Appendix B

Survey Design
Revision 1

ORIGINAL

FirstEnergy

SNEC CALCULATION COVER SHEET

CALCULATION DESCRIPTION

Calculation Number	Revision Number	Effective Date	Page Number
E900-05-015	1	5/19/05	1 of 13

Subject

OL1 Paved and Miscellaneous concrete surfaces MA8, PF1, DB5, DB1, SS12, SS24 - 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 ☐

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

1 - Revision 1 adds the use of the 43-37 extra large probe to the design. Numerous additions are made to provide setpoints, mdcr, useage protocols, etc. and attachments. The complete text of pages 1 through 13 is provided here, but only the added attachments are included. This revision also adds the survey units and layout for the concrete in the SSGS area OL1-8.

APPROVAL SIGNATURES

Calculation Originator	W. J. Cooper CHP/	Date	5/19/05
Technical Reviewer	T. Tritch/	Date	5/19/05
Additional Review	A. Paynter/	Date	19 May 2005
Additional Review		Date	

1.0 PURPOSE

1.1 The purpose of this calculation is to develop a survey design for the residual concrete surfaces in the Saxton Nuclear Experimental Corporation SNEC and SSGS site areas. The total area (OL1) including the soil and solid surface portions is approximately ***11600 square meters*** . Portions of the solid surface (concrete, macadam, brick) are Class1, Class 2, and Class 3 survey areas. Because the survey area exceeds the size limitations in the SNEC LTP (**Reference 3.5**) Table 5-5 for maximum Class 1 survey unit area and it includes survey units of all three classifications, this survey area is subdivided into multiple survey units: OL1-7 is an existing excavation in the SNEC site area, that will be backfilled after survey. OL1-8 through OL1-13 are subdivisions of the large open land area and comprise the majority of the total surface area. These open land areas and the excavation are covered by other design calculations. Several additional areas comprise the residual exposed concrete and macadam surfaces:

1.1.1 PF1 is a pre-existing Class 1 survey unit for the Personnel Access Facility (PAF) floor and includes the north edge of the PF1 portion of the slab with approximately **37 m^2**

1.1.2 DB1 is a pre-existing Class 1 survey area for the Decommissioning Support Building (DSB) floor pad and door ramp. This area is further divided into two survey units due to LTP survey unit area limitations. DB1-1(85 m^2) and DB1-2 (109 m^2) with **194 m^2** total. DB1-1 includes the full width of the north edge of the DSB portion of the pad.

1.1.3 DB5 is a pre-existing Class 1 survey unit for the DSB carport floor of approximately **54 m^2**

1.1.4 SS12 is a pre-existing survey area for the SSGS boiler pad. This concrete, although it is in a Class 1 soil area, is classified as Class 3 in the LTP Table 5-2. Some minor details of residual concrete hidden by soil may be present. This will not affect the survey since it is class 3 and only 10% scan is needed. Since SS12 is Class3, the entire pad is a single survey unit of approximately **658 m^2** .

1.1.5 SS24-1 is a Class 3 survey unit defined for the miscellaneous SSGS pads north of the turbine hall. There is likely to be a buried portion of this slab west of this area which is separately defined as SS24-2. Since SS24 is Class 3, the entire exposed pad is a single survey unit. Design scan area is 105 m^2. The west edge of the exposed concrete is uneven and the area is approximately **249 m^2**.

1.1.6 SS24-2 is a Class 3 survey unit defined for the miscellaneous SSGS pads north of the turbine hall. This is a buried portion of this slab west of the area defined as SS24-1. This area must first be surveyed as open land per E900-05-014, then cleared of soil and the residual concrete surveyed per this design. Since SS24 is Class 3, the entire buried portion of the pad is a single survey unit. Design scan area is 118 m^2. The area is approximately **321 m^2**.

1.1.7 MA8-6 through 13, 16, and 17: Ten survey units of the old parking lot and driveway macadam. Because of the 100 m^2 survey unit limitation for Class 1 surfaces, the surface was subdivided into ten approximately 100 m^2 (or less) survey units. The pavement occupies all of, or a large portion of, grids AT131, AU127, AU128, AU129, AU130, AU131, AV130, AV131, AW131, AX131, AY131. These are all class 1 survey units due to verbal reports of minor remediation and due to their proximity to

the C&A building, the barrel bunker, and containment. Total area is about **772 m^2**. General arrangement of these units is shown in the drawing **Attachment 6-17.**

1.1.8 MA8-16 and MA8-17 have about 4 to 6 inches of soil on top of the pavement. This soil is to be surveyed per E900-05-014 and then removed and placed in a PRI pile to allow the pavement survey per this design.

1.1.9 MA8-14 – the Line Shack concrete including garage door ramps and sidewalks. This area is not specifically classified in the SNEC LTP (**Reference 3.5**) but is selected to be class 2 consistent with the class 3 classification of the line shack exterior and the class 1 assigned to the surrounding soil. This is a Class 2 survey unit with about **33 m^2** total area.

1.1.10 MA8-15 is additional concrete surfaces around the CV. There is some SSGS concrete and additional small monoliths in OL1-9 NW of the CV. This small concrete area is not specifically addressed in the SNEC LTP but is assumed to be Class 1 due to proximity to the CV and is about **37 m^2**.

1.1.11 A summary list of survey unit areas is included as **Attachment 5-1.**

1.2 This survey design applies only to the residual concrete, macadam, and other paved surfaces in the survey area. The design for the open land areas, fences, the east yard excavation, and the portion of OL1 covering the SSGS will be provided in separate calculations. The general layout of this survey unit is shown on **Attachment 1-1.**

1.3 If additional areas of concrete not identified here are found under soil, this design may to be revised to include the additional area.

