Appendix A (pages 1 to 10)

FirstEnergy

SNEC CALCULATION COVER SHEET

CALCULATION DESCRIPTION

Calculation Number	Revision Number	Effective Date	Page Number
E900-05-023	0	4/18/05	1 of 10

Subject

Miscellaneous Chain Link Fences MA9- 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

APPROVAL SIGNATURES

Calculation Originator	W. J. Cooper CHP/	Date	4/14/05
Technical Reviewer	T. Tritch/	Date	4/14/05
Additional Review	A. Paynter/	Date	16 Apr. 2005
Additional Review		Date	

APPENDIX A MA9

1.0 PURPOSE

1.1 The purpose of this calculation is to develop a survey design for the miscellaneous chain link fences MA9 survey area throughout the Saxton Nuclear Experimental Corporation open land areas. The fences total approximately ***1000 linear meters***.

1.2 No classification for the fences is provided in the SNEC LTP **(Reference 3.5)** and the survey of remaining fences is a unique survey, not a soil or concrete surface as expected in the MARSSIM process **(Reference 3.12)**. Because of the unique character of the fences, little or no residual contamination is expected.

1.3 Although MARSSIM does not address such unique surveys as open chain fencing, the survey will be designed to MARSSIM to the extent practicable.

1.4 The fences will be divided into two survey units, with those in and around class 1 areas surveyed as class 2 (10% to 50% scan) as MA9-1 and those in class 2 and 3 areas surveyed as class 3 (1% to 10% scan) as survey unit MA9-2. See **Attachment 1-1** for general layout of the fencing.

1.5 Because of the unique character of this survey, static measurements will be in the center of randomly selected sections of fence, selected by grid. Random grid placement would place all of the survey points at the same (but random) height anyway since the survey unit is effectively one continuous strip.

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 from **Reference 3.15**. This data source is used because of the presence of significant portions of fencing in the OL1 and OL2 areas, and the assumption that variability throughout the site is best represented by the activity from the site compound area. 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 the chain link fence shall be performed using a ***L2350 with 43-68B large area gas flow proportional counter*** calibrated to Cs-137 (see typical calibration information on **Attachment 3-1**).

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*** (Ei*Es).

2.1.3 Other instruments of the type 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 value listed in Section 2.1.2 above.

2.1.4 An area correction factor (ACF) is applied in place of the usual efficiency correction factor (ECF) to compensate for the limited actual surface area of the chain link.

2.1.4.1 The actual area covered by the link is slightly more then 10% (see **Attachment 5**). In order to account for this, the surface area factor of 0.1 is applied as the ACF.

2.1.4.2 Some geometry effects are present, but the distances are reasonably uniform and the absolute efficiency should be higher with metal substrate than for concrete. Since these two effects are contradictory, no account is taken of them in this design for simplicity.

2.1.4.3 The 0.1 ACF is very conservative. Since the standing fence is essentially equivalent to a standing wall, the dose effects of activity on the wire of the fence at any distance greater than an inch or two from the fence is entirely equivalent to the same activity uniformly distributed over the same area. In addition, residence times would be lower for a fence than a building re-use scenario. Therefore, the application of a 0.1 area factor to the detector geometry essentially introduces a conservatism factor of at least 10 into the survey when compared to a standing wall dose model.

2.1.5 The fraction of detectable beta emitting activity affects the efficiency and is determined by the nuclide mix. The mix 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 100cm2. The Cs-137 adjusted surrogate activity already accounts for the beta yield of the mix.

Table 2, GFPC Detection Efficiency Results Used for Planning

Material Type	EI	Es	Et(as %)	ACF	Adjusted efficiency
Concrete	.478	.5	23.9	0.1	2.39%

Table 3, Surface Scanning Parameters for Misc. Chain Link Fence

MDCscan (dpm/100cm^2)*	Scan Speed (cm/sec)	Maximum Distance from Surface	DCGLw Action Level	% Coverage
11966	10	1" (gap between detector face & surface)	> 600 ncpm	varies

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

2.1.6 This MDCscan is based on an assumed rounded value at the upper end of the observed background range, 500 cpm background. This produces a slightly higher

MDCscan result, which demonstrates that the MDCscan is still less than the adjusted DCGLw at the upper end of expected background. Most backgrounds are lower than this assumed value, with an average of about 300 cpm.

2.1.7 On 4/7/05 open window and shielded GFPC measurements were obtained directly from the fences in numerous locations. This data (**Attachment 8-2**) is used for the variability assessment for the COMPASS determination of sample requirements (**Attachment 8-1**). If local backgrounds exceed the background count rate assumed for the MDCscan (~500cpm - see **Attachment 4-1**) **contact the cognizant SR coordinator**.

2.1.8 The scan DCGLw Action Level listed in Table 3 does not include 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**).

2.1.9 If a count rate greater than the "DCGLw action level" of Table 3 is encountered during the scanning process, 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

2.1.9.1 ***Class 3*** fencing (MA9-2) should be scanned to include between 1% and up to 10% surface coverage at a scan rate of about 10 cm per second. Fencing in approximately 70 grids is included in the class 3 portion which equates to about 1400 square meters of fence area and about 140 square meters of actual surface area. Class 3 structure survey units may be as large as 10,000 square meters per Table 5-5 of the SNEC LTP (**Reference 3.5**). Ten grids in the class 3 area are selected for survey based on random numbers derived from an Excel spreadsheet as listed in **Attachment 6-3**. This would greatly exceed the needed 1% minimum coverage.

2.1.9.2 ***Class 2*** fencing (MA9-1) should be scanned to include between 10% and up to 50% surface coverage at a scan rate of about 10 cm per second. Fencing in approximately 30 grids is included in the class 2 portion which equates to about 600 square meters of fence area and about 60 square meters of actual surface area. Class 2 structure survey units may be as large as 1000 square meters per Table 5-5 of the SNEC LTP (**Reference 3.5**). Eleven grids are selected for survey. Ten grids in the class 2 area are selected based on random numbers derived from an Excel spreadsheet. An additional grid, AX123 is a biased selection due to the personnel gate in the fence and its proximity to the RWDF. **Attachment 6-2** lists the class 2 fence grids selected for scanning. These eleven selections would greatly exceed the needed 10% minimum coverage.

