyses using the building occupancy (surface area) scenario. The dose modeling for this scenario is explained in the SNEC LTP, Chapter 6. The derived concentration guideline levels ($DCGL_w$s) listed in the LTP form the basis for satisfying the site release criteria.

Radioactivity sample results for surfaces inside/outside the Line Shack were compared to calculated gross activity $DCGL_w$s. These gross activity $DCGL_w$s were developed using the

methodology described in the SNEC LTP Section 5.2.3.2.4, based on radionuclide specific DCGLs listed in Table 5-1 of the LTP.

As described in Chapter 6 of the SNEC LTP (Reference 6.1) a correction to the gross activity $DCGL_w$ was made to address de-listed radionuclides. The SNEC facility has instituted an administrative limit of 75% for the allowable dose (DCGL) for all measurement results. The de-listed radionuclide dose is accounted for within the 75% administrative limit.

2.3 Survey Designs

The original FSS survey design is provided in Appendix A. This design utilized the NRC surface area default value for Cs-137 for the initial scans. Scan coverage measurements were set at 10-50% for Class 2 areas and approximately 10% for Class 3 areas. The number of static measurement points was to be determined if the SRA survey sensitivity did not meet 10% of the design $DCGL_w$.

After the original FSS survey a new method for determining nuclide mixes was developed and concurred with the NRC. This mix determination method slightly reduced the original surface $DCGL_w$ used in the original survey design. An assessment calculation was written to ensure the scans performed under the first design criteria met the new criteria using the new nuclide mix. This assessment is contained in Appendix B. As a result, the original FSS survey met the criteria specified in Appendix B.

Survey designs use gross activity $DCGL_w$ values developed from results of samples taken in the respective areas. These samples consisted of soil and sediment from environs surrounding the Line Shack. The gross activity surface area $DCGL_w$ was determined from the mean concentration percent of applicable samples. The CV Soil and Boulder radionuclide mix tables were used to determine a representative $DCGL_w$ for the Line Shack. This was based on the assumption that soil/boulder radioactivity became airborne, as a result of site wind erosion, and therefore impacted the Line Shack. The Line Shack surface materials consist of concrete, metal and/or wallboard. Therefore the release limit is based on the surface $DCGL_w$.

From the calculation logic contained in Appendix B the mean percent of total activity for positively detected nuclides was used to determine the mix. This calculation methodology determines 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. The mean percent values are averaged using only the positive sample results for each nuclide. Four of the SNEC eleven radionuclides were used to determine mix ratios. These radionuclides are Co-60 (<1%), Cs-137 (59.5%), H-3 (39.5%), and Sr-90 (<1%). Cs-137 and H-3 accounted for the majority of radionuclides, i.e. greater than 99% of the mix. Using the above calculation logic from Appendix B the calculated gross activity $DCGL_w$ is 44,434 dpm/100 cm^2. This value is reduced by 25% as part of SNEC's requirement to apply an administrative limit as discussed in the License Termination Plan (LTP). The administrative gross activity then is therefore 33,325 dpm/100 cm^2.

Table 1 presents data quality objectives (DQOs) and other relevant information, which went into the survey design and assessment calculation (Appendix A and B) for the Line Shack.

Table 1

DQO/Design Parameter	LS1-1, LS1-2, LS2-1, LS2-2, LS4	LS3
SNEC Design Calc. No.	E900-03-014	E900-03-014
MARSSIM Classification	2	3
Area Size (m^2)	1394	343
Statistical Test	WRS	WRS
Type I Decision Error (α)	0.05	0.05
Type II Decision Error (β)	0.10	0.10
Gross $DCGL_w$ (dpm/100 cm^2)	33,325	33,325
Cs-137 $DCGL_w$ (dpm/100 cm^2)	19,834	19,834
Sample #(s) used for nuclide mix	SXSD3164	SXSD3164
SNEC Survey Request No.	81	81
Survey Instrument Model	SCM	SCM
Instrument Total Efficiency	23-37%	23-37%
Measurement Type	Scan	Scan

3.0 Final Status Survey Results

The following sections provide the survey summary results for the Line Shack survey units as required by the respective design. Summary data was taken from Reference 6.7. Survey coverage was 631 m^2, which represented 36% of the total estimated surface area (1,737 m^2).