2.0 SUMMARY OF RESULTS

The following information should be used to develop a survey request for this survey unit. The effective DCGLw value is listed below. This value is derived from previously approved derived values for "CV Yard Soil and Boulders", Attachment 2 in SNEC calculation E900-04-005 (**Reference 3.15**). The US NRC has reviewed and concurred with the methodology used to derive these values. See **Attachment 2-1** and **Reference 3.9.**

Table 1, DCGLw Values

Gross Activity DCGLw (dpm/100 cm^2)
26445 (19834 A.L.)

NOTE: A.L. is the site Administrative Limit (75% of effective DCGLw)

2.1 Survey Design

2.1.1 Scanning of concrete and macadam surfaces shall be performed using a L2350 with 43-68B gas flow proportional counter or a 43-37 'extra large' probe calibrated to Cs-137 (see typical calibration information on **Attachments 3-1 and 3-2**). Generic approval for use of the 43-37 is included in **Reference 3.10.**

2.1.2 The instrument conversion factor/efficiency (Et) shall not be less than that assumed on **Attachment 4-1** as ***23.9% – Cs-137*** for the 43-68B nor less than ***20.0%-Cs137*** for the 43-37 in its lowest efficiency region as assumed on **Attachment 4-3.**

2.1.3 Other instruments of the types specified in Section 2.1.1 above may be used during the final status survey (FSS), but must demonstrate detection efficiencies at or above the values listed in Section 2.1.2 above.

2.1.4 An efficiency correction factor (ECF) is applied to compensate for efficiency loss when surveying rough surfaces based on **Reference 3.1** and **Attachment 2-2.**

2.1.5 The fraction of detectable beta emitting activity affects the efficiency and is determined by the nuclide mix. The mix detectable beta fraction is determined to be 60% based on **Reference 3.15**. Because the adjusted DCGLw used is based only on the modified Cs-137 DCGLw, the mix percentage is not applied to the adjusted surrogate DCGLw. The gross activity DCGLw, which would include all the low energy activity and would require mix percentage adjustment is considerable higher, at 44434 dpm 100cm^2. The Cs-137 adjusted surrogate activity already accounts for the detectable beta yield of the mix.

2.1.6 The ECF is derived from **Attachment 2-2** and **Reference 3.1** based on a surface irregularity of 3 inches or less FOR THE 43-68B DETECTOR. This is conservative, as actual observed irregularity is typically less than one inch. Also, the loss of efficiency is based on moving the detector away from a 150 cm^2 source. If the area of the residual activity is larger, than the efficiency loss would be smaller due to the increase in 'field-of-view' of the detector.

2.1.7 The ECFs developed for the 43-68B probe per reference 3.1 are assumed to apply to the 43-37. The ECF for the 43-37 are based on the ASSUMPTION that the detector face will not be more than about 1 inch farther from the surface than from the source in the test jig (0.5 inches apart) and that the surface will be fairly smooth, typical of poured concrete or macadam.

2.1.8 Because the alarm point and MDCscan are based on the highly conservative surface irregularity assumptions (intended to bound all cases to simplify design and performance of the survey), where surfaces are much smoother (e.g. 1 inch irregularity or less per probe area for the 43-68B) than the assumed 3 inch variability, short (e.g. ½ to 1 inch) standoff support pegs may be attached to the 43-68B in order to reduce the possibility of mylar damage. These standoffs must only be used when the surface smoothness is well within the assumed 3 inch variability. Because the high surface irregularity is assumed and used for the efficiency of the instrument for the entire design, this standoff will not affect the assumed efficiency if limited as discussed above.

Table 2, GFPC Detection Efficiency Results Used for Planning

Detector	Material Type	Ei	Es	Et(as %)	ECF	Adjusted efficiency
43-68B	Concrete or asphalt	.478	.5	23.9	.2	4.8%
43-37	Concrete or asphalt	.4	.5	20.0	.5	10.0%

Table 3, Surface Scanning Parameters for Solid Misc. Concrete & Pavement Sections

Detector	MDCscan (dpm/100cm²)*	Scan Speed (cm/sec)	Maximum Distance from Surface	DCGLw Action Level	% Coverage
43-68B	4634	10	3" (gap between detector face & surface or 3 inch irregularity)	> 1450 cpm	Up to 100%
43-37	7311	30.5	1.5" (gap between detector face & surface)	>2900 cpm	Up to 100%

See Attachment 2-1, 2-2, 4-1, and 4-3 for calculations*

2.1.9 The 43-68B MDCscan (shown in **Attachment 4-1**) is based on a 300 cpm background. Typical backgrounds are similar to this value assumed, as shown in the variability data shown as "CW" (closed window or shielded detector) in **Attachment 8-2**. Unaffected material backgrounds were determined at the Williamsburg station, which resulted in a mean background value of 306 cpm +/- 34.5. On 3/7/05, measurements were collected on three different surfaces in OL1: the DSB pad, the old parking lot, and the SSGS boiler pad.

2.1.10 The 43-37 MDCscan (shown in **Attachment 4-2**) is based on a 1020 cpm background. On 5/12/05, measurements were collected on three different surfaces in OL1: the DSB pad, the asphalt, and the SSGS boiler pad. These are shown in **Attachment 8-7** and **Attachment 8-8**.

2.1.11 The 43-37 detector is to be used as a screening process.

2.1.11.1 Since the efficiency is determined with the same source as used for the 43-68B, the effective area of the detector is assumed to be 100 cm^2 for determining the MDCscan. This will underestimate the response of the detector to larger sources but produce similar efficiencies and MDCs as for the 43-68B.

2.1.11.2 Scanning using the 43-37 will be done only on flat surfaces with surface irregularities typical of poured concrete or rolled macadam pavement. Uneven surfaces, edges, etc. will be scanned with the 43-68B.