2.1.9.3 The surface of the fence toward the higher classification land areas is required to be scanned. See **Attachment 1-1** for grid layout for the survey unit. Areas that cannot be accessed should be clearly noted along with the reason for not completing the scan in that area.

2.1.9.4 The full length and height of fences within each defined grid are to be scan surveyed. The vertical and horizontal support poles should also be surveyed. Because of the different geometry for the poles, the MDCscan and AL are very conservative for the poles. Do not attempt to scan barbed wire or other sharp projections.

2.1.9.5 Some gas flow proportional counters can be sensitive to sunlight. This depends on the condition of the mylar. Care should be taken to minimize sunlight effects. If an AL is measured but sunlight response is suspected or possible, it can be confirmed that the AL is or is not a result of sunlight by placing a small, previously surveyed, clean backplate (e.g. 1 square foot piece of plywood) behind the fence to reduce sunlight effects.

2.1.10 The minimum number of fixed measurement sampling points (N+20%) indicated by the COMPASS computer program **(Reference 3.3)** is ***11*** for the aggregate survey unit (see COMPASS output on **Attachment 7-1** to **7-3**). Fixed point measurements should be IAW Section 2.2. The MDCscan (fence) is below the effective administrative $DCGLw_{Cs-137}$ (11966 DPM/100cm^2 MDCscan @500cpm bkg < 19834 DPM/100cm2 AL).

2.1.11 MARSSIM specifies that sample point determination in Class 3 areas can be a simple random selection process. MARSSIM recommends a random systematic grid layout arrangement for class 2 survey point selection. Due to the unique nature of this survey, a simple random survey point selection process is used here for the class 2 survey as well because of the simple linear layout of the fences. Therefore Excel **(Reference 3.13)** is used to produce random numbers (see **Attachment 6-1**). These numbers are used to select grids for scanning. See **Attachment 6-2** and **6-3** for sampling point locations.

2.1.12 An additional biased grid fixed point in the class 2 MA9-1 area is selected. Grid AX123 is a biased selection due to the personnel gate in the fence and its proximity to the RWDF.

2.1.13 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.

2.1.14 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 since it is based on a class 2 and 3 survey units.

2.2 Measure 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 Clearly mark, identify and document all sample locations.

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

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 GFPC measurements on fences 4/7/05

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 6900–02-028 "GFPC Instrument Efficiency Loss Study"

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"

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**). COMPASS calculation of the DCGL equivalent cpm does not appear to use the full 126 cm^2 of the detector. The COMPASS value can be duplicated if only 100cm^2 is used. See **Attachment 4-1** for the DCGLeq calculation used.

4.2 Survey unit specific shielded measurements were obtained on 4/7/05. These are used as the initial estimate of variability. These results are shown on **Attachment 8-1** and **8-2.**

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 assigned to grids based on the sequential listing of fence grids as shown in **Attachment 6.**

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

4.6 Background has been measured in the area, and ranges from about 125 cpm to about 450 cpm **(Reference 3.7)** with an average of about 300 cpm.

4.7 The determination of the physical extent of this area is based on the drawing **Reference 3.8.**

4.8 Remediation History

There has been no known remediation of the remaining chain link fences. Some of the fences were installed since decommissioning began.

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. 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 fences is based on the OL1 and OL2 areas and 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. The expected range of background values varies from about 125 cpm to ~450 cpm with average about 300 cpm, but the design assumes (for MDCscan assessment) that background may be as high as 500 cpm.

4.10 The survey unit described in this survey design was inspected. A copy of the fence specific portion of the SNEC facility post-remediation inspection report **(Reference 3.11)** 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 Although this survey is not one of the "Special measurements" as described in the SNEC LTP this is a non-standard survey since it is not the typical soil or concrete. Unique assumptions and design requirements are included, with the intent that the design be as consistent with a standard MARSSIM survey as practicable.

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 of **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 a diagram of survey area.

6.2 **Attachment 2-1** is the DCGLw calculation logic for the survey unit from **Reference 3.15 .**

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

6.4 **Attachment 4-1,** is the MDCscan calculation sheet for open chain link in dpm/100cm^2.

6.5 **Attachment 5-1** and **5-2,** is a review of the impact of the 'open weave' of the fence and derivation of the ECF

6.6 **Attachment 6-1** to **6-3,** show the randomly picked scan locations (random numbers from Excel) and reference coordinates for the survey unit areas.

6.7 **Attachment 7-1** through **7-4,** 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 summary of the surface variability results for the 4/7/05 survey data in the survey unit. **Attachment 8-2** is a listing of the background measurements from the 4/7/05 survey.

6.9 **Attachment 9-1,** is the results of the inspection report for the fencing

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).