3.1 Line Shack Interior Walls and Floor

3.1.1 Survey Unit Results

Four (4) survey units were developed. These survey units are designated as LS1-1, LS1-2, LS2-1 and LS2-2, which cover the floors, interior walls up to 2 meters, interior walls above 2 meters and the ceiling. These survey units are described in section 2.1.1 of this report. The FSS design and assessment calculation for these survey units are provided in Appendix A and B. DQOs are listed in Table 1. Surveys were performed in accordance with Reference 6.6 (i.e. SR-81). Surface scan measurements were performed using SRA's surface contamination monitor (SCM). The SCM utilizes large-area position sensitive proportional counters (PSPCs) in either rolling (scanning) or static modes.

Per Appendix B the gross $DCGL_w$ for all areas was calculated to be 44,434 dpm/100 cm^2. The 75% administrative gross activity is therefore 33,325 dpm/100 cm^2. Since Cs-137 represented 59.5% of the total mix the $DCGL_w$ was calculated to be 19,834 dpm/100 cm^2. These Class 2 areas were given a scan coverage that ranged from 10-50% of the total survey unit size.

No WRS statistical analysis and/or static measurements are necessary for these survey units since all measurements are less than 10% of the assigned $DCGL_w$. The following tables provide the summary results from the Shonka survey. The file SCS# represents the areas surveyed and are indexed on maps in Appendix C.

Survey Unit:	**LS1-1 (floors) Class 2**				
File SCS#	Survey Average (dpm/100 cm^2)	Scan MDC (dpm/100 cm^2)	Total Efficiency	Survey Coverage (m^2)	% 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 cm^2)	Scan MDC (dpm/100 cm^2)	Total Efficiency	Coverage (m^2)	% 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 cm^2)	Scan MDC (dpm/100 cm^2)	Total Efficiency	Coverage (m^2)	% 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 cm^2)	Scan MDC (dpm/100 cm^2)	Total Efficiency	Coverage (m^2)	% 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%

3.2 Line Shack Exterior Walls and Roof

3.2.1 Survey Unit Results

Two (2) survey units were developed. These survey units are designated as LS3 and LS4, which cover the exterior walls and the roof of the Line Shack. These survey units are described in section 2.1.2 of this report. The FSS design and assessment calculation for these survey units are in Appendix A and B. DQOs are listed in Table 1. Surveys were performed in accordance with Reference 6.6 (i.e. SR-81). Surface scan measurements were performed using SRA's surface contamination monitor (SCM). The SCM utilizes large-area position sensitive proportional counters (PSPCs) in either rolling (scanning) or static modes.

Per Appendix B the gross $DCGL_w$ for all areas was calculated to be 44,434 dpm/100 cm2. The 75% administrative gross activity is therefore 33,325 dpm/100 cm^2. Since Cs-137 represented 59.5% of the total mix the its $DCGL_w$ was calculated to be 19,834 dpm/100

cm^2. Scan coverage ranged approximately 10% for LS3 (Class 3) and 10-50% for LS4 (Class 2) of the respective total survey unit size.

No WRS statistical analysis is necessary for these survey units since the measurements are well below the assigned $DCGL_w$. The following tables provide the summary results from the Shonka survey. The file SCS# represents the areas surveyed and are indexed on maps in Appendix C.

Survey Unit:	**LS3 (exterior walls) Class 3**				
File SCS#	Survey Average (dpm/100 cm^2)	Scan MDC (dpm/100 cm^2)	Total Efficiency	Coverage (m^2)	% 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 cm^2)	Scan MDC (dpm/100 cm^2)	Total Efficiency	Coverage (m^2)	% of Total Area
7006Z	4154	10346	0.2336	169.38	52%

Residual radioactivity was identified on the Line Shack roof. The contamination appeared to be uniformly distributed across all the surveyed area with the exception of the new section of roofing on the west end of the south side of the roof (which contained no residual contamination). However, no area of the roof was found to be above the applicable $DCGL_w$.

A sodium iodide study was conducted to determine the reason for the residual radioactivity on the old portion of the Line Shack roof. This study is documented in Appendix B. The conclusion of the study is 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 Ra-226 daughters in the roof materials. Ra-226 is naturally present in coal dust materials found on-site. The key Ra-226 daughters that emit alpha and beta radiations are most likely Po-210 and Bi-214. Over the years coal dust fallout on the Line Shack roof has combined with rain to cause an oxidation reaction on the roof surface. This reaction is believed to be a possible reason for the thin layer of corrosion (patina), which is likely the significant cause for the residual activity.

3.3 Shonka Survey Methodology

3.3.1 Surface Contamination Monitor (SCM) Description

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.