2.1.11.3 Because the 43-37 has a much larger effective surface area than the 43-68B, and the MDC and action level are based only on a 100 cm^2 elevated spot, the 43-37 may provide action level count rates on larger diffuse source areas that actually are less than the DCGL. Therefore, the 43-37 will be used to screen surfaces and will be considered to be the 'official' results only if no action levels are observed.

2.1.11.4 Any action levels observed with the 43-37 will be rescanned with the 43-68B. If no AP is observed with the 43-68B, there is no AP. APs observed in follow-up rescans with the 43-68B will be handled and documented in the SR per section 2.1.16 below.

2.1.11.5 Fraction scanned with the 43-37 and results should be separately reported in the SR for each survey unit / grid/ etc. in a similar manner as used for the

43-68B. E.G. '90% scanned with 43-37, one alarm rescanned with 43-68B no 43-68B AP' .

2.1.12 The 3/7/05 survey data shown as "OW" (open window or unshielded) is used for the variability assessment for the COMPASS determination of sample requirements and is shown in **Attachment 8-2.**

2.1.13 A background of 1300 cpm for the 43-68B would still result in MDCscan less than about 50% of the DCGLw (**Attachment 4-2**). Since the Action level cited in Table 3, above, is total counts per minute including background, if local backgrounds significantly exceed the background count rate assumed for the MDCscan (about 300cpm for the 43-68B see - **Attachment 4-1** or 1020 cpm for the 43-37 – see **Attachment 4-3**) ***contact the cognizant SR coordinator*** to determine need for additional background count rate adjustments.

2.1.14 The scan DCGLw Action Level for the 43-68B listed in Table 3 includes 1200 cpm DCGL equivalent count rate from **Attachment 4-1** and an estimated 260 cpm background . The DCGLw action level is based on fixed measurement and does not include 'human performance factors' or 'index of sensitivity' factors (see **Reference 3.12**).

2.1.15 The scan DCGLw Action Level for the 43-37 listed in Table 3 includes 1950 cpm DCGL equivalent count rate from **Attachment 4-3** and an estimated 950 cpm background. Although the 43-37 is assumed to be geometrically and functionally equivalent to the 43-68B for MDC and action level determination (a conservative assumption), the ECFs and probe areas are different and therefore result in a higher net count rate for the action level for the 43-37. The DCGLw action level is based on fixed measurement and does not include 'human performance factors' or 'index of sensitivity' factors (see **Reference 3.12**).

2.1.16 If a total count rate greater than the "DCGLw action level" of Table 3 is encountered during the scanning process with a 43-68B, the surveyor should stop and locate the boundary of the elevated area, and then perform a "second phase" fixed point count of at least 30 seconds duration. If the second phase result equals or exceeds the "DCGLw action" level noted in table 3, the surveyor should then mark the elevated area with appropriate marking methods and document the count rate observed and an estimate of the affected area. Subsequent investigation may take the actual surface irregularity into account for the efficiency.

2.1.16.1 ***Class 1*** concrete should be scanned to include 100% surface coverage at a scan rate of about 10 cm per second for the 43-68B or 30.5 cm per second for the 43-37. All accessible surfaces are required to be scanned. Areas that cannot be accessed should be clearly noted along with the reason for not completing the scan in that area.

2.1.16.2 ***Class 2*** concrete would normally be scanned to include 10% to 100% surface coverage. Only the concrete around the line shack is class 2. Due to the small size of the unit and the distribution of small areas, the unit (MA8-14) will be 100% scanned at a scan rate of about 10 cm per second for the 43-68B or 30.5 cm per second for the 43-37. Areas that cannot be accessed

should be clearly noted along with the reason for not completing the scan in that area.

2.1.16.3 ***Class 3*** concrete would normally be scanned to include up to 10% surface coverage. The concrete and pavement in and around the SSGS is class 3 and will be approximately 10% scanned at a scan rate of about 10 cm per second for the 43-68B or 30.5 cm per second for the 43-37. Three 25 square meter scan areas are shown on **Attachment 6-34** for SS12, two regions totaling 105 square meters are shown on **Attachment 6-36** for SS24-1, and two regions totaling 118 square meters are shown on **Attachment 6-38** for SS24-2. Areas that cannot be accessed should be clearly noted along with the reason for not completing the scan in that area.

2.1.16.4 See **Attachment 1-1** for grid layout for the survey units.

2.1.16.5 The surfaces of the concrete or other pavement materials should be clear of debris to ensure detection parameters are not affected.

2.1.17 The minimum number of fixed measurement sampling points indicated by the COMPASS computer program (**Reference 3.3**) is ***11*** for each survey unit (see COMPASS output on **Attachment 7-1** to **7-5**). Fixed point measurements should be done only with the 43-68B IAW Section 2.2. The MDCscan (concrete) is below the effective administrative $DCGLw_{Cs-137}$ (4634 DPM/100cm^2 MDCscan @300cpm bkg < 19834 DPM/100cm^2 AL for the 43-68B and 7311 DPM/100cm^2 MDCscan @1020cpm bkg < 19834 DPM/100cm^2 AL for the 43-37).

2.1.18 The minimum number of fixed point samples is increased to 13 (18% increase) for survey unit DB1-2 due to the slightly oversized (109 m^2, 9% over LTP guideline) area of the unit. This oversize is due to the selection of a grid line as the separation point between DB1-1 and DB1-2. Survey Unit DB1-1 is only 85 m^2. Since both units are class 1, the DSB pad will be 100% scanned regardless of the survey unit separation. Relocation of the arbitrary separation line could make these both equal and <100m^2 but is not considered to be useful since: separation on a grid line simplifies survey layout, the two units combined are <200 m^2, and the two units combined have more than the required number of fixed points (26 total vs. 22 required per MARSSIM).