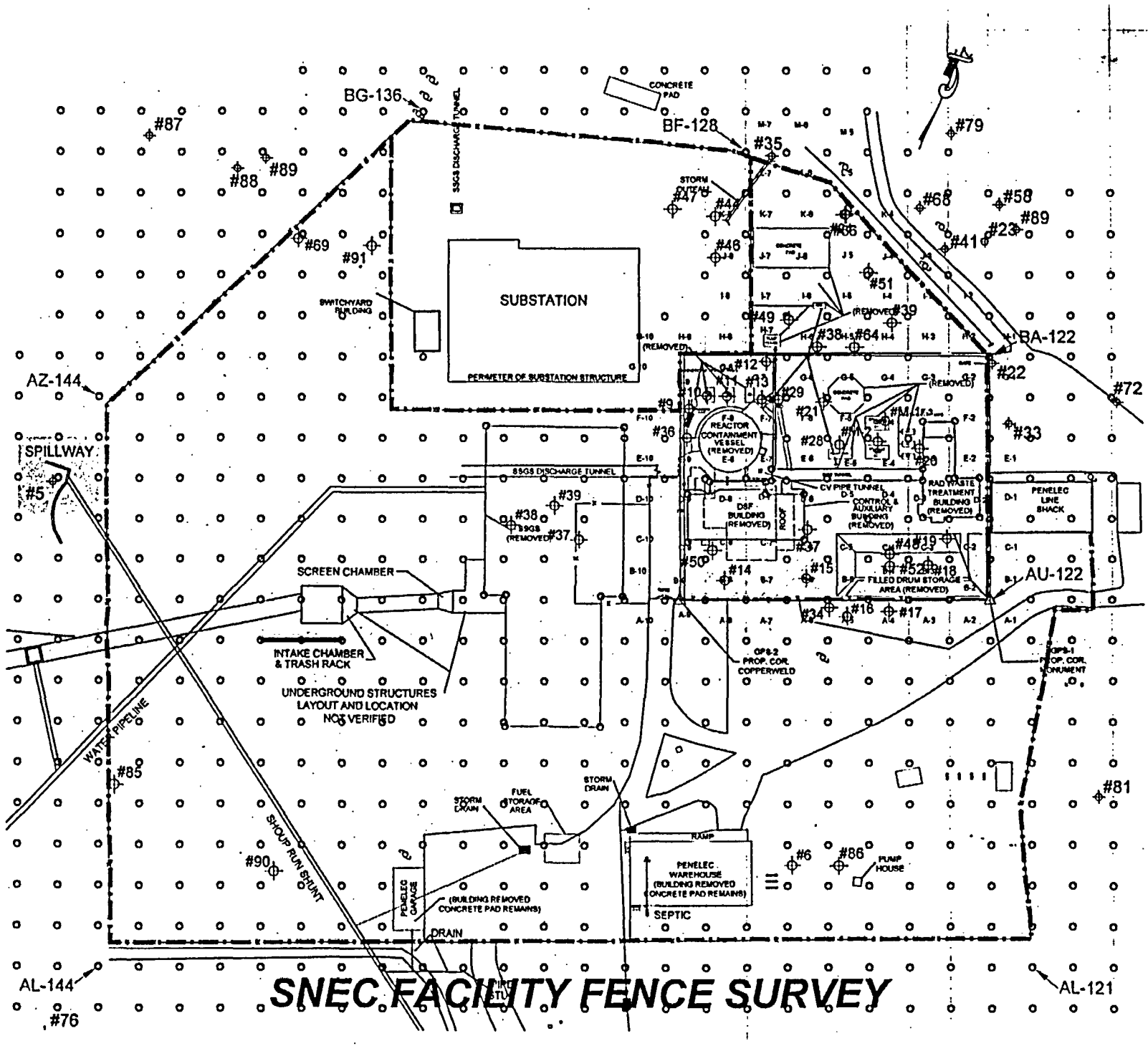
Exhibit 2
Survey Design Checklist

Calculation No. E900-05-023	Location Codes Miscellaneous Chain Link Fences MA9		
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	T.M.T. 6/14/05
2	Are drawings/diagrams adequate for the subject area (drawings should have compass headings)?	(Yes) N/A	T.M.T. 6/14/05
3	Are boundaries properly identified and is the survey area classification clearly indicated?	(Yes) N/A	T.M.T. 6/14/05
4	Has the survey area(s) been properly divided into survey units IAW EXHIBIT 10	(Yes) N/A	T.M.T. 6/14/05
5	Are physical characteristics of the area/location or system documented?	(Yes) N/A	T.M.T. 6/14/05
6	Is a remediation effectiveness discussion included?	(Yes) N/A	T.M.T. 6/14/05
7	Have characterization survey and/or sampling results been converted to units that are comparable to applicable DCGL values?	(Yes) N/A	T.M.T. 6/14/05
8	Is survey and/or sampling data that was used for determining survey unit variance included?	(Yes) N/A	T.M.T. 6/14/05
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	T.M.T. 6/14/05
10	Are applicable survey and/or sampling data that was used to determine variability included?	(Yes) N/A	T.M.T. 6/14/05
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	T.M.T. 6/14/05
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)	T.M.T. 6/14/05
13	Are all necessary supporting calculations and/or site procedures referenced or included?	(Yes) N/A	T.M.T. 6/14/05
14	Has an effective DCGLw been identified for the survey unit(s)?	(Yes) N/A	T.M.T. 6/14/05
15	Was the appropriate $DCGL_{EMC}$ included in the survey design calculation?	Yes (N/A)	T.M.T. 6/14/05
16	Has the statistical tests that will be used to evaluate the data been identified?	(Yes) N/A	T.M.T. 6/14/05
17	Has an elevated measurement comparison been performed (Class 1 Area)?	Yes, (N/A)	T.M.T. 6/14/05
18	Has the decision error levels been identified and are the necessary justifications provided?	(Yes) N/A	T.M.T. 6/14/05
19	Has scan instrumentation been identified along with the assigned scanning methodology?	(Yes) N/A	T.M.T. 6/14/05
20	Has the scan rate been identified, and is the MDCscan adequate for the survey design?	(Yes) N/A	T.M.T. 6/14/05
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)	T.M.T. 6/14/05
22	Is survey instrumentation calibration data included and are detection sensitivities adequate?	(Yes) N/A	T.M.T. 6/14/05
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	T.M.T. 6/14/05
24	Are investigation levels and administrative limits adequate, and are any associated actions clearly indicated?	(Yes) N/A	T.M.T. 6/14/05
25	For sample analysis, have the required MDA values been determined.?	Yes, (N/A)	T.M.T. 6/14/05
26	Has any special sampling methodology been identified other than provided in Reference 6.3?	Yes, (N/A)	T.M.T. 6/14/05

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

originally reviewed 6/14/05, overlooked completion of this page until 6/16/05 T.M.Tritch.