In rolling mode, the SCM logs information in 25 cm^2 bins by logging data for each 5 cm width of the PSPC and for every 5 cm of forward travel. A precision wheel encoder measures the distance the SCM travels. Corner mode data is recorded in a similar manner, except the wheel encoder is replaced with a computer-based timer and a "speed" parameter is set so that the desired count time corresponds to a "distance" of 5 cm. In either mode, data are recorded in 25 cm^2 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 cm^2 measurement as ¼th of four separate 100 cm^2 areas. This technique ensures that the highest-activity 100-cm^2 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 cm^2 data is calculated as:

Total 100cm^2 Efficiency= $\varepsilon T_{100} = \varepsilon i * \varepsilon s$

Where	εT_{100},	Total Efficiency
	εi,	Instrument Efficiency
	εs,	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.

4.0 Data Assessment

The final status survey data has been reviewed to verify authenticity, appropriate documentation, and technical acceptance. The review criteria for data acceptability are:

1. The instruments used to collect the data were capable of detecting the radiation of interest at or below the investigation level.

2. The calibration of the instruments used to collect the data was current and radioactive sources used for calibration were traceable to recognized standards or calibration organizations.

3. Instrument response was checked before and, where required, after instrument use each day data was collected.

4. Survey team personnel were properly trained in the applicable survey techniques, and this training was documented.

5. The MDCs and the assumptions used to develop them were appropriate for the instruments and the survey methods used to collect the data.

6. The survey methods used to collect the data were appropriate for the media and types of radiation being measured.

7. Special measurement methods used to collect data were applied as warranted by survey conditions, and were documented in accordance with an approved site Survey Request procedure.

8. The custody of samples that were sent for off-site laboratory analysis, were tracked from the point of collection until the final results were obtained, and

9. The final status survey data consists of qualified measurement results representative of current facility status, and were collected in accordance with the applicable survey design package.

If a discrepancy existed where one or more criteria were not met, the discrepancy was reviewed and corrective actions taken (as appropriate) in accordance with site procedures.

The statistical test does not need to be performed for this final status survey since the data clearly show that the survey unit meets the site release criteria. The survey units clearly meet the criterion since all measurements in the survey units are less than or equal to the $DCGL_W$.

5.0 Final Survey Conclusions

The FSS for the Line Shack was performed in accordance with the SNEC LTP and site implementing procedures. Final status survey data was collected to meet and/or exceed the quantity and quality specified for each survey unit as prescribed by the applicable survey design. The survey data for each survey unit met the following conditions:

1. The average residual radioactivity inside and outside the respective Line Shack area was less than the assigned $DCGL_w$.

2. Since all measurements were less than the $DCGL_w$, no $DCGL_{EMC}$ criteria needed to be applied.

3. Except for the Line Shack roof, where natural residual radioactivity is present, all scan measurements were less than 10% of the $DCGL_w$. Therefore, no static measurements were required per section 5.4.3 of the SNEC LTP.

These conditions satisfy the release criteria established in the SNEC LTP and the radiological criteria for unrestricted use given in 10 CFR 20.1402. Therefore, it is concluded that the SNEC Line Shack as described in this report, is suitable for unrestricted release.

6.0 References

6.1 SNEC License Termination Plan, Revision 3, February 2004.

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

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

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

6.5 SNEC Procedure E900-ADM-4500.60, "Final Status Survey Report".

6.6 SNEC Survey Request (SR) # 081 – Line Shack– Shonka SCM Measurements.

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

7.0 Appendices

Appendix A - SNEC Calculation #E900-03-014, "Shonka Line Shack & Warehouse/Garage Pads FSS Survey Design," July 21 2003.

Appendix B – SNEC Calculation #E900-04-010, Rev 0, "Assessment of E900-03-014, Rev 0, "Shonka Line Shack & Warehouse/Garage Pads FSS Survey Design," June 2004.

Appendix C – Penelec Line Shack Diagrams

Appendix A

SNEC Calculation #E900-03-014, “Shonka Line Shack & Warehouse/Garage Pads FSS Survey Design,” July 21 2003

Appendix B

SNEC Calculation #E900-04-010, Rev 0, “Assessment of E900-03-014, Rev 0, “Shonka Line Shack & Warehouse/Garage Pads FSS Survey Design,” June 2004