2.1.19 One Biased direct measurement point is placed in DB1-1 on the face of the exposed slab. This point should be taken centered vertically on the vertical face at the 128 grid line.

2.1.20 The minimum number of sample points for SS24-2 is increased to 18 to account for the unknown extent of the concrete below the soil layer to provide sufficient samples if some areas are not concrete.

2.1.21 VSP (**Reference 3.4**) is used to plot all sampling points on the included diagrams. The actual number of random start systematically spaced measurement points may be greater than that required by the COMPASS computer code because of any or all of the following:

- placement of the initial random starting point (edge effects),
- odd shaped diagrams, and/or
- coverage concerns

(see **Attachment 6-1** to **6-39** for VSP sampling point locations)

2.1.22 Because this design is a conglomerate of multiple slab surfaces into multiple survey units, the sample point locations are not derived from a single starting point. Measurement location details for the sample points are provided in the diagrams in **Attachment 6.**

2.1.23 Some sampling points may need to be adjusted to accommodate obstructions within the survey area. Contact the SR coordinator to report any difficulties encountered when laying out systematic grid sampling points.

2.1.24 Because of the unusual arrangement of this survey area, with multiple disjointed slabs that do not correspond directly to single grids, the drawings in **Attachment 6** are intended to be as close as practicable to as-left conditions. However, if actual layout is different from that shown, review with the cognizant SR coordinator, finish the survey if practicable, and mark up the drawings to indicate actual layout.

2.1.25 When an obstruction is encountered that will not allow collection of a sample, ***contact the cognizant SR coordinator*** for permission to delete the sampling point.

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

2.2 Measure concrete fixed point and elevated areas(s) IAW SNEC procedure E900-IMP-4520.04 sec 4.3.3 (**Reference 3.2**) and the following.

2.2.1 Use only the 43-68B to confirm and 'finalize' elevated area measurements or to collect fixed point measurements.

2.2.2 Clearly mark, identify and document all sample locations.

2.3.1 Second phase scan any location that is above the action level cited in Table 3.

2.3.2 Investigation of APs may require surface and sub-surface samples per the LTP section 5.5.3.4.5 (**Reference 3.5**).

3.0 REFERENCES

3.1 SNEC Calculation number 6900-02-028, "GFPC Instrument Efficiency Loss Study"

3.2 SNEC Procedure E900-IMP-4520.04, "Survey Methodology to Support SNEC License Termination".

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

3.4 Visual Sample Plan, Version 3.0, Copyright 2004, Battelle Memorial Institute.

3.5 SNEC Facility License Termination Plan.

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

3.7 SNEC survey 43-68B GFPC measurements in OL1 dated 3/7/05

3.8 GPU Nuclear, SNEC Facility, "Site Area Grid Map", SNECRM-020, Sheet 1, Rev 4, 1/18/05.

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

3.10 SNEC calculation E900–05-031 "Use of the 43-37 Detector and Ludlum 239 Floor Monitor for FSS Surveys"

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

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

3.13 Microsoft Excel 97, Microsoft Corporation Inc., SR-1 and SR-2, 1985-1997.

3.14 Left intentionally blank

3.15 SNEC Calculation E900-04-005 "CV Yard Survey Design – North West Side of CV"

3.16 SNEC survey 43-37 GFPC measurements in OL1 dated 5/12/05

4.0 ASSUMPTIONS AND BASIC DATA

4.1 The COMPASS computer program is used to calculate the required number of random start systematic samples to be taken in the survey unit (**Reference 3.3**).

4.2 Reference background data from offsite at the Williamsburg station were used as the initial estimate of variability. These results are shown on **Attachment 8-1** and in **Reference 3.15**. Additional variance data that is used to assess sampling requirements is derived from the survey, **Reference 3.7**. Background data for the 43-37 is not used for variability assessment, since the fixed point data is only collected with the 43-68B

4.3 The MARSSIM Sign Test (**Reference 3.12**) will be applicable for this survey design. No background subtraction will be performed under this criteria during the DQA phase.

4.4 The required points chosen by COMPASS are located on the survey map for the survey unit by the Visual Sample Plan (VSP) computer code (**Reference 3.4**).

4.5 **Reference 3.5** and **3.6** were used as guidance during the survey design development phase.

4.6 Background for the 43-68B detector has been measured in the area, and ranges from about 250 to 300 cpm with averages of slightly less than 300 cpm (**Reference 3.7**). These recent survey result averages are used as the basis for the MDCscan. Background for the 43-37 detector has been measured in the area, and ranges from about 875 to 1100 cpm with averages of about 950 cpm to 1020 cpm (**Reference 3.16** and **Attachment 8-7**). These recent survey result averages are used as the basis for the MDCscan.

4.7 The determination of the physical extent of this area is based on the drawing **Reference 3.8** and a thorough walkdown / measurement of the survey unit.

4.8 Remediation History:

4.8.1 OL1 is an open land area. Portions contained the original SNEC site facility and the Saxton Steam Generating Station. Extensive remediation has occurred in the survey area. The SNEC Radwaste building (RWDF), Control and Auxiliary (C&A) building, Containment Vessel (CV), the SSGS, various buried pipe tunnels and underground tanks were all removed to grade or below. The residual portions of the buildings have been previously surveyed and the release surveys have been accepted.

4.8.2 The SSGS was backfilled when it was permanently shut down. Subsequently, residual licensed activity was found using core bores. The SSGS backfill was removed and surveyed through an automated conveyor system. Additional concrete surfaces in the SSGS basement were remediated and then the scanned backfill was replaced following survey.

4.8.3 The underground tank excavation was backfilled after the tanks were removed early in the project. This backfill was removed and scanned using a automated conveyor scanning system and is currently stored for re-use.