Appendix A (attachments 1-1 to 6-3)



SNEC FACILITY FENCE SURVEY

Attachment 1-1, E900-05-023

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

SAMPLE NO(s)⇒ CV YARD SOIL & BOULDER SAMPLES

Cs-137 Limit		Cs-137 Administrative Limit	
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 2-1
E900-05-023

2350 INSTRUMENT AND PROBE EFFICIENCY CHART

7/01/04 (Typical 43-68 Beta Efficiency Factors)

Different Instrument/Probe Cal Due	Use unit with instrument that's up to date.

INST #	INST C/D	43-68 PROBE #	PROBE C/D	44-10 PROBE #	PROBE C/D	BETA EFF	ALPHA EFF
79037	04/05/05	122014	04/23/05			25.2%	N/A
126188	1/27/05	099186	1/27/05			28.2%	N/A
126218	01/08/05	095080	01/09/05			27.9%	N/A

Attachment 3-1
E900-05-023

GFPC Scan MDC Calculation

MDCscan = 11966 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 = 500 cpm p = 0.5 Wd = 8.8 cm

SR = 10 cm d = 1.38 DCGL = 19834 dpm/100 cm2

Ei= 0.478 cpm/dpm Es= 0.500 A= 126 cm 2

ECF= 0.1

Es*Ei= 0.239 = Et

$\frac{Wd}{SR}$ = 0.88 = Oi (sec) $\frac{b*Oi}{60\ (sec/min)}$ = 7.3 = bi (counts)

$\frac{1}{Ei*Es*ECF*A/100*sqrt(p)}$ = 46.96 =C

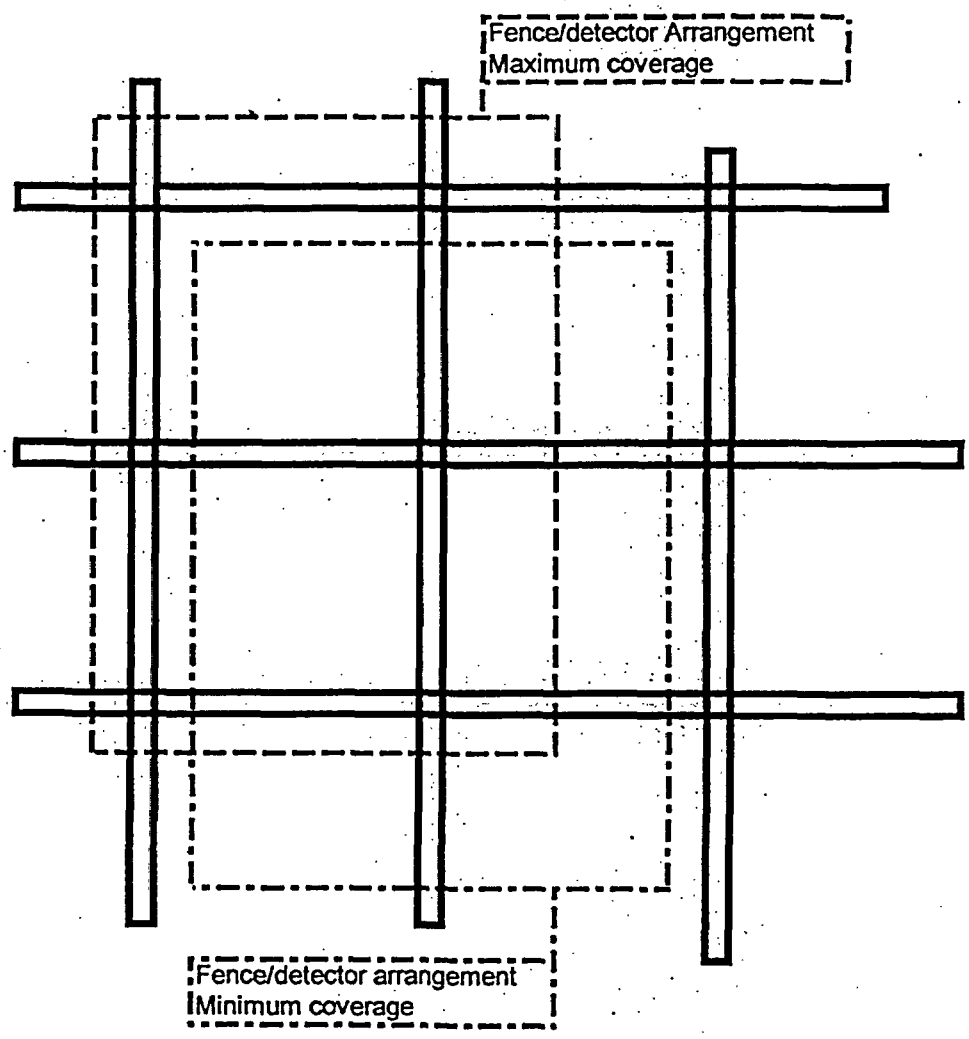
$\frac{d*sqrt(bi)*60}{Oi}$ = 255 =MDCRi (net cpm) MDCRi+b= 755 = gross cpm at MDCRi

MDCRi * C = 11966 = MDCscan in dpm/100cm2

$\frac{DCGL*Ei*Es*ECF*A}{100}$ = 597 = DCGLeq cpm

Attachment 4-1
E900-05-023

General Arrangement - 43-68 survey of Chain Link Fence



Attachment 5-1
E900-05-023

Efficiency Assessment - 43-68 survey of Chain Link Fence

Fence wire is 1/8 inch diameter
Fence links are 2 1/4 inches apart center to center

Given that links are actually diagonally arranged
Horizontal and vertical refer to the axes of the detector

Given probe is about 8.8 cm wide(from MDCcalc sheet).
For 126 cm^2 must be 14.3 cm long (126/8.8=14.3)
Depending on probe/fence alignment, probe will cover more or less of the fence links as shown in Attachment 5-1

Minimum coverage:

Probe covers 2 links horizontally, with 8.8 cm span
covers 1 link vertically with14.3 cm span
link is 1/8 inch diameter = .3 cm

area covered is sum of horizontal and vertical spans times width of link
so 2 horizontal links times 8.8 cm span times .3 cm thick = 5.28 cm^2
and 1 vertcal link times 14.3 cm span times .3 cm thick = 4.29 cm^2

Add the two together: Total = 9.6 cm^2

Similarly for Maximum coverage:

probe covers 3 horizontal links, 8.8 cm span
probe covers 2 vertical links 14.3 cm span
link is 1/8 inch diameter = .3 cm

horizontal 3 * 8.8 * 0.3 = 7.92 cm^2
vertical 2 * 14.3 * 0.3 = 8.58 cm^2

Total = 16.5 cm^2

Average = (16.5+9.6)/2 = **13.05 cm^2**

% detector coverage (ACF) 13 / 126 = **10.4%**
ACF= area correction factor - see section 2.1.4 in text

Attachment 5-2
E900-05-023

Chain Link Fences

Random numbers for class 2 scans and fixed point

Scan	Sample
2	7
6	8
7	13
12	15
18	16
19	22
20	23
26	24
27	27
29	28
	29

Random numbers for class 3 scans and fixed point

Scan	Sample
4	4
6	10
22	15
23	21
33	28
35	35
49	45
51	47
55	49
61	64
	67

Attachment 6-1
E900-05-023

MA9-1 Class 2 Chain Link Fences
Survey Location Selection

	GRID	SCAN	SAMPLE
1	AV123		
2	AW123	Yes	
3	AX123	Biased	Biased
4	AY123		
5	AZ123		
6	BA123	Yes	
7	BB124	Yes	Yes
8	BC125		Yes
9	BD126		
10	BE126		
11	BE127		
12	BF129	Yes	
13	BF130		Yes
14	BF131		
15	BD128		Yes
16	BC128		Yes
17	BB128		
18	BA128	Yes	
19	BA129	Yes	
20	BA130	Yes	
21	AZ130		
22	AY130		Yes
23	AY131		Yes
24	AY132		Yes
25	AY133		
26	AY134	Yes	
27	AY135	Yes	Yes
28	AT121		Yes
29	AU120	Yes	Yes
30	AV120		

Yes = random point / grid

Biased = judgemental selected point/grid

Attachment 6-2
E900-05-023

MA9-2 Class 3 Chain Link Fences
Survey Location Selection

	GRID	SCAN	SAMPLE
1	BF132		
2	BF133		
3	BF134		
4	BF135	Yes	Yes
5	BF136		
6	BF137	Yes	
7	BF138		
8	BE138		
9	BD139		
10	BD140		Yes
11	BC140		
12	BC141		
13	BB141		
14	BB142		
15	BA142		Yes
16	BA143		
17	AZ143		
18	AZ144		
19	AY144		
20	AX144		
21	AW144		Yes
22	AV144	Yes	
23	AU144	Yes	
24	AT144		
25	AS144		
26	AR144		
27	AQ144		
28	AP144		Yes
29	AO144		
30	AN144		
31	AM144		
32	AL144		
33	AL143	Yes	
34	AL142		
35	AL141	Yes	Yes

	GRID	SCAN	SAMPLE
36	AL140		
37	AL139		
38	AL138		
39	AL137		
40	AL136		
41	AL135		
42	AL134		
43	AL133		
44	AL132		
45	AL131		Yes
46	AL130		
47	AL129		Yes
48	AL128		
49	AL127	Yes	Yes
50	AL126		
51	AL125	Yes	
52	AL124		
53	AL123		
54	AL122		
55	AM122	Yes	
56	AN122		
57	AO122		
58	AP122		
59	AQ121		
60	AR121		
61	AS121	Yes	
62	AT120		
63	AY136		
64	AY137		Yes
65	AX137		
66	BA137		
67	BB137		Yes
68	BC137		
69	BD137		
70	BE137		

Yes = random point / grid

Attachment 6-3
E900-05-023

Appendix A (attachments 7-1 to 9-1)

Site Report

Site Summary

Site Name: Fences

Planner(s): WJCooper

Contaminant Summary

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

Contaminant	Type	DCGLw	Screening Value Used?	Area (m²)	Area Factor
Cs-137	Building Surface	19,834	No	36	1
				25	1.2
				16	1.5
				9	2.2
				4	3.7
				1	11.2

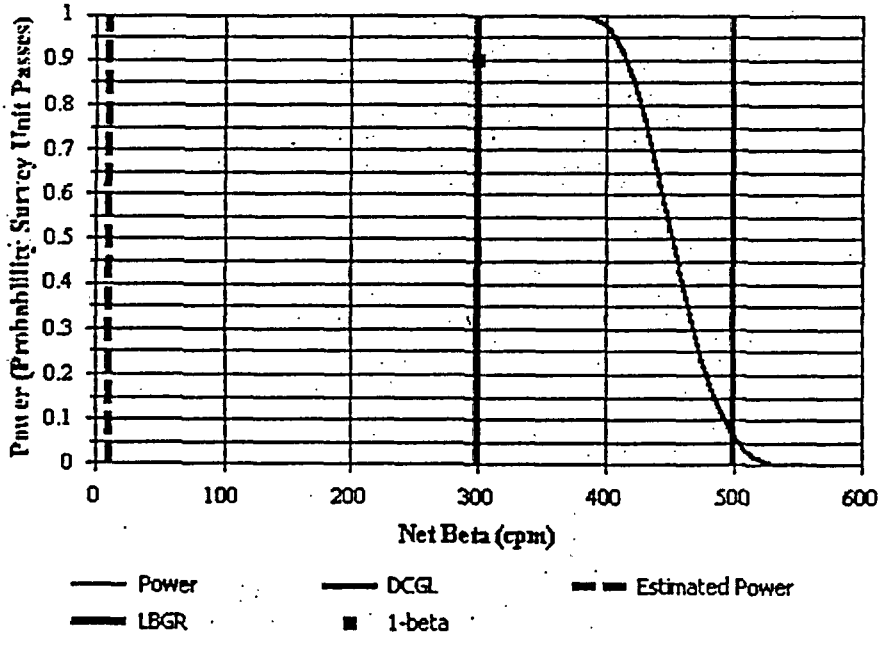
Attachment 7-1
E900-05-023

Building Surface Survey Plan

Survey Plan Summary

Site:	Fences		
Planner(s):	WJCooper		
Survey Unit Name:	Fences Class 2 MA 9-1 JC 4/13/05		
Comments:			
Area (m²):	600	Classification:	2
Selected Test:	Sign	Estimated Sigma (cpm):	77
DCGL (cpm):	500	Sample Size (N):	11
LBGR (cpm):	300	Estimated Conc. (cpm):	11
Alpha:	0.050	Estimated Power:	1.00
Beta:	0.100		