Appendix C

Penelec Line Shack Diagrams

Name of CAD Map	Survey Request	SCM File Name(s)	Description of Surveyed Area
Penelec Lineshack	SR-0081	SRS7007Z	Inside North Wall Below 2 m
		SCS7010Z	Inside North Wall Below 2 m
		SCS7011Z	Inside South Wall Below 2 m
		SCS7012Z	Inside North Wall Above 2 m
		SCS7013Z	Inside South Wall Above 2 m
		SCS7014Z	Inside South Wall Below 2 m
		SCS7016z	Main Floor
		SCS7039Z	Office Floor
		SCS7040N	South Office South Wall Below 2 m
		SCS7042Z	Bathroom East Wall
		SCS7043Z	East Wall Above 2 m
		SCS7044Z	West Wall Below 2 m
		SCS7045Z	West Wall Above 2 m
Radiation Survey Map Penelec Lineshack	SR-0081	SRS7008Z	Inside East Wall Below 2 m
		SRS7009Z	Inside East Wall Above 2 m
		SRS7017Z	Main Room Ceiling
		SRS7017X	Main Room Ceiling
		SCS7040Z	North Office North Wall Below 2 m
		SCS7040L	North Office South Wall Below 2 m
		SCS7040M	North Office West Wall Below 2 m
		SCS7040O	South Office West Wall Below 2 m
		SCS7040P	South Office North Wall Below 2 m
		SCS7041Z	Office Ceiling
		SCS7042L	Bathroom South Wall
		SCS7042M	Bathroom West Wall
Radiation Survey Map Penelec Lineshack	SR-0081	SRS7006X	Roof
		SRS7015Z	Outside North Wall
		SRS7015R	Outside West Wall
		SRS7015S	Outside South Wall