4.8.4 The barrel bunker was removed as part of the remediation process.

4.8.5 Underground drainage, sewerage systems and surface soils have been removed.

4.8.6 Some pavement was remediated during the building removal phase.

4.9 This survey design uses Cs-137 as a surrogate for all SNEC facility related radionuclides in the survey unit. The effective DCGLw is the Cs-137 DCGLw from the SNEC LTP (28000 dpm/100cm^2) adjusted (lowered) to compensate for the presence (or potential presence) of other SNEC related radionuclides (**Reference 3.9**). In addition, an administrative limit (75%) has been set that further lowers the permissible Cs-137 concentration to an effective surrogate DCGLw for this survey area.

The sample database used to determine the effective radionuclide mix for the OL1 area has been drawn from samples that were assayed at off-site laboratories. This nuclide mix is copied from **Reference 3.15**.

The GFPC detector scan MDC calculation is determined based on a 10 cm/sec scan rate, a 1.38 index of sensitivity (95% correct detection probability and 60% false positive) and a detector sensitivity (Et) of 23.9% cpm/dpm for Cs-137 for the 43-68B and 20% for the 43-37. The expected range of background values varies from about 250 cpm to about 300 cpm for the 43-68B detector and about 875 cpm to about 1100 for the 43-37.

4.10 The survey unit described in this survey design was inspected after remediation efforts were shown effective. A copy of the specific portion of the SNEC facility post-remediation inspection report (**Reference 3.11**) applicable to this design is included as **Attachment 9-1**.

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

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" (as described in the SNEC LTP, **Reference 3.5**) are included in this survey design. Section 5.5.3.4.5 discusses pavement surveys. This survey design is consistent with the LTP. Use of the 43-37 detector as a screening device may be considered a 'special measurement'. Use is explained and authorized in a SNEC calculation (**Reference 3.10**).

4.14 No additional sampling will be performed IAW this survey design beyond that described herein.

4.15 SNEC site radionuclides and their individual DCGLw values are listed on **Exhibit 1** of this calculation based on Table 5-1 in **Reference 3.5.**

4.16 The survey design checklist is listed in **Exhibit 2.**

4.17 Area factors are shown as part of COMPASS output (see **Attachment 7-1**) and are based on the Cs-137 area factors from the SNEC LTP.

5.0 CALCULATIONS

5.1 All calculations are performed internal to applicable computer codes or within an Excel (**Reference 3.13**) spreadsheet.

6.0 APPENDICES

6.1 **Attachment 1-1** is the general layout diagram of the survey units.

6.2 **Attachment 2-1** *and* **2-2** *are the DCGLw calculation logic for the survey unit from* **Reference 3.15** and the estimate of effect on efficiency of the irregular surface.

6.3 **Attachment 3-1,** is a copy of the calibration data from typical 43-68B GFPC radiation detection instrumentation that will be used in this survey area. **Attachment 3-2,** is a copy of the calibration data for a typical 43-37 GFPC radiation detection instrumentation that will be used in this survey area.

6.4 **Attachment 4-1,** is the 43-68B MDCscan calculation sheet for concrete (and macadam) surfaces in dpm/100cm^2. **Attachment 4-2** shows the effect of elevated background on the 43-68B MDCscan. **Attachment 4-3** is the 43-37 MDCscan calculation sheet for concrete (and macadam) surfaces in dpm/100cm^2.

6.5 **Attachment 5-1,** is a summary list of survey units included in this design, with the estimated area of each.

6.6 **Attachment 6-1** through **6-39,** show the randomly picked scan locations (from VSP) and reference coordinates for the survey unit areas.

6.7 **Attachment 7-1** *through* **7-5,** *are COMPASS output for the survey unit showing the number* of sampling points in the survey unit, area factors, and prospective power.

6.8 **Attachment 8-1,** is the surface variability results for concrete surface measurements from the Williamsburg station (**Reference 3.15**). **Attachment 8-2** is the summary of 43-68B backgrounds and surface measurements taken in the survey unit. **Attachments 8-3** through **8-6** are copies of the survey used for variability. **Attachment 8-7** is the summary of 43-37 backgrounds and surface measurements taken in the survey unit which are shown in **Attachment 8-8.**

6.9 **Attachment 9-1,** is the results of the inspection report for the residual surface portion of the OL1 area. **Attachments 9-2** through **9-5** are the surface test measurement data.

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. E900-05-015 rev 1	Location Codes SNEC plant areas : OL1 Paved and Miscellaneous concrete surfaces MA8, PF1, DB5, DB1, SS12, SS24		
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	
2	Are drawings/diagrams adequate for the subject area (drawings should have compass headings)?	Yes, N/A	
3	Are boundaries properly identified and is the survey area classification clearly indicated?	Yes, N/A	
4	Has the survey area(s) been properly divided into survey units IAW **EXHIBIT 10**	Yes, N/A	
5	Are physical characteristics of the area/location or system documented?	Yes, N/A	
6	Is a remediation effectiveness discussion included?	Yes, N/A	
7	Have characterization survey and/or sampling results been converted to units that are comparable to applicable DCGL values?	Yes, N/A	
8	Is survey and/or sampling data that was used for determining survey unit variance included?	Yes, N/A	
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	
10	Are applicable survey and/or sampling data that was used to determine variability included?	Yes, N/A	
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	
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	
13	Are all necessary supporting calculations and/or site procedures referenced or included?	Yes, N/A	
14	Has an effective DCGLw been identified for the survey unit(s)?	Yes, N/A	
15	Was the appropriate $DCGL_{EMC}$ included in the survey design calculation?	Yes, N/A	
16	Has the statistical tests that will be used to evaluate the data been identified?	Yes, N/A	
17	Has an elevated measurement comparison been performed (Class 1 Area)?	Yes, N/A	
18	Has the decision error levels been identified and are the necessary justifications provided?	Yes, N/A	
19	Has scan instrumentation been identified along with the assigned scanning methodology?	Yes, N/A	
20	Has the scan rate been identified, and is the MDCscan adequate for the survey design?	Yes, N/A	
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	
22	Is survey instrumentation calibration data included and are detection sensitivities adequate?	Yes, N/A	
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	
24	Are investigation levels and administrative limits adequate, and are any associated actions clearly indicated?	Yes, N/A	
25	For sample analysis, have the required MDA values been determined.?	Yes, N/A	
26	Has any special sampling methodology been identified other than provided in **Reference 6.3**?	Yes, N/A	