Prospective Power Curve



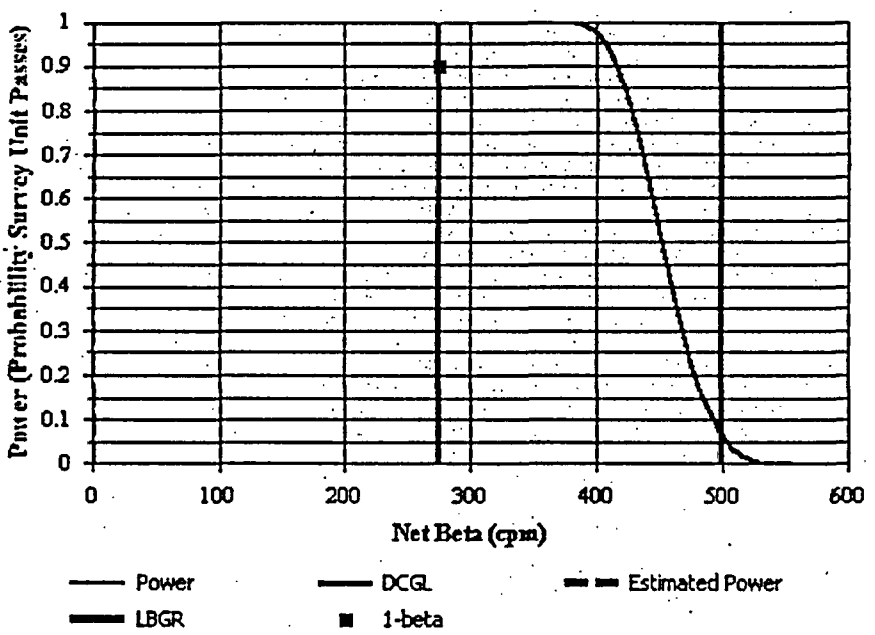
Attachment 7-2
E900-05-023

Building Surface Survey Plan

Survey Plan Summary

Site:	Fences		
Planner(s):	WJCooper		
Survey Unit Name:	Fences Class 3 MA9-2		
Comments:	JP 4/13/05		
Area (m²):	1,400	Classification:	3
Selected Test:	Sign	Estimated Sigma (cpm):	77
DCGL (cpm):	500	Sample Size (N):	11
LBGR (cpm):	275	Estimated Conc. (cpm):	0
Alpha:	0.050	Estimated Power:	1.00
Beta:	0.100		

Prospective Power Curve



Attachment 7-3
E900-05-023

Building Surface Survey Plan

Contaminant Summary

Contaminant	DCGLw (dpm/100 cm²)
Cs-137	19,834

Beta Instrumentation Summary

Gross Beta DCGLw (dpm/100 cm²): 19,834
Total Efficiency: 0.02
Gross Beta DCGLw (cpm): 500

ID	Type	Mode	Area (cm²)
3	GFPC	Beta	126

Contaminant	Energy[1]	Fraction[2]	Inst. Eff.	Surf. Eff.	Total Eff.
Cs-137	187.87	1.0000	0.24	0.10	0.0239

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

Gross Survey Unit Mean (cpm): 313 ± 77 (1-sigma)
Count Time (min): 1

Material	Number of BKG Counts	Average (cpm)	Standard Deviation (cpm)	MDC (dpm/100 cm²)
Fence	1	313	0	3,384

SEE ATT 4-1
4/12/05

Attachment 7-4
E900-05-023

Background / shielded GFPC values for fence survey
collected 4/7/05

322	
306	
274	
280	
339	
302	
368	
462	
418	
305	
345	
367	
396	
360	
316	
287	
185	
254	
129	
243	
129	Min
462	Max
313	Average
77	Std Dev