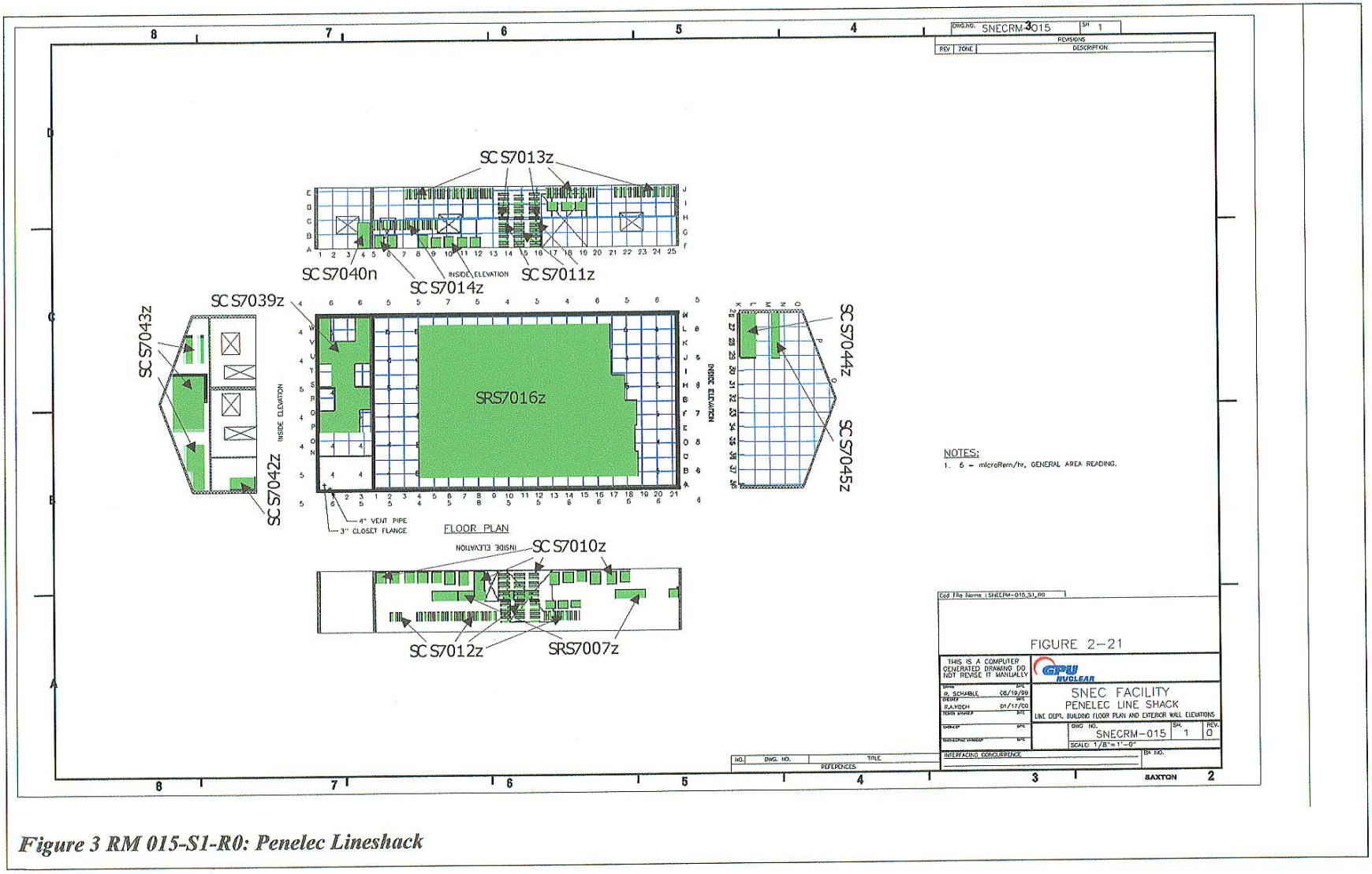

Figure 3 RM 015-S1-R0: Penelec Lineshack

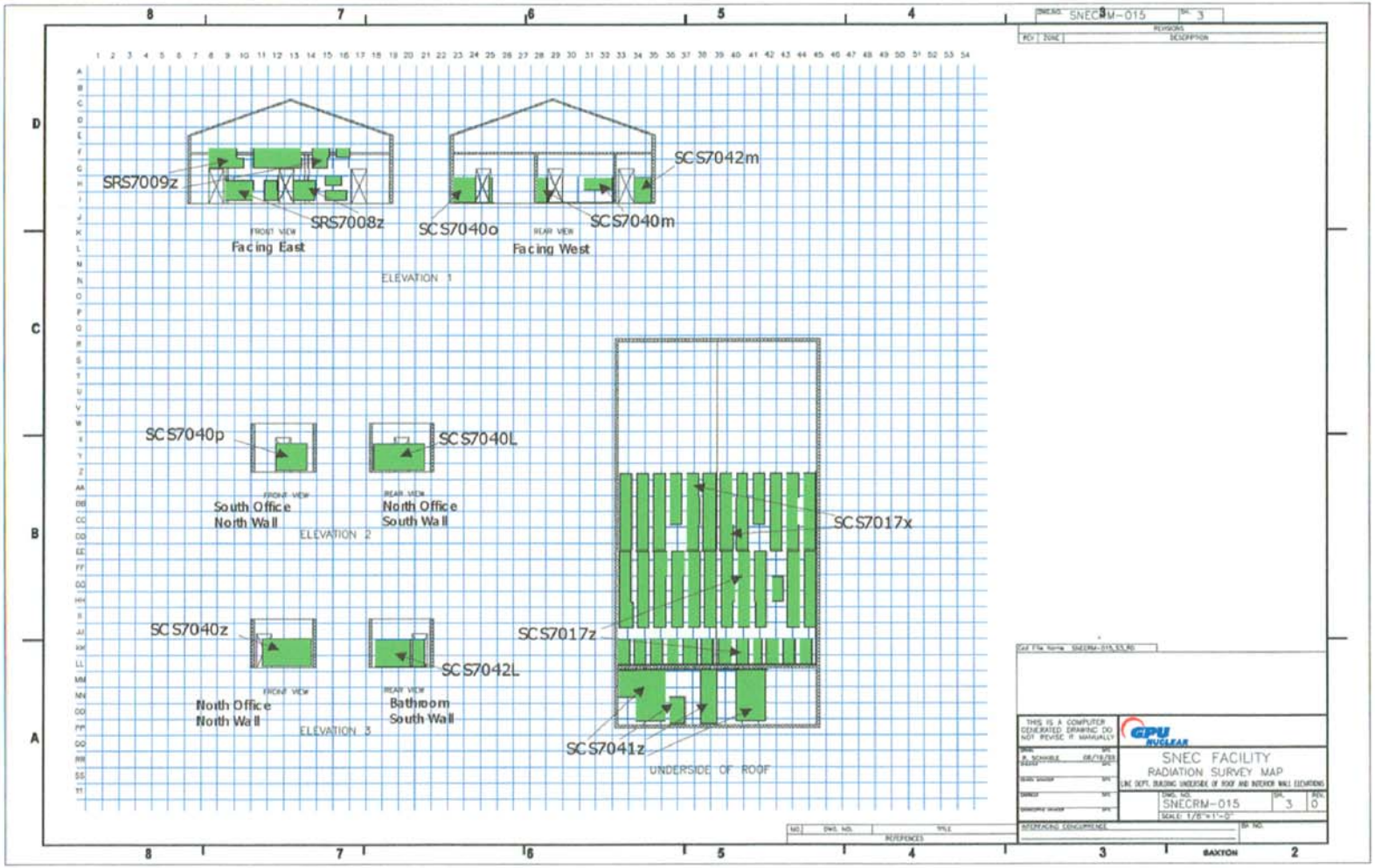