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

ORIGINAL

GFPC Radiation Measurement Instrument Calibration Worksheet

Performed By:	Thomas Madden	Date:	4/29/04
Instrument S/N:	95348	Probe S/N:	92501 (A)
Instrument Vendor Cal. Date:	5/3/06	Cal. Due Date:	5/3/06

Source No.	ISO 7503-1 Values "ε_s"	Reference Date	A_0 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	5/16/05

Decay Factor⇒	8.687E-01
Elapsed Time (days)⇒	2230
Activity (µCi)⇒	2.700E-01
Source dpm⇒	5.994E+05
Source dpm/in Probe Area (cm^2)⇒	5.035E+05
2π Emission Rate (sec-1)⇒	5.986E+03
2π Emission Rate (min-1)⇒	3.591E+05
2π Emission Rate in Probe Area (min-1)⇒	3.017E+05

Probe Area (cm^2)
126

Record of 1 Minute Source & Background Counting Results

No.	OW Source Gross CPM	OW Background CPM	OW Source Net CPM
1	1.32E+05	972	1.309E+05
2	1.32E+05	938	1.309E+05
3	1.32E+05	947	1.309E+05
4	1.31E+05	964	1.305E+05
5	1.33E+05	951	1.318E+05
6	1.32E+05	975	1.308E+05
7	1.32E+05	997	1.308E+05
8	1.32E+05	946	1.309E+05
9	1.32E+05	942	1.309E+05
10	1.33E+05	1005	1.318E+05
	Mean⇒	963.7	1.310E+05

☑ Check if using ISO 7503-1 Value

RESULTS
Counts/Emission (ε_i)
43.4%
2π Emission/Disintigration (ε_s)
50.0%
Counts/Disintigration (ε_t)
21.7%

Approved: [signature]

Date: 5/17/05

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

Attachment 3-2
3E00-05-015

Attachment 1-1
SEE 05-016

43-37 GFPC Scan MDC Calculation

MDCscan =	7311	dpm/100cm2

b = background in counts per minute
bi = background counts in observation interval
Ei = GFPC Detector / meter calibrated response in cpm/dpm
Es = Source efficiency emissions / disintegration
Et = Net detector efficiency
d = Index of sensitivity from MARSSIM Table 6.5 based on 95% detection, 60% false positive
p = human performance adjustment factor - unitless
SR = Scanning movement rate in centimeters per second
MDCscan = MinimumDetectable Concentration for scanning in dpm/100cm2
C= Constant to convert MDCR to MDC
Wd = Detector width in cm
A= area of probe in cm2
Oi = Observation interval in seconds
DCGLeq = Net count rate equivalent to the Adjusted DCGL
ECF = Efficiency correction factors (surface roughness)
AL = Action level, DCGLeq adjusted for d and p

b =	1020 cpm	p =	0.5	Wd =	13.3 cm
SR =	30.5 cm/sec	d =	1.38	DCGL =	19834 dpm/100 cm2
Ei=	0.4 cpm/dpm	Es=	0.500	A=	100 cm 2

ECF= 0.5

Es*Ei= 0.2 = Et

$\frac{Wd}{SR}$ = 0.43607 = Oi (sec) $\frac{b*Oi}{60\ (sec/min)}$ = 7.4 = bi (counts)

$\frac{1}{Ei*Es*ECF*A/100*sqrt(p)}$ = 14.14 =C

$\frac{d*sqrt(bi)*60}{Oi}$ = 517 =MDCRi (net cpm) MDCRi+b= 1537 = gross cpm at MDCRi