Attachment 8-1
E900-05-023

ORIGINAL

SNEC FSS RADIOLOGICAL SURVEY DATA FORM								Survey # FSS-1442
		Technician		B. Horton				
Log #	Location	Date	Time	Det	Reading (cpm)	Count Time (sec)	Media	Comments
3	E FNC 1 S	4/7/05	13:22	1	322	60	SCL	
4	E FNC 1 U	4/7/05	13:23	1	372	60	SCL	
5	E FNC 2 S	4/7/05	13:24	1	308	60	SCL	
6	E FNC 2 U	4/7/05	13:26	1	358	60	SCL	
7	E FNC 3 S	4/7/05	13:27	1	274	60	SCL	
8	E FNC 3 U	4/7/05	13:28	1	342	60	SCL	
9	E FNC 4 S	4/7/05	13:32	1	280	60	SCL	
10	E FNC 4 U	4/7/05	13:33	1	343	60	SCL	
11	E FNC 5 S	4/7/05	13:39	1	339	60	SCL	
12	E FNC 5 U	4/7/05	13:40	1	395	60	SCL	
13	E FNC 6 S	4/7/05	13:41	1	302	60	SCL	
14	E FNC 6 U	4/7/05	13:43	1	395	60	SCL	
15	E FNC 7 S	4/7/05	13:44	1	368	60	SCL	
16	E FNC 7 U	4/7/05	13:45	1	417	60	SCL	
17	E FNC 8 S	4/7/05	13:48	1	462	60	SCL	
18	E FNC 8 U	4/7/05	13:49	1	449	60	SCL	
19	E FNC 9 S	4/7/05	13:51	1	418	60	SCL	
20	E FNC 9 U	4/7/05	13:52	1	512	60	SCL	
21	S FNC10 S	4/7/05	14:08	1	305	60	SCL	
22	S FNC10 U	4/7/05	14:09	1	365	60	SCL	
23	S FNC11 S	4/7/05	14:11	1	345	60	SCL	
24	S FNC11 U	4/7/05	14:12	1	443	60	SCL	
25	S FNC12 S	4/7/05	14:20	1	367	60	SCL	
26	S FNC12 U	4/7/05	14:22	1	457	60	SCL	
27	S FNC13 S	4/7/05	14:23	1	396	60	SCL	
28	S FNC13 U	4/7/05	14:24	1	425	60	SCL	
29	S FNC14 S	4/7/05	14:28	1	360	60	SCL	
30	S FNC14 U	4/7/05	14:29	1	444	60	SCL	
31	NE FNC15 S	4/7/05	15:21	1	316	60	SCL	
32	NE FNC15 U	4/7/05	15:22	1	551	60	SCL	
33	NE FNC16 S	4/7/05	15:24	1	287	60	SCL	
34	NE FNC16 U	4/7/05	15:25	1	405	60	SCL	
35	NE FNC17 S	4/7/05	15:26	1	185	60	SCL	
36	NE FNC17 U	4/7/05	15:28	1	440	60	SCL	
37	NE FNC18 S	4/7/05	15:30	1	254	60	SCL	
38	NE FNC18 U	4/7/05	15:31	1	405	60	SCL	
39	NE FNC19 S	4/7/05	15:32	1	129	60	SCL	
41	NE FNC19 U	4/7/05	15:35	1	423	60	SCL	
42	NE FNC20 S	4/7/05	15:38	1	243	60	SCL	
43	NE FNC20 U	4/7/05	15:39	1	392	60	SCL	

E = East, S = South, NE = North East FNC = Fence U = Unshielded S = Shielded

Attachment 8-2
E900-05-023

Exhibit 1
Survey Unit Inspection Check Sheet

ORIGINAL

SECTION 1 - SURVEY UNIT INSPECTION DESCRIPTION

Survey Unit #	MA9	Survey Unit Location	First Energy/Penelec Fence lines
Date	4/13/05	Time	1545
Inspection Team Members	R. Shepherd, K. Lane		

SECTION 2 - SURVEY UNIT INSPECTION SCOPE

Inspection Requirements (Check the appropriate Yes/No answer.)	Yes	No	N/A
1. Have sufficient surveys (i.e., post remediation, characterization, etc.) been obtained for the survey unit?	X		
2. Do the surveys (from Question 1) demonstrate that the survey unit will most likely pass the FSS?	X		
3. Is the physical work (i.e., remediation & housekeeping) in or around the survey unit complete?		X	
4. Have all tools, non-permanent equipment, and material not needed to perform the FSS been removed?		X	
5. Are the survey surfaces relatively free of loose debris (i.e., dirt, concrete dust, metal filings, etc.)?		X	
6. Are the survey surfaces relatively free of liquids (i.e., water, moisture, oil, etc.)?	X		
7. Are the survey surfaces free of all paint, which has the potential to shield radiation?	X		
8. Have the Surface Measurement Test Areas (SMTA) been established? (Refer to Exhibit 2 for instructions.)			X
9. Have the Surface Measurement Test Areas (SMTA) data been collected? (Refer to Exhibit 2 for instructions.)			X
10. Are the survey surfaces easily accessible? (No scaffolding, high reach, etc. is needed to perform the FSS)		X	
11. Is lighting adequate to perform the FSS?	X		
12. Is the area industrially safe to perform the FSS? (Evaluate potential fall & trip hazards, confined spaces, etc.)		X	
13. Have photographs been taken showing the overall condition of the area?	X		
14. Have all unsatisfactory conditions been resolved?		X	

NOTE: If a "No" answer is obtained above, the inspector should immediately correct the problem or initiate corrective actions through the responsible site department, as applicable. Document actions taken and/or justifications in the "Comments" section below. Attach additional sheets as necessary.

Comments:

Response to Question 1:

A portion of fence line adjacent to Class 1 areas had static GFPC survey performed and all open land fence line areas had characterization surveys.

Response to Question 3, 4, 5:

Fence lines will need to be de-weeded prior to FSS. Additionally, sharps/misc. items attached to fences will have to be removed prior to FSS. Notified L. Shamenek.

Response to Question 10:

Some areas around east fence have been excavated below grade making personnel access to perform FSS difficult. Recommend scaffold or other access aid. Notified L. Shamenek.

Response to Question 12:

Fence line perimeter requires general housekeeping. Tripping/Safety hazards present on ground. Notified L. Shamenek.

Survey Unit Inspector (print/sign)	Ray Shepherd/ R Shepherd Kevin Lane/ K L	Date	4/13/05
Survey Designer (print/sign)	William Cooper	Date	4/14/05

Attachment 9-1
E900-05-023

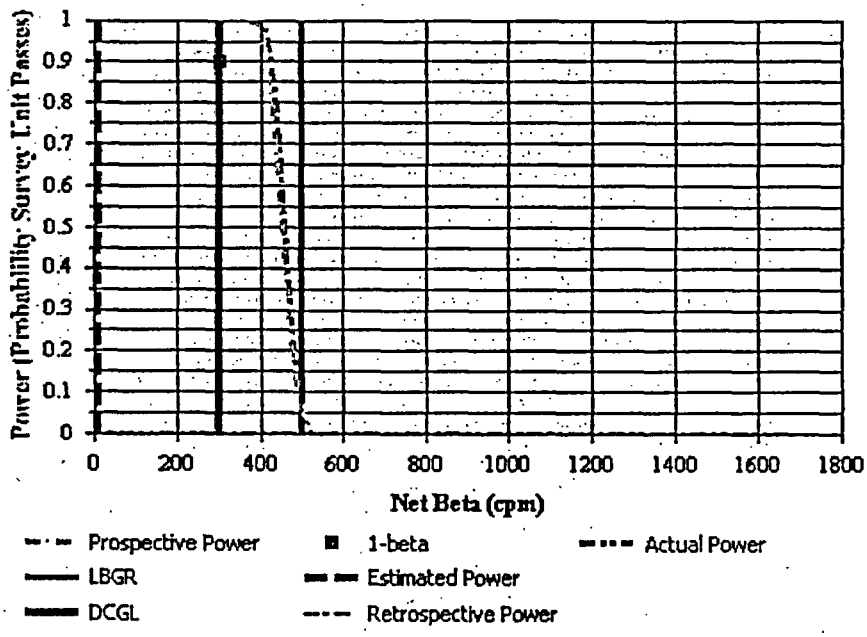
Appendix B to Appendix D

DQA Building Surface Report

Assessment Summary

Site:	Fences		
Planner(s):	WJCooper		
Survey Unit Name:	Fences Class 2		
Report Number:	1		
Survey Unit Measurements:	11		
Reference Area Measurements:	0		
Test Performed:	Sign	Test Result:	Not Performed
Judgmental Areas:	0	EMC Result:	Not Performed
Assessment Conclusion:	***Reject Null Hypothesis (Survey Unit PASSES)***		

Retrospective Power Curve



Appendix B
MA9

DQA Building Surface Report

Survey Unit Data

NOTE: Type = "S" indicates survey measurement.
Type = "R" indicates reference measurement.

Measurement	Material	Type	Gross Beta (cpm)
1	Fence	S	396
2	Fence	S	341
3	Fence	S	541
4	Fence	S	363
5	Fence	S	417
6	Fence	S	332
7	Fence	S	278
8	Fence	S	346
9	Fence	S	355
10	Fence	S	342
11	Fence	S	402

Basic Statistical Quantities Summary

Statistic	Survey Unit	Background	DQO Results
Sample Number	11	N/A	N=11
Mean (dpm/100 cm²)	2,417.03	N/A	11.0
Median (dpm/100 cm²)	1,666.67	N/A	N/A
Std Dev (dpm/100 cm²)	2,672.76	N/A	77
High Value (dpm/100 cm²)	9,047.62	N/A	N/A
Low Value (dpm/100 cm²)	-1,388.89	N/A	N/A

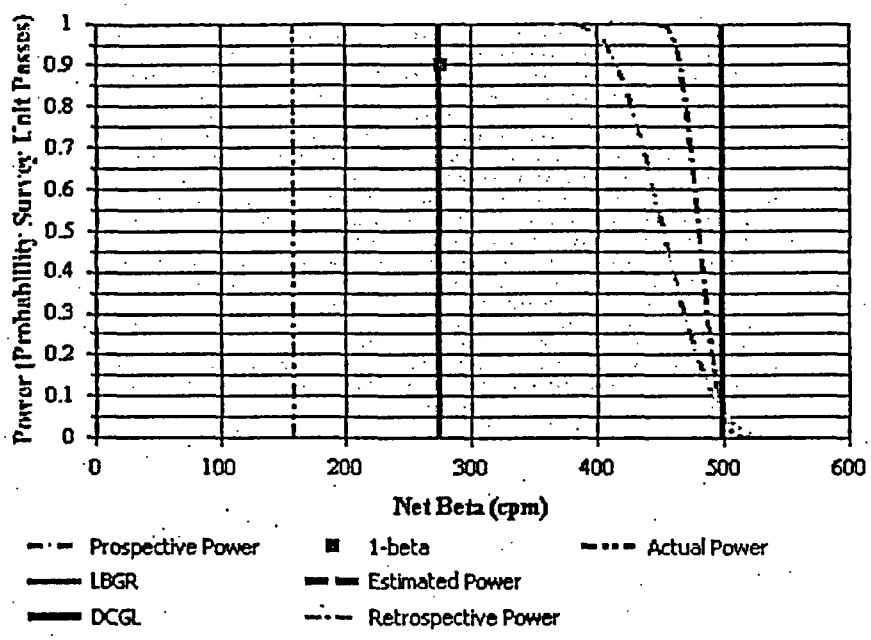
Appendix B
MA9

DQA Building Surface Report

Assessment Summary

Site:	Fences		
Planner(s):	WJCooper		
Survey Unit Name:	Fences Class 3		
Report Number:	1		
Survey Unit Measurements:	11		
Reference Area Measurements:	0		
Test Performed:	Sign	Test Result:	Not Performed
Judgmental Areas:	0	EMC Result:	Not Performed
Assessment Conclusion:	***Reject Null Hypothesis (Survey Unit PASSES)***		

Retrospective Power Curve



Appendix C
MA9

DQA Building Surface Report

Survey Unit Data

NOTE: Type = "S" indicates survey measurement.
Type = "R" indicates reference measurement.

Measurement	Material	Type	Gross Beta (cpm)
1	Fence	S	271
2	Fence	S	300
3	Fence	S	275
4	Fence	S	292
5	Fence	S	298
6	Fence	S	326
7	Fence	S	317
8	Fence	S	348
9	Fence	S	358
10	Fence	S	348
11	Fence	S	339

Basic Statistical Quantities Summary

Statistic	Survey Unit	Background	DQO Results
Sample Number	11	N/A	N=11
Mean (dpm/100 cm²)	104.62	N/A	.0
Median (dpm/100 cm²)	158.73	N/A	N/A
Std Dev (dpm/100 cm²)	1,210.32	N/A	77
High Value (dpm/100 cm²)	1,785.71	N/A	N/A
Low Value (dpm/100 cm²)	-1,666.67	N/A	N/A

Appendix C
MA9