Figure 4 RM 015-S3-R0: Radiation Survey Map, Penelec Lineshack

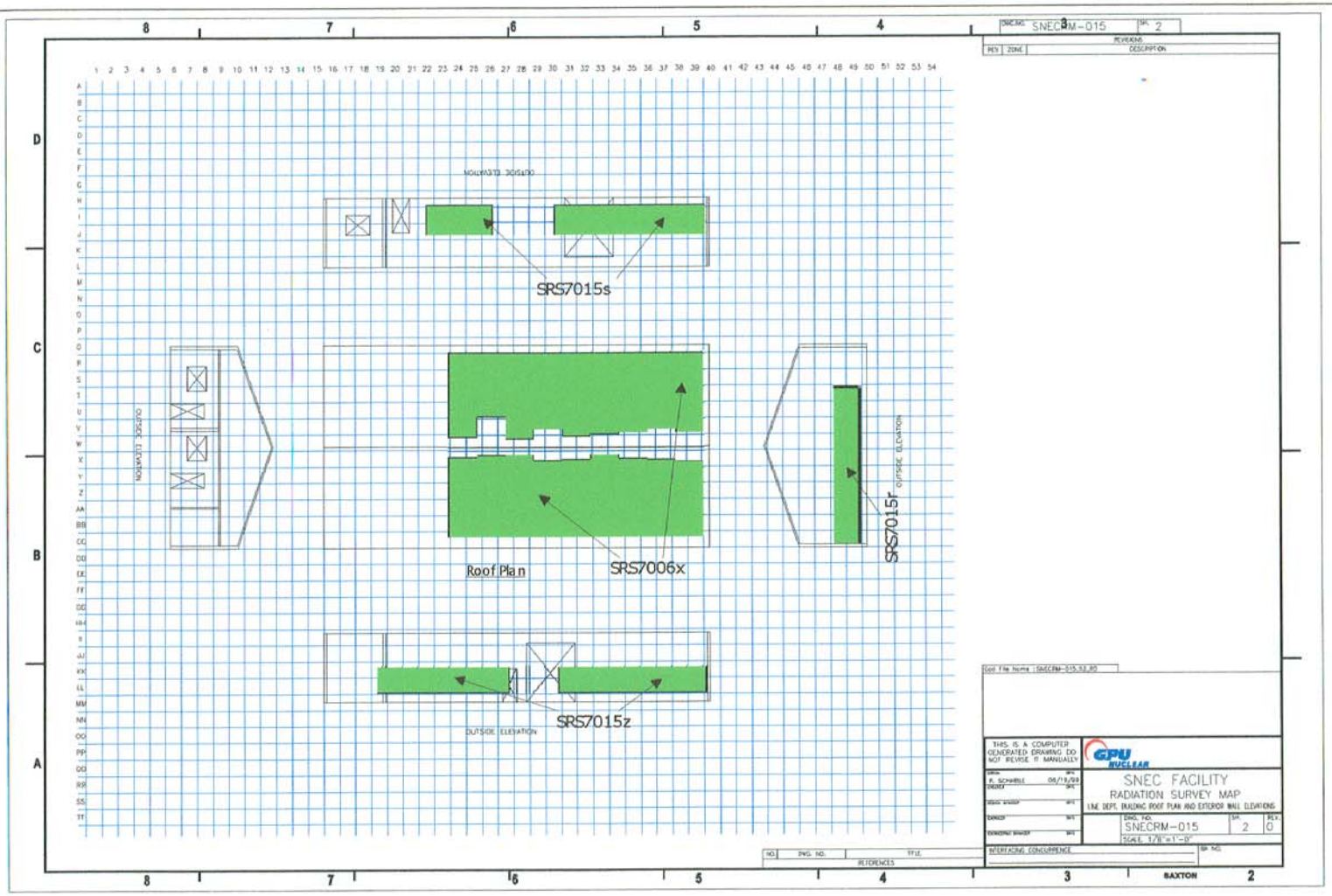

Figure 5 RM 015-S2-R0: Radiation Survey Map, Penelec Lineshack