MDCRi * C = 7311 = MDCscan in dpm/100cm2

$\frac{DCGL*Ei*Es*ECF*A}{100}$ = 1983 = DCGLeq cpm

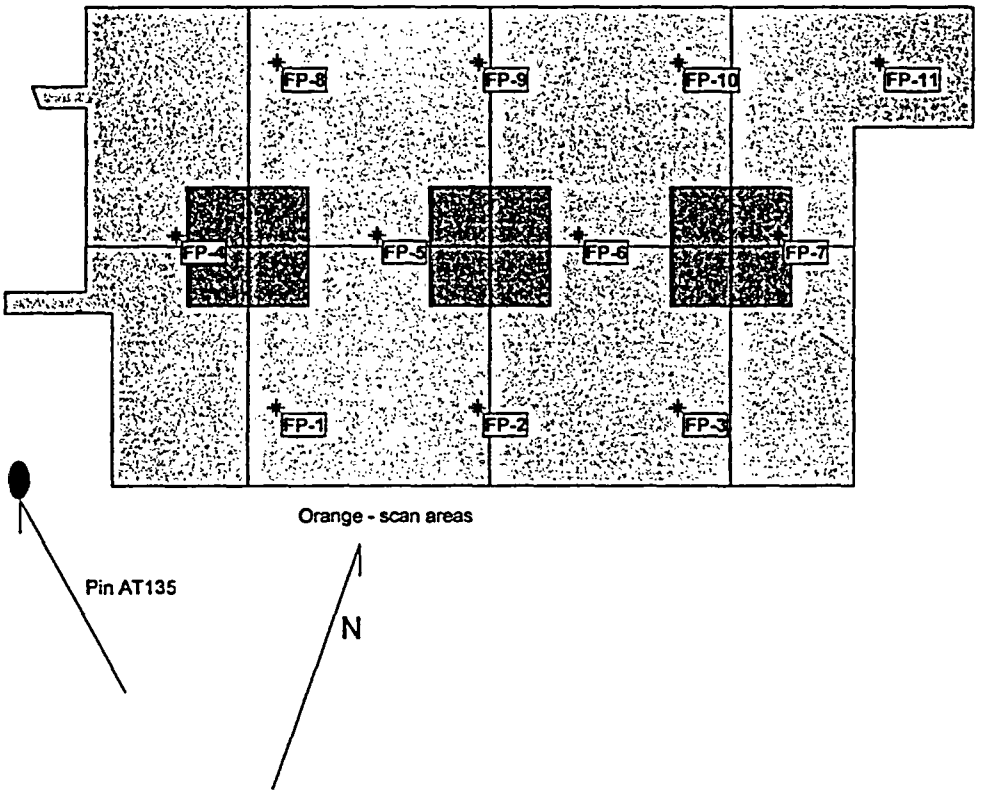
Attachment 4-3
E900-05-015

OL1 Concrete and Pavement Surfaces Survey Units

Unit	Area m^2	Description
MA8-6	76	Macadam - old SNEC parking lot, grid AU127
MA8-7	76	Macadam - old SNEC parking lot, grid AU128
MA8-8	76	Macadam - old SNEC parking lot, grid AU129
MA8-9	76	Macadam - old SNEC parking lot, grid AU130
MA8-10	102	Macadam - old SNEC parking lot, primarily grid AT131
MA8-11	42	Macadam - old SNEC parking lot, primarily grid AU131
MA8-12	73	Macadam - old SNEC parking lot, V shaped on N and E sides of AV131
MA8-13	100	Macadam - old SNEC parking lot, primarily grid AV131
MA8-14	33	Pavements around line shack
MA8-15	37	Concrete slabs and blocks NW of CV
MA8-16	93	Macadam - old SSGS driveway, grid AX131
MA8-17	58	Macadam - old SSGS driveway, grid AY131
PF1	37	Concrete - PAF floor slab
DB5	54	Concrete - DSB Carport slab
DB1-1	85	Concrete - DSB floor slab, west portion
DB1-2	109	Concrete - DSB floor slab, east portion
SS12	658	Concrete - SSGS Boiler Pad
SS24-1	249	Concrete - SSGS on grade concrete North of the turbine hall
SS24-2	321	Concrete - SSGS on grade concrete North of the turbine hall-under soil

Attachment 5-1
E900-05-015

SS12 SSGS Boiler Pad Concrete



Attachment 6-34
E900-05-015

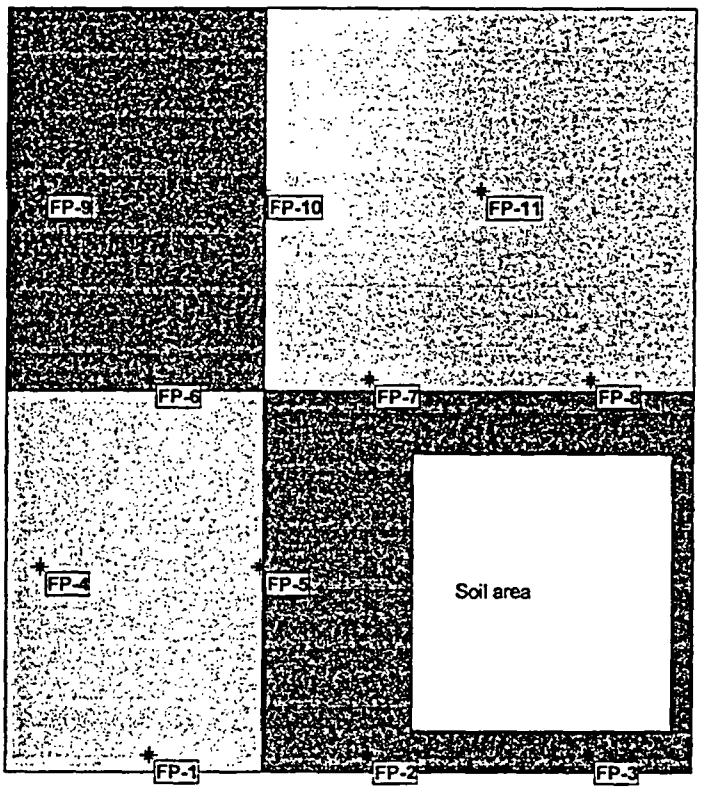
SS12 SSGS Boiler Pad Floor Slab
Measurements in FEET
658 sq meters

X Coord	Y Coord	Label	Value	Type
36.7	10.7	FP-1	0	Systematic
64.0	10.7	FP-2	0	Systematic
91.2	10.7	FP-3	0	Systematic
23.1	34.3	FP-4	0	Systematic
50.3	34.3	FP-5	0	Systematic
77.6	34.3	FP-6	0	Systematic
104.9	34.3	FP-7	0	Systematic
36.7	57.9	FP-8	0	Systematic
64.0	57.9	FP-9	0	Systematic
91.2	57.9	FP-10	0	Systematic
118.5	57.9	FP-11	0	Systematic

measured from pin AT135

Attachment 6-35
E900-05-015

SS24-1 SSGS north pad



Soil

Pin AX133

Scan orange areas

N

Attachment 6-36
E900-05-015

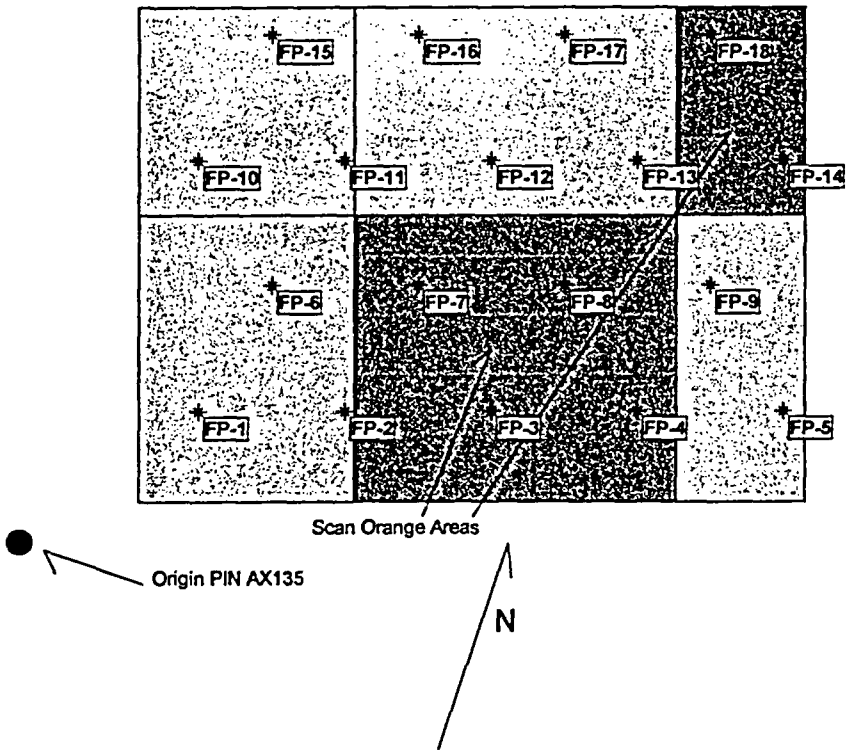
SS24-1 SSGS North Pad
Measurements in FEET
249 sq meters

X Coord	Y Coord	Label	Type
24.2	4.6	FP-1	Systematic
41.0	4.6	FP-2	Systematic
57.7	4.6	FP-3	Systematic
15.8	19.1	FP-4	Systematic
32.6	19.1	FP-5	Systematic
24.2	33.7	FP-6	Systematic
41.0	33.7	FP-7	Systematic
57.7	33.7	FP-8	Systematic
15.8	48.2	FP-9	Systematic
32.6	48.2	FP-10	Systematic
49.4	48.2	FP-11	Systematic

measured from pin AX133

Attachment 6-37
E900-05-015

SS24-2 North SSGS pad under soil



Attachment 6-38
E900-05-015

SS24- SSGS North Pad under soil
Measurements in FEET
231 sq meters

X Coord	Y Coord	Label	Type
16.9	12.6	FP-1	Systematic
31.8	12.6	FP-2	Systematic
46.7	12.6	FP-3	Systematic
61.6	12.6	FP-4	Systematic
76.5	12.6	FP-5	Systematic
24.4	25.5	FP-6	Systematic
39.3	25.5	FP-7	Systematic
54.2	25.5	FP-8	Systematic
69.1	25.5	FP-9	Systematic
16.9	38.4	FP-10	Systematic
31.8	38.4	FP-11	Systematic
46.7	38.4	FP-12	Systematic
61.6	38.4	FP-13	Systematic
76.5	38.4	FP-14	Systematic
24.4	51.3	FP-15	Systematic
39.3	51.3	FP-16	Systematic
54.2	51.3	FP-17	Systematic
69.1	51.3	FP-18	Systematic

Measured from pin AX135

Attachment 6-39
E900-05-015

OL1 43-37 Backgrounds

	DSB	Asph		Boiler Pad
	974	1025		971
	953	941		1115
	~~947~~	~~967~~		1000
	999	974		985
	873	911		1020
		~~926~~	928	
		902		
		953		
		978		
		949		
mean	949.2	~~952.66~~		1018.2
std dev	47.2	~~36.1~~ 35.9	7/K 5/19/15	57.1

Attachment 8-7
E900-05-015

Information Only

cpm

37122N21	95348						
0	DSBBKG1	5/12/05	14:09	5	974	60	SCL
1	DSBBKG2	5/12/05	14:11	5	953	60	SCL
2	DSBBKG3	5/12/05	14:12	5	947	60	SCL
3	DSBBKG4	5/12/05	14:14	5	999	60	SCL
4	DSBBKG5	5/12/05	14:15	5	873	60	SCL
5	ASPHBKG1	5/12/05	14:18	5	1025	60	SCL
6	ASPHBKG2	5/12/05	14:20	5	941	60	SCL
7	ASPHBKG3	5/12/05	14:21	5	967	60	SCL
8	ASPHBKG4	5/12/05	14:23	5	974	60	SCL
9	ASPHBKG5	5/12/05	14:25	5	911	60	SCL
10	BPADBKG1	5/12/05	14:30	5	971	60	SCL
11	BPADBKG2	5/12/05	14:32	5	1115	60	SCL
12	BPADBKG3	5/12/05	14:34	5	1000	60	SCL
13	BPADBKG4	5/12/05	14:36	5	985	60	SCL
14	BPADBKG5	5/12/05	14:38	5	1020	60	SCL
15	ASP2BKG1	5/12/05	14:41	5	928	60	SCL
16	ASP2BKG2	5/12/05	14:42	5	902	60	SCL
17	ASP2BKG3	5/12/05	14:44	5	953	60	SCL
18	ASP2BKG4	5/12/05	14:45	5	978	60	SCL
19	ASP2BKG5	5/12/05	14:47	5	949	60	SCL
LOGGED DATA DUMP COMPLETED.							

43-37 concrete + asphalt backgrounds

Attachment 8-8
E900-05